MARCH 2023









WASHINGTON COUNTY, OREGON

NATURAL HAZARD MITIGATION PLAN

U.S. Department of Homeland Security
FEMA Region 10
130 228th Street, SW
Bothell, WA 98021-8627

FEMA

December 4, 2023

The Honorable Kathryn Harrington
At-Large Chair, Washington County Board of Commissioners
155 N. First Avenue
Hillsboro, Oregon 97124

Dear Commissioner Harrington:

On April 18, 2023, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10, approved the Washington County Natural Hazard Mitigation Plan as a multi-jurisdictional local plan as outlined in Code of Federal Regulations Title 44 Part 201. This approval provides the below jurisdictions eligibility to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's Hazard Mitigation Assistance grants projects through April 17, 2028, through your state:

Washington County	City of Hillsboro	City of Tigard
Tualatin Valley Water District	City of North Plains	City of Sherwood
Clean Water Services	Tualatin Hills Park and Recreation District	City of Beaverton
City of Cornelius	City of Forest Grove	

The updated list of approved jurisdictions includes the City of North Plains, City of Sherwood, Clean Water Services, Tualatin Hills Park and Recreation District, and the City of Beaverton that recently adopted the Washington County Natural Hazard Mitigation Plan. FEMA individually evaluates all application requests for funding according to the specific eligibility requirements of the applicable program. Though a specific mitigation activity or project identified in the plan may meet the eligibility requirements, it may not automatically receive approval for FEMA funding under any of the programs.

Approved mitigation plans may be eligible for points under the National Flood Insurance Program's Community Rating System. For additional information regarding the Community Rating System, please visit: www.fema.gov/national-flood-insurance-program-community-rating-system or contact your local floodplain manager.

Over the next five years, we encourage your communities to follow the plan's schedule for monitoring and updating, and to develop further mitigation actions. To continue eligibility, jurisdictions must review, revise as appropriate, and resubmit the plan within five years of the original approval date.

If you have questions regarding your plan's approval or FEMA's mitigation grant programs, please contact Joseph Murray, Planner with Oregon Office of Emergency Management, at (503) 378-2911, who coordinates and administers these efforts for local entities.

Sincerely,

Kristen Meyers, Director
Mitigation Division

Enclosures

cc: Anna Feigum, Oregon Office of Emergency Management

EC:vl

Release Statement

Upon approval by Federal Emergency Management Agency (FEMA) Region 10 and adoption by the participating jurisdictions and special districts within the planning area, the entire document, or any specific part, may be released to the agencies or organizations determined by the Washington County, Oregon, Natural Hazard Mitigation Plan (NHMP) Steering Committee.

Release to the public of the entirety or any part of this document will follow current state and local public information statutes and practices.

Record of Plan Distribution

Table 1: Record of Plan Distribution

Number	Agency	Contact Name	Position/Title	Date

Record of Changes

The 2023 Washington County, Oregon, Multi-Jurisdiction Natural Hazard Mitigation Plan (NHMP) is a dynamic document that is under continual review. The document may be changed administratively under the authority of Washington County Emergency Management, the administrative agency responsible for the update, in coordination with the Steering Committee.

Administrative changes may include:

- Corrections or revisions that clarify context and readability;
- Updates that reflect adopted policy and/or procedures;
- Hazard data and risk information that enhances the current plan; and
- Other authorized changes granted to the administrative agency by the Steering Committee.

It shall be the responsibility of the administrative agency's point of contact (POC) or their designee to maintain this record of changes throughout the current planning cycle.

Table 2: Description of Changes

Section/Page	Description of Change	Authorized by	Date

Executive Summary

Hazard mitigation is any sustained action that reduces or eliminates long-term risk to people and property from natural hazards and their effects.

The impact of anticipated yet unpredictable natural events can be reduced through holistic planning and implementation of cost-effective, preventive mitigation efforts.

Washington County and its cities and special districts understand that it is not only less costly to reduce vulnerability to disasters than to repeatedly repair damage, but that proactive steps should be taken where possible to protect the economy, environment, and most vulnerable citizens from inevitable natural hazard events.

This NHMP recognizes that local jurisdictions and special districts have the opportunity to address their vulnerability more comprehensively by identifying mitigation strategies during all phases of emergency management (preparedness, mitigation, response, and recovery). Though hazards cannot be eliminated, vulnerability to hazards can be reduced by improving understanding of the natural hazards faced and their potential impacts and by implementing mitigation strategies.

The 2023 NHMP presents the hazard impacts most likely to affect Washington County, including its cities and special districts, and mitigation strategies to reduce or eliminate the most significant vulnerabilities. This update to the 2017 Washington County NHMP adds eight new plan participants and the hazards of dam failure and extreme heat. It also provides updated hazard and risk data and analyses, mitigation strategies, and plan implementation details. The plan provides strategic direction to mitigate hazards and protect people, property, and the environment and increase resilience.

The plan fulfills the requirements of the Federal Disaster Mitigation Act of 2000 (DMA 2000) as administered by the Oregon Department of Emergency Management and FEMA. The project was funded by the Fiscal Year 2019 FEMA Pre-Disaster Mitigation Grant (PDMC-PL-10-OR-2019-002). An Emergency Management Coordinator at the Washington County Department of Land Use and Transportation administered the grant and led the project.

The planning area for this plan is for Washington County, Oregon, and the planning participants include the following jurisdictions and special districts:

- City of Beaverton[1]
- City of Cornelius[2, 3]
- City of Forest Grove[2, 3]
- City of Hillsboro
- City of North Plains[2]
- City of Sherwood[2]

[1] The City of Beaverton NHMP was adopted in 2020. This plan was updated and incorporated into the 2023 Washington County plan as the City's annex.
[2] Did not participate in the 2017 Washington County NHMP.
[3] The cities of Cornelius and Forest Grove had a joint NHMP that was adopted in September 2011. The 2011 plan was updated and incorporated into this plan as separate annexes for the cities.

- City of Tigard
- Clean Water Services[2]
- Tualatin Hills Park & Recreation District[2]
- Tualatin Valley Water District[2]
- Washington County

Figure 1 shows the locations of all participating jurisdictions and the service areas of participating special districts. The unincorporated areas of the county fall under Washington County's purview.

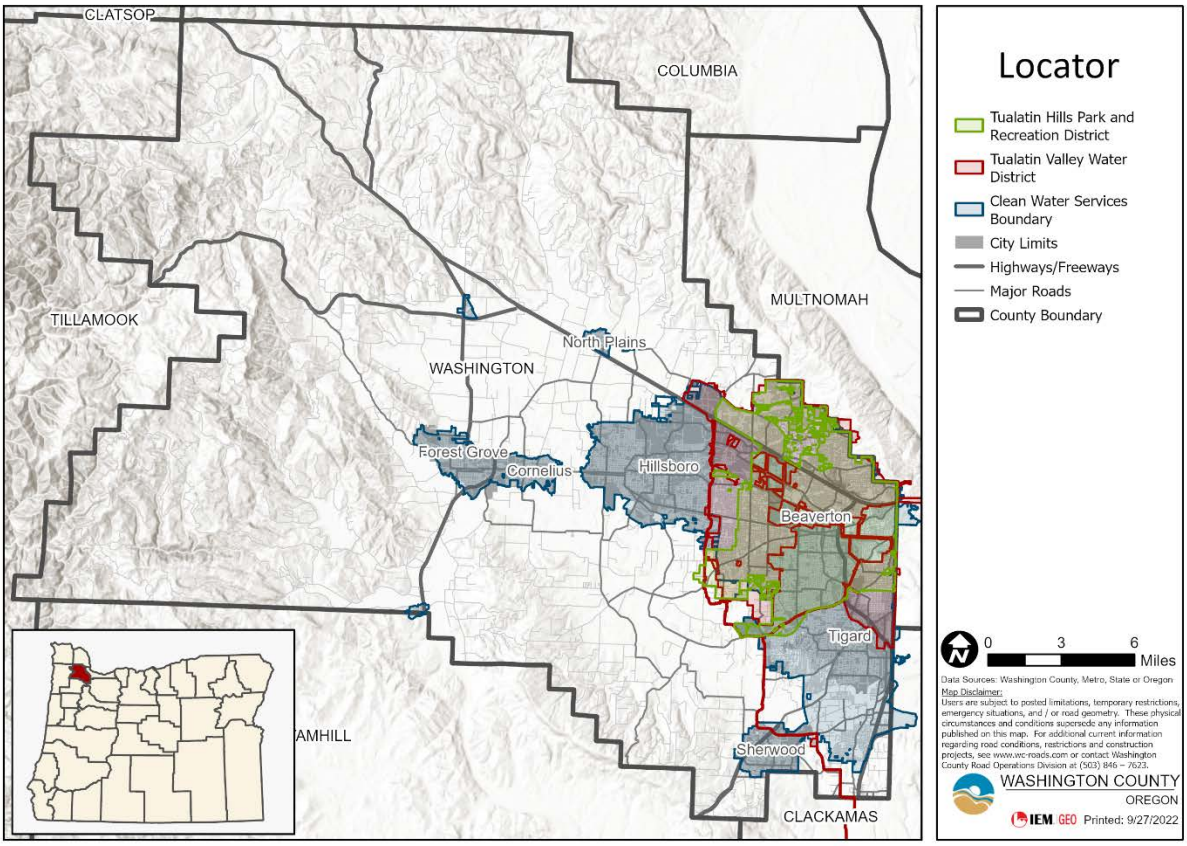


Figure 1: Washington County Natural Hazards Mitigation Plan Planning Area

The NHMP Steering Committee identified the following hazards as impacting the planning area. These hazards are profiled in Volume 1, Section 2 of this plan, and specific hazard risk and vulnerability information unique to each participant is presented in the respective participant annexes. These hazards are shown in alphabetical order and do not represent the probability, vulnerability, or hazard risk rank identified during the planning process.

- Dam failure[4]
- Drought
- Earthquake

[4] New hazard for the 2023 NHMP update

- Extreme heat[5]
- Flooding
- Landslide
- Volcanic ash
- Wildland fire
- Windstorm, including tornado
- Winter storm

Data collection periods during the planning process varied for planning participants, depending on their previous NHMP participation, and are shown in Table 3.

Table 3: Data Collection Periods for Planning Participants

Participant	Data Collection Period	
	From	To
Washington County and the cities of Tigard and Hillsboro	11/1/2016	2/22/2022
City of Beaverton	1/1/2020	2/22/2022
Cities of Cornelius and Forest Grove	9/1/2011	2/22/2022
All other participants	As far back as was available	2/22/2022

The format of this plan is designed to provide a user-friendly source for all hazard information for participants.

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- Record of Plan Distribution
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- Volume I: Natural Hazards Base Plan
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[5] New hazard for the 2023 NHMP update

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  - Appendix A: Planning Area Profile
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  - Appendix C: Implementation Resources and Funding Opportunities

The Washington County 2023 NHMP will be a useful tool for all participants, communities, and their stakeholders for increasing public awareness about local hazards and risks while providing information about options and resources available to reduce those risks. Informing the public about potential hazards will enable informed decision making on where to live, purchase property, or locate businesses and will help each of the jurisdictions and special districts protect themselves against the effects of the identified hazards.

Abbreviations and Acronyms

AEBM	Hazus Advanced Engineering Building Module
APA	Approved Pending Adoption
ARPA	American Rescue Plan Act
ASOS	automated surface observing systems
AWIA	America's Water Infrastructure Act of 2018
BCD	Oregon Building Codes Division
BFE	base flood elevation
BRIC	Building Resilient Infrastructure and Communities Grant Program
CARES	Coronavirus Aid, Relief, and Economic Security Act
CDBG	Community Development Block Grant
CDC	Centers for Disease Control and Prevention
CDC	Community Development Code
CERT	Community Emergency Response Team
CFR	Code of Federal Regulations
CIG	Conservation Innovation Grants
CPAWC	Cooperative Public Agencies of Washington County
CSZ	Cascadia Subduction Zone
CVO	United States Geological Survey-Cascades Volcano Observatory
CWPP	community wildfire protection plan
CWS	Clean Water Services
DLCD	Oregon Department of Land Conservation and Development
DMA 2000	Disaster Mitigation Act of 2000
DOGAMI	Oregon Department of Geology and Mineral Industries
DOT	Department of Transportation
DR	Major federal disaster declaration
DSCI	Drought Severity and Coverage Index
EAP	emergency action plan
EM	Federal emergency declaration
EMC	Washington County Emergency Management Cooperative
EMPG	Emergency Management Performance Grant
ENSO	El Niño Southern Oscillation
ERP	Emergency Response Plan

ERT	Emergency Response Team
EO	Executive Order
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FM	Federal fire management assistance declaration
FMA	Flood Mitigation Assistance
FPA	floodplain administrator
FWS	Fish and Wildlife Service
G	acceleration due to gravity
GIS	geographic information system
HAZMAT	hazardous materials
Hazus-MH	Hazards U.S. Multi-Hazard software
HMA	Hazard Mitigation Assistance
HMPG	Hazard Mitigation Grant Program
HOA	Home Owners Association
HUD	Housing and Urban Development (Department of)
HVAC	heating, ventilation, and air conditioning system
ISO	Insurance Services Office
JWC	Joint Water Commission
MGD	million gallons per day
MM	Modified Mercalli Intensity Scale
MPH	miles per hour
NEHRP	National Earthquake Hazards Reduction Program
NEPA	National Environmental Policy Act
NFP	National Fire Plan
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NHMP	Natural Hazard Mitigation Plan, Washington County, Oregon Multi-Jurisdiction Natural Hazard Mitigation Plan
NID	National Inventory of Dams
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	National Resources Conservation Service
NSF	National Science Foundation
NWS	National Weather Service
ODF	Oregon Department of Forestry

OEM	Oregon Department of Emergency Management
ORWARN	Oregon Water/Wastewater Agency Response Network
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
P	primary seismic waves
PA	Public Assistance
PDM	Pre-Disaster Mitigation Grant Program
PGA	peak ground acceleration
PG&E	Pacific Gas and Electric Company
PNW	Pacific Northwest region of the United States, which includes Washington County
POC	**p**oint of contact
RDPO	Regional Disaster Preparedness Organization
RFO	Regulatory Floodplain Overlay
RL	repetitive loss property
RWPC	Regional Water Providers Consortium
S	secondary seismic waves
SBA	Small Business Administration
SBA EIDL	Small Business Administration Economic Injury Disaster Loan
SCADA	supervisory control and data acquisition software
SFHA	Special Flood Hazard Area
SFIP	Standard Flood Insurance Policy
SHMO	state hazard mitigation officer
SRL	severe repetitive loss property
SWSI	Surface Water Supply Index from the Natural Resources Conservation Service
TMDL	total maximum daily load
THPRD	Tualatin Hills Park & Recreation District
TVF&R	Tualatin Valley Fire and Rescue
TVWD	Tualatin Valley Water District
URM	unreinforced masonry structures
USACE	U.S. Army Corps of Engineers
USDA	United States Department of Agriculture
VEI	Volcanic Explosivity Index
WUI	Wildland-urban interface
WWSP	Willamette Water Supply Program
WWSS	Willamette Water Supply System
°F	Degrees Fahrenheit

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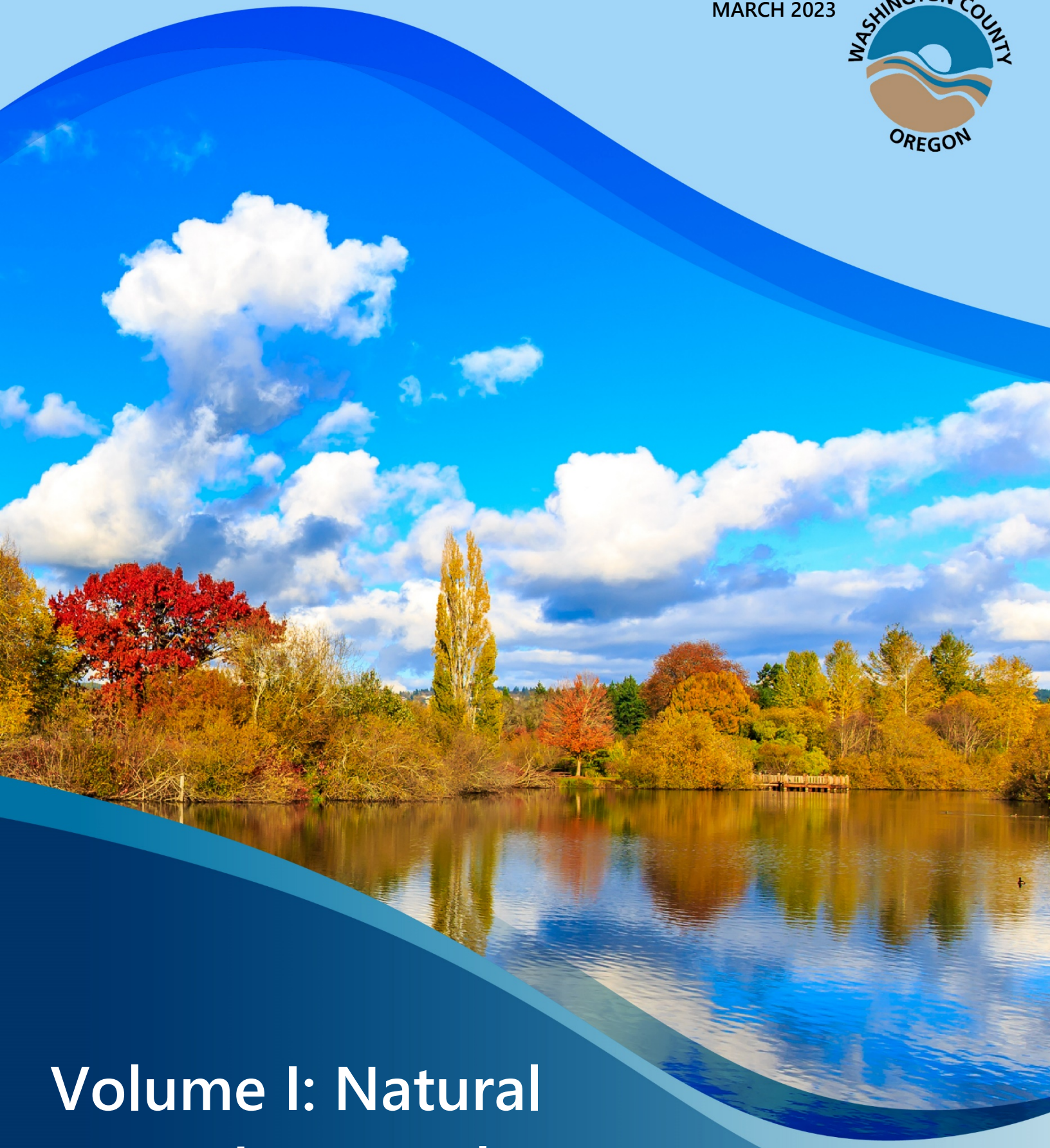
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MARCH 2023



Volume I: Natural Hazards Base Plan

1. Introduction

Code of Federal Regulations (CFR) Title 44, Part 201.6 (44 CFR §201.6) Requirements

- **§201.6(c)(3)(i):** [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.
- **§201.6(c)(4)(i):** [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

What is Hazard Mitigation?

- Mitigation is commonly defined as sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects. Hazard mitigation focuses attention and resources on policies and actions that will produce benefits over time.
- A mitigation plan states the specific courses of action that participants intend to follow to reduce vulnerability and exposure to future hazard events. These plans are formulated through a systematic process centered on the participation of individuals, businesses, public officials, and other stakeholders.
- A local hazard mitigation plan documents the jurisdiction's commitment to reduce risks from natural hazards. Local officials can refer to the plan in their day-to-day activities and in decisions regarding regulations and ordinances, granting permits, and funding capital improvements and other community initiatives. Additionally, local plans serve as the basis for states to prioritize grant funding.

To reduce the nation's mounting natural disaster losses, the United States Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) of 1988. Section 322 of DMA 2000 emphasizes the need for state and local government entities to closely coordinate mitigation planning activities and makes the development of a hazard mitigation plan a specific eligibility requirement for any local government applying for federal mitigation grant funds. These funds include the Hazard Mitigation Grant Program, and the Building Resilient Infrastructure and Communities grant program (formerly known as the Pre-Disaster Mitigation grant program) administered by the Federal Emergency Management Agency (FEMA) under the Department of Homeland Security. Communities with an adopted and federally approved hazard mitigation plan thereby become pre-positioned and more apt to receive available mitigation funds before and after the next disaster strikes.

1.1. Overview

Local hazard mitigation planning is the process of organizing community resources, identifying and assessing hazard risks, and determining how to best minimize or manage those risks. This process results in a hazard mitigation plan that identifies specific mitigation actions, each designed to achieve both short-term planning objectives and a long-term risk reduction. To ensure the functionality of each mitigation action, responsibility is assigned to a specific individual, department, or agency along with a schedule for its implementation. The plan maintenance process and procedures are established with an eye toward developing an ongoing assessment and monitoring of implementation progress, as well as the evaluation and enhancement of the mitigation plan itself. These plan maintenance procedures ensure the plan remains a current, dynamic, and effective planning document over time.

Mitigation planning offers many benefits, including the following:

- Awareness of risks and vulnerabilities for decision makers, planners, and the public.
- Saving lives, property, environments, and money.
- Reduction of hazard impacts and faster recovery following disasters, which enhances resilience.
- Creation of strong community partnerships across sectors and with the public.
- Reduction of future vulnerability through wise development and post-disaster recovery and reconstruction.
- Expediting the receipt of pre-disaster and post-disaster grant funding.
- Integration of mitigation actions into other local planning efforts, goals, and initiatives.

The 2023 NHMP has been prepared in coordination with the offices of FEMA Region 10 and the Oregon Department of Emergency Management (OEM) to ensure that it meets all applicable DMA 2000 and state requirements. A Local Mitigation Plan Review Tool, found in Volume III, Appendix B, provides a summary of federal minimum planning standards, and notes the location in this plan where each requirement is met.

1.2. Background

The most recent update of the Washington County NHMP was adopted in 2017. The 2017 Washington County NHMP participants included the cities of Hillsboro and Tigard. and was adopted by the Washington County Board of County Commissioners on November 22, 2016. The city of Beaverton updated its NHMP in 2020, and it was adopted by the Beaverton City Council on April 28, 2020. The city of Beaverton opted to join the 2023 Washington County NHMP update as did seven other new participants, for a total of eight new participants. This update adds dam failure and extreme heat as hazards that impact the planning area.

1.3. Purpose

Hazard mitigation plans are prepared and adopted by communities with the primary purpose of identifying, assessing, and reducing long-term risk to life and property from hazard events. Effective mitigation planning can break the cycle of disaster damage, reconstruction, and repeated damage by natural hazards in the following ways:

- Identifying how a community will work together to reduce risks which will protect life, safety, and property by reducing the potential for future damages and economic losses that result from all hazards.
- Improve public awareness of the need for individual preparedness and building safer, more disaster-resilient communities.
- Make communities safer places to live, work, and play.
- Qualify for grant funding in both the pre-disaster and post-disaster environments.
- Develop strategies for long-term community sustainability during community disasters, which will speed recovery and redevelopment following future disaster events.
- Demonstrate a firm local commitment to hazard mitigation principles.
- Comply with state and federal requirements for local multi-jurisdictional hazard mitigation plans.

1.4. Authority and Guidance

This plan was prepared in compliance with Section 322 of the Stafford Act, 42 U.S.C. 5165, as amended by Section 104 of the DMA 2000. Local mitigation planning requirements are codified in the Code of Federal Regulations (CFR) Title 44, Part 201.6 (44 CFR §201.6), Local Mitigation Plans. DMA 2000 specifies requirements for local governments to undertake a risk-based approach to reducing the impacts and consequences from natural hazards through mitigation planning. In addition, DMA 2000 requires that local plans be updated every five years, with each planning cycle requiring a complete review, revision, and approval of the plan by the state and FEMA.

The plan shall be routinely monitored, evaluated, and revised to maintain compliance with the following provisions, rules, and legislation:

- Section 322, Mitigation Planning, of the Stafford Act, as enacted by Section 104 of the DMA 2000 (Public Law 106-390); and
- FEMA's Interim Final Rule published in the Federal Register on February 26, 2002, 44 CFR §201.

The method and schedule for plan maintenance is provided in additional detail in Volume I, Section 4.

1.5. Applicability and Scope

The scope of this NHMP encompasses all participating entities in Washington County, as noted in the Executive Summary. This plan identifies natural hazards that could threaten life, property, and the environment throughout the County. The scope of this plan includes both short- and long-term mitigation strategies, implementation strategies, and possible sources of project funding to mitigate identified hazards. This plan complements and is consistent with the 2020 State of Oregon Natural Hazard Mitigation Plan (2020 Oregon NHMP) and builds on and updates the 2017 Washington County NHMP.

The information provided in the Hazard Identification and Risk Assessment (Volume I, Section 2) reflects the impact of the hazards on all of Washington County, not solely the participating entities. Additionally, the historical events documented in Volume I, Section 2 reflect the events that impacted the entire county, not solely the unincorporated areas of the County. Participant-specific vulnerability analyses, risk assessments, and historical events are in the individual participant annexes.

1.6. Policy Framework for Natural Hazards Planning in Oregon

Planning for natural hazards is an integral element of Oregon's statewide land use planning program, which began in 1973. All Oregon cities and counties have comprehensive plans and implementing ordinances that are required to comply with the statewide planning goals. The challenge faced by state and local governments is to keep this network of local plans coordinated in response to the changing conditions and needs of Oregon communities.

The Oregon Statewide Land Use Planning Goal 7, Areas Subject to Natural Hazards, calls for local plans to include inventories, policies, and ordinances to guide development in hazard areas. Planning Goal 7, along with other land use planning goals, has helped reduce losses from natural hazards. Through risk identification and the recommendation of risk reduction actions, the 2023 NHMP aligns with the goals of the comprehensive plans for Washington County and all participating cities, and the Tualatin Valley Water District Master Plan, and helps all participants meet the requirements of Planning Goal 7.

The primary responsibility for the development and implementation of risk reduction strategies and policies lies with local jurisdictions. However, resources exist at the state and federal levels. Some of the key agencies at these levels include OEM, Oregon Building Codes Division, Oregon Department of

Forestry (ODF), Oregon Department of Geology and Mineral Industries (DOGAMI), and the Department of Land Conservation and Development.

1.7. Plan Development and Update Process

This plan update was facilitated, written, and completed in collaboration with the contracting firm IEM. The project was funded by Fiscal Year 2019 FEMA Pre-Disaster Mitigation Grant (PDMC-PL-10-OR-2019-002). The grant was administered, and the project led by, an Emergency Management Coordinator at the Washington County Department of Land Use and Transportation. Additional information about the plan development and update process, including public engagement opportunities and outcomes, is in Volume III, Appendix B.

1.8. Mitigation Goals

The Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 city of Beaverton NHMP, 2011 NHMP for the cities of Cornelius and Forest Grove, and 2020 Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals below. These goals are the basis of this plan and summarize what the Steering Committee will accomplish by implementing this plan.

1. Develop and implement strategies to minimize loss of life, public and private property damage, and damage and disruption of essential infrastructure from the impact of natural hazards while protecting and restoring the environment.
2. Ensure effective implementation of mitigation strategies and increased success in receiving funding. This includes:
    a. Develop and maintain partnerships and promote mitigation leadership within local and regional public agencies; the public; non-profit organizations; and businesses.
    b. Ensure consistency between city, county, regional, and state mitigation strategies.
    c. Consistently seek diverse funding and resource partnerships for future mitigation efforts.
3. Develop and implement natural hazard education and outreach programs to increase awareness, engagement, and partnership among the public; local, city, and regional agencies; nonprofit organizations; and businesses. Includes:
    a. Engage and motivate the public to invest in natural hazard risk reduction policies and projects.
    b. Motivate the “whole community” to build resilience and mitigate against the effects of natural hazards through engagement, listening, learning, information-sharing, and funding opportunities.
4. Support the adoption and application of development policies and standards that address the potential impacts of natural disasters and prevent development within mapped hazardous areas where risks to people and property cannot be practicably mitigated.
5. Enhance communication, collaboration, and coordination among agencies at all levels of government and the private sector to mitigate natural hazard risks.
6. Integrate and align hazard mitigation strategies with local comprehensive plans, climate adaptation efforts, and emergency operations plans and procedures, when possible.
7. Enhance the ability of the economies of Washington County and its jurisdiction to rebound quickly from natural hazard events, by strengthening emergency operations including increasing communication, collaboration, and coordination among public agencies, non-profit organizations, and businesses. Includes mitigating the inequitable impacts of natural hazards by prioritizing and directing resources and investments to build resilience in the most vulnerable populations and the communities least able to respond and recover.

1.9. Plan Organization, Format, and Content

The NHMP is organized into three volumes that satisfy the mitigation requirements in 44 CFR §201.6. Volume I has four sections, each participant annex in Volume II has six sections, and Volume III has three appendices containing supporting documentation.

Volume I

The following sections are included in Volume I:

- Section 1: Introduction
  - Describes the purpose of the NHMP and introduces the mitigation planning process.
- Section 2: Hazard Identification and Risk Assessment
  - Describes the hazards identified, location of hazards, previous events, and jurisdictional profiles, satisfying the requirements under 44 CFR Parts 201.6(c)(2)(i) and 201.6(c)(2)(ii).
- Section 3: Mitigation Strategy
  - Reflects on the mitigation actions previously identified and examines the ability of participating entities to implement and manage a comprehensive mitigation strategy, satisfying the requirements under 44 CFR Parts 201.6(b)(3), 201.6(c)(1), 201.6(c)(3)(i), 201.6(c)(3)(ii), 201.6(c)(3)(iii), 201.6(c)(3)(iv), and 201.6(c)(4)(ii), and
- Section 4: Plan Execution, Maintenance, and Adoption
  - Describes strategies for monitoring, evaluating, and updating plans; NHMP incorporation into other plans and policies; and future public updates for each participating jurisdiction, satisfying the requirements under 44 CFR Parts 201.6(c)(4)(i), 201.6(c)(4)(ii), and 201.6(c)(4)(iii).

Volume II

Volume II includes eleven participant annexes. Each participant annex contains six sections that satisfy the requirements under 44 CFR Parts 201.6(b)(1), 201.6(b)(2), 201.6(b)(3), 201.6(c)(1), 201.6(c)(2)(i), 201.6(c)(2)(ii), 201.6(c)(4)(i), and 201.6(c)(4)(iii).

- Section 1: Introduction
- Section 2: Planning Process
- Section 3: Hazard Identification and Risk Assessment
- Section 4: Capability Assessment
- Section 5: Mitigation Strategy
- Section 6: Action Items

Volume III

Volume III comprises the following three appendices:

- Appendix A: Planning Area Profile
- Appendix B: Planning Process and Public Engagement

    - Describes the planning process and organization for each participating jurisdiction, satisfying the requirements of 44 CFR Parts 201.6(b)(1), 201.6(b)(2), 201.6(b)(3), 201.6(c)(1), 201.6(c)(4)(i), and 201.6(c)(4)(iii).
- Appendix C: Implementation Resources and Funding Opportunities

1.10. Maintenance Process

The Steering Committee, consisting of a representative from each participating jurisdiction and special district, will continue to collaborate as a planning group in coordination with the Washington County NHMP Project Manager. Primary contact will be through emails and conference calls, with strategy meetings occurring at least annually and following a disaster declaration for natural hazards covered in this plan for any planning participants. The Steering Committee points of contact for the participants will jointly lead the plan maintenance and update process by:

- Discussing methods for continued public involvement and education;
- Documenting successes and lessons learned;
- Researching new or updated data, laws, policies, regulations, or initiatives that can contribute to hazard histories, risk assessments, loss estimates, vulnerabilities of assets, or action items for plan participants;
- Reviewing potential funding availability, including state and federal grant program Notices of Funding Opportunities;
- Assessing the progress of previously implemented actions that reduce vulnerability and losses, and any new opportunities for mitigation actions; and
- Maintaining and completing documentation of the NHMP maintenance process.

Each Steering Committee member is responsible for monitoring and tracking the progress of action items identified by their jurisdiction or special district in this NHMP and submitting a status summary to the County's project manager biannually using the action item planning document.

Additionally, each Steering Committee member will work with their Technical Committee and other jurisdictional or special district representatives to:

- Review existing action items to determine appropriateness for local funding;
- Prioritize potential mitigation projects; and
- Update decision makers on progress of the plan.

1.11. Plan Approval and Adoption Process

Once the NHMP has received FEMA Approvable Pending Adoption (APA) status, each participating jurisdiction or special district will take the plan to their governing body for final public comment and adoption. A copy of each adoption resolution will be inserted into Volume III, Appendix B and held on file at FEMA, OEM, and the Washington County Emergency Management Office.

2. Hazard Identification and Risk Assessment

Significant Changes

- Detailed information on the OEM hazard analysis methodology included.
- Dam failure, extreme heat, and wildfire smoke added as hazards impacting the planning area.
- Disaster declarations expanded to include federal, state, and local declarations.
- Summary table of participant hazard risk scores for all hazards added.
- Information on characteristics, location, extent, history, probability of future events, vulnerabilities, and how climate change may impact frequency and or intensity added for all natural hazards in the planning area.
- Updated all tables and figures to reflect current information.
- Inclusion of additional maps and graphics showing hazard information.
- Drought hazard profile expanded to include ecological drought, cascading hazards and impacts, and measure of drought extent.
- Earthquake hazard profile expanded to include information about liquefaction and coseismic landslides. Information about the Portland Hills, Gales Creek, and Beaverton fault zones and Hazus®-MH event scenarios with damage data for these faults added to the hazard profile.
- Flooding hazard profile expanded to include streambank and riverbed erosion and channel migration.
- Volcano hazard profile streamlined to focus on volcanic ash.
- Wildfire smoke impacts included in wildfire hazard profile.
- Enhanced Fujita scale added to illustrate extent of tornadoes in windstorm, including tornado hazard profile.

CFR 44 §201.6 Requirements

- **§201.6(c)(2)(i):** [The risk assessment shall include a] description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.
- **§201.6(c)(2)(ii):** [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. All plans approved after October 1, 2008, must also address NFIP [National Flood Insurance Program] insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:
  - **§201.6(c)(2)(ii)(A):** The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.
  - **§201.6(c)(2)(ii)(B):** An estimate of the potential dollar losses to vulnerable structures identified in…this section and a description of the methodology used to prepare the estimate.
  - **§201.6(c)(2)(ii)(C):** Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.
- **§201.6(d)(3):** A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within 5 years in order to continue to be eligible for mitigation project grant funding.

2.1. Risk Assessment Overview

Completing a natural hazard mitigation risk assessment allows planning participants to identify and characterize hazards that can impact them and determine what populations, built environment infrastructure, and systems are most vulnerable to each hazard. The risk assessment provides the factual basis for the mitigation strategy, including the mitigation action items, identified by each plan participant that will reduce losses from identified hazards. The assessment process consisted of three phases conducted sequentially, as each phase builds on data from prior phases.

- **Phase 1:** Phase 1 includes identification of natural hazards that can impact the jurisdiction. This includes an evaluation of potential hazard impacts, including type, location, and extent.
- **Phase 2:** Phase 2 includes identification of important community assets and system vulnerabilities. Example vulnerabilities include populations, economies, existing and future structures, agriculture land and property, critical facilities and infrastructure, natural environment, and changes due to climate change.
- **Phase 3:** Phase 3 includes evaluation of the extent to which the identified hazards overlap with, or impact, the important assets identified by the community.

Each hazard profile in this section contains an analysis of hazard characteristics, hazard history, probability of future events, vulnerability assessment, and a Hazard Risk Score Summary.

This risk assessment applies to all plan participants. Relevant participant-specific risk information is in the participant annexes. This section supports the Oregon Statewide Planning Goal 7, Areas Subject to Natural Disasters and Hazards by evaluating the risk to people and property from natural hazards.

The information presented below, along with information presented in Volume III, Appendix A: Planning Area Profile, is used to inform the risk reduction actions identified in Volume I, Section 3: Mitigation Strategy.

2.2. Hazard Analysis Methodology

OEM created a hazard analysis methodology to examine hazard vulnerability and probability by collecting information about the four rating criteria of history, vulnerability, maximum threat, and probability for each hazard that impacts the communities in the planning area.

The 2017 NHMP used the OEM methodology, and for this 2023 update, the Steering Committee chose to use this methodology again to provide consistency and continuity from plan to plan. The vast majority of local NHMPs and the Oregon NHMP use this methodology, which allows comparison of the same hazard across jurisdictions statewide. This methodology does not compare hazards to each other or rank hazards against one another. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants. It provides planning participants with a sense of hazard priorities, or relative risk. By doing this analysis, mitigation can focus on the greatest risk. While hazards occur together or as a consequence of others (e.g., dam failure may cause flooding and earthquakes may cause landslides), participants considered hazards as a singular event for the purposes of rating.

This hazard analysis methodology can:

- Help establish priorities for planning, capability development, and hazard mitigation;
- Serve as a tool in the identification of hazard mitigation measures;
- Be one tool in conducting a hazard-based needs analysis;
- Serve to educate the public and public officials about hazards and vulnerabilities; and

- Help communities make objective judgments about acceptable risk.

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. For every hazard, scores for the four rating criteria are determined by multiplying each criterion's severity rating by its weight factor. The rating criteria scores for the hazard are then summed to provide a total score for that hazard. The methodology produces scores that range from 24 (lowest possible) to 240 (highest possible).

Vulnerability and probability are the two key components of the methodology. Vulnerability examines both typical and maximum credible events and accounts for approximately 60% of the total score. Probability endeavors to reflect how physical changes in the jurisdiction and scientific research modify the historical record for each hazard and accounts for approximately 40% of the total score.

Definitions and values for the ratings and severity criteria and weight factors are explained below.

2.2.1. Severity Ratings

Severity ratings are applied to the four categories of history, vulnerability, maximum threat, and probability. The severity rating scales are unique to each category and are provided below.

- **Low:** Choose the most appropriate number between 1 and 3 points.
- **Medium:** Choose the most appropriate number between 4 and 7 points.
- **High:** Choose the most appropriate number between 8 and 10 points.

2.2.2. History

History is the record of previous occurrences and has a weight factor of two. Events to include in assessing the history of a hazard are events for which the following types of activities were required:

- The emergency operations center (EOC) or alternate EOC was activated.
- Three or more emergency operations plan functions were implemented.
- An extraordinary multijurisdictional response was required.
- A local emergency was declared.

A severity rating is applied based on the following:

- **Low:** 0–1 event in the past 100 years scores between 1 and 3 points.
- **Medium:** 2–3 events in the past 100 years scores between 4 and 7 points.
- **High:** 2–3 events in the past 100 years scores between 8 and 10 points.

2.2.3. Vulnerability

Vulnerability is the percentage of population and property likely to be affected under an average occurrence of the hazard. It has a weight factor of five. A severity rating is applied based on the following:

- **Low:** < 1% affected scores between 1 and 3 points.
- **Medium:** 1% to 10% affected scores between 4 and 7 points.
- **High:** > 10% affected scores between 8 and 10 points.

2.2.4. Maximum Threat

Maximum threat is the highest percentage of population and property that could be impacted under a worst-case scenario. It has a weight factor of 10. A severity rating is applied based on the following:

- **Low:** < 5% affected scores between 1 and 3 points.
- **Medium:** 5% to 25% affected scores between 4 and 7 points.
- **High:** > 25% affected scores between 8 and 10 points.

2.2.5. Probability

Probability is the likelihood of future occurrence within a specified period of time and has a weight factor of seven. A severity rating is applied based on the following:

- **Low:** One incident likely within 75 to 100 years scores between 1 and 3 points.
- **Medium:** One incident likely within 35 to 75 years scores between 4 and 7 points.
- **High:** One incident likely within 10 to 35 years scores between 8 and 10 points.

2.3. Hazards Identified

Through an assessment of previous federally declared disasters in Washington County, historical events and potential events in the County, and a review of available local mitigation action plans, the NHMP Steering Committee determined this plan will address the risks associated with the following 10 natural hazards:

- Dam failure[6]
- Drought
- Earthquake
- Extreme heat[6]
- Flooding
- Landslide
- Volcanic ash
- Wildland fire
- Windstorm, including tornado
- Winter storm

Summary information and risk assessments for each of these hazards is presented in Volume I, Section 2.7. Specific hazard risk and vulnerability information unique to each participant is presented in the participant annexes. These hazards are shown in alphabetical order and do not represent the probability, vulnerability, or hazard risk rank identified during the planning process.

The timeframe of the data collected during the planning process varied for planning participants depending on their previous NHMP participation and is reflected in Table 4 below.

[6] New hazard for the 2023 NHMP update

Table 4: Timeframe of Data Collected for Planning Participants

Participant	Timeframe of Data Collected	
	From	To
Washington County and the cities of Tigard and Hillsboro	11/1/2016	2/22/2022
City of Beaverton	1/1/2020	2/22/2022
Cities of Cornelius and Forest Grove	9/1/2011	2/22/2022
All other participants	As far back as was available	2/22/2022

The timeframe for county-level data and information, including disaster declarations, demographics, and hazard event history, is from November 1, 2016 to February 22, 2022.

2.4. Disaster Declaration History

Since the adoption of the most recent NHMP, Washington County has been a part of four federal disaster declarations, eight Oregon disaster declarations, and two local disaster declarations. A review of federal and local disaster declarations and emergency executive orders issued by the Oregon governor since November 1, 2016, shows that wildfire, winter storm, and extreme heat events are the main hazards that significantly impacted the County.

Table 5: Federal Disaster Declarations Including Washington County Since November 1, 2016[7]

Declaration Number	Declaration Date	Incident Period		Incident	Individual Assistance	Public Assistance Categories*
		From	To			
Major Federal Disaster Declarations (DR) Including Washington County Since November 1, 2016						
DR-4562	9/15/2020	9/7/2020	11/3/2020	Wildfire and Straight-line Winds	No	B
Federal Fire Management Assistance Declarations (FM) Including Washington County Since November 1, 2016						
FM-5371	9/10/2020	9/8/2020	9/15/2020	Wildfire	None	B
FM-5358	9/8/2020	9/8/2020	9/14/2020	Wildfire	None	B
Federal Emergency Declarations (EM) Including Washington County Since November 1, 2016						
EM-3542	9/10/2020	9/8/2020	9/15/2020	Wildfires	None	B

* Eligible work in Public Assistance Category B is emergency protective measures that must be completed within six months. Eligible work must be required as a result of the declared incident, be located in the designated area, be the legal responsibility of the applicant, and be undertaken at a reasonable cost.

[7] Federal Emergency Management Agency. (2022). Declared Disasters. https://www.fema.gov/disaster/declarations

Table 6: Governor Executive Orders Declaring State of Emergency Including Washington County Since November 1, 2016[8]

Declaration Number	Declaration Date(s)	Incident Period		Incident	Individual Assistance	Public Assistance
		From	To			
EO-21-37	12/23/2021	12/23/2021	1/3/2022	Severe Winter Storm	Statewide	No
EO-21-27	8/10/2021	8/10/2021	8/20/2021	Extreme Heat	Statewide	No
EO-21-26	7/29/2021	7/29/2021	8/5/2021	Extreme Heat	No	No
EO-21-02	2/13/2021	2/11/2021	2/18/2021	Severe Winter Storm, High Winds, Flooding, and Landslides	No	No
EO-20-43	9/14/2020	9/8/2020	9/14/2020	Invocation of Emergency Conflagration Act for the Powerline Fire	No	No
EO-20-41	9/9/2020	9/8/2020	11/1/2020	Invocation of Emergency Conflagration Act	Statewide	No
EO-17-06	4/13/2017	1/11/2017	3/20/2017	Severe Winter Storm, High Winds, Flooding, and Landslides	No	No
EO-17-02	4/13/2017	1/11/2017	2/1/2017	Severe Winter Storm, High Winds, Flooding, and Landslides	Statewide	No

Table 7: Local Disaster Declarations and Resolutions in Washington County Since November 1, 2016[9]

Participants	Declaration Date	Incident Period		Incident
		From	To	
Washington County	2/13/2021	2/12/2021	2/13/2021	Severe Winter Storm
Washington County	9/11/2020	9/8/2020	9/29/2020	Two concurrent wildfires: Powerline–Henry Hagg Lake–Cherry Grove wildfire (Powerline wildfire) and Chehalem Mountain–Bald Peak wildfire

[8] Office of Oregon Governor. (n.d.). Executive Orders. https://www.oregon.gov/gov/Pages/executive-orders.aspx
[9] 2023 NHMP Participant Planning Documentation

2.5. Vulnerability Assessments

A detailed community profile, which includes information on the vulnerabilities below, is in Volume III, Appendix A. Participant-specific information and vulnerabilities are identified in the annexes, as appropriate, and include:

- Populations
- Economies
- Structures (existing and future)
- Improved property
- Critical facilities and infrastructure
- Natural environment

Changes in development for participants with previous mitigation plans are described in participant annexes, as applicable. This includes information about increases and decreases in vulnerability and changes in priorities, as appropriate.

2.6. Summary of Participant Hazard Risk Scores

Based on the risk assessment methodology outlined in Section 2.2, each NHMP participant assigned a risk score to each of the hazards identified in this plan. Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible).

Table 8: Summary of Participant Hazard Risk Scores

Participant	Hazard Risk Score										
	Dam Failure	Drought	Earthquake: Cascadia (3–5-minute event)	Earthquake: Crustal (1-minute event)	Extreme Heat	Flooding	Landslide	Volcanic Ash	Wildland Fire	Windstorm, Including Tornado	Winter Storm
City of Beaverton	–	198	196	196	212	188	86	178	–	208	203
City of Cornelius	83	186	201	201	148	48	118	99	240	240	240
City of Forest Grove	83	186	201	201	148	48	118	99	240	240	240
City of Hillsboro	81	184	201	201	179	159	34	126	177	205	205
City of North Plains	56	170	201	71	177	181	24	124	201	132	187
City of Sherwood	74	175	186	158	162	79	61	119	142	178	208
City of Tigard	95	167	203	203	162	162	73	137	168	205	205
Clean Water Services	78	165	148	155	152	189	96	86	127	147	142
Tualatin Hills Park & Recreation District	24	166	161	161	199	143	72	152	143	198	208
Tualatin Valley Water District	133	186	201	159	177	67	88	119	161	169	206
Washington County	83	186	201	201	177	173	102	124	191	132	211

2.7. Hazard Profiles

The following natural hazard profiles are listed in alphabetical order and do not represent their rank, as each jurisdiction prioritized the hazards independently. The information provided in this section reflects the impact of the hazards on all of Washington County, not solely the participating jurisdictions and special districts.

Each profile provides a hazard description, significant events since the adoption of the 2017 NHMP, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are presented in the same order, as applicable: populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

The timeframe of data collected during the planning process for Washington County was November 1, 2016 to February 22, 2022.

Participant-specific hazard and vulnerability information is identified in the annexes, as appropriate.

2.7.1. Dam Failure

Significant Changes
- Created standalone hazard profile.
- Additional information on vulnerabilities and how climate change may impact the frequency and severity of dam failure added.

2.7.1.1. Characteristics

Dams protect water resources used for drinking, agriculture, and recreation and protect downstream development from inundation. Dams may be multi-functional, serving two or more of these purposes. Human-made dams may be classified according to the type of construction material used, construction methods, the slope or cross-section of the dam, the way the dam resists the forces of the water pressure behind it, the means used for controlling seepage and, occasionally, the purpose of the dam.[10]

Embankment dams are the most common type of dam in use today. Materials used for embankment dams include natural soil or rock, or waste materials obtained from mining or milling operations. An embankment dam is called an “earthfill” or “rockfill” dam depending on whether it is comprised of compacted earth or mostly compacted or dumped rock. The ability of an embankment dam to resist the reservoir water pressure is primarily a result of the mass weight, type, and strength of the materials from which the dam is made.[11]

The National Inventory of Dams assigns classification categories to dams as a measure of the probable impacts of failure. A dam classified as high hazard does not indicate it is unsafe or likely to fail. The level of risk or probability of failure of a given dam is not a factor in this classification scheme. Instead, the high hazard classification means if the dam were to fail, people in the inundation area downstream from the dam are at risk of loss of life.

Dams assigned to the significant hazard potential classification are those where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities. Such dams are often located in predominantly rural or agricultural areas.

Dams assigned to the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life. Failure of dams in the high hazard classification will generally also result in economic, environmental, or lifeline losses, but the classification is based solely on probable loss of life.

Dam failures can occur at any time in a dam’s life; however, failures are most common when water storage for the dam is at or near design capacity. At high water levels, the water force on the dam is higher, and several of the most common failure modes are more likely to occur. Correspondingly, for any dam, the probability of failure is much lower when water levels are substantially below the design capacity for the reservoir.

For embankment dams, the most common failure mode is erosion of the dam during prolonged periods of rainfall and flooding. When dams are full and water inflow rates exceed the capacity of the controlled release mechanisms, overtopping may occur. When overtopping occurs, scour and erosion of the dam and/or of the abutments may lead to partial or complete failure of the dam. Internal erosion, piping, or seepage through the dam, foundation, or abutments can also lead to failure of this type of dam.

[10] Association of State Dam Safety Officials. (2020). Dams 101. https://damsafety.org/dams101
[11] Association of State Dam Safety Officials. (2020). Dams 101. https://damsafety.org/dams101

Earthquake ground motions may cause dams to settle or spread laterally. Such settlement does not generally lead, by itself, to immediate failure. However, if the dam is full, relatively minor amounts of settling may cause overtopping to occur, with resulting scour and erosion that may progress to failure. Landslides into the reservoir, which may occur on their own or be triggered by earthquakes, may lead to surge waves that overtop dams or hydrodynamic forces that cause dams to fail under the unexpected load. In rare cases, high winds may also cause waves that overtop or overload dam structures.

Concrete dams are also subject to failure due to seepage of water through foundations or abutments. For waterways with a series of dams, downstream dams are also subject to failure induced by the failure of an upstream dam. If an upstream dam fails, then downstream dams also fail due to overtopping or hydrodynamic forces.

For smaller dams, the erosion and weakening of dam structures by growth of vegetation and burrowing animals is a common cause of failure.

Any dam is susceptible to failure due to improper design or construction, improper operation, and unusual hydrodynamic forces.

Dam failures can occur rapidly and with little warning. Fortunately, most failures result in minor damage and pose little or no risk to life safety. However, the potential for severe damage still exists.

Where a dam's failure is expected to result in loss of life downstream of the dam, an emergency action plan (EAP) must be developed. The EAP contains a map showing the area that could be inundated by floodwaters from the failed dam. These dams are often monitored so that conditions that pose a potential for dam failure are identified to allow for emergency evacuations.

2.7.1.2. Location and Extent

Oregon follows FEMA's guidance for assigning hazard ratings to dams and for the contents of EAPs, which are now required for all dams rated as high hazard. Each dam is rated according to the anticipated impacts of its potential failure. The state has adopted the following definitions for state-regulated dams:

- **High Hazard:** This rating is assigned when loss of life is expected if the dam fails.
- **Significant Hazard:** This rating is assigned when loss of life is not expected if the dam fails, but extensive damage to property or public infrastructure is.
- **Low Hazard:** This rating is assigned to all other state-regulated dams.

There are 3 high hazard, 15 significant hazard, and 59 low hazard dams in Washington County. Although there are high hazard dams in the County, none of them meet all FEMA High Hazard Potential Dam eligibility requirements.[12]

Table 9: High Hazard and Significant Hazard Dams Located in Washington County[13]

Name	State Classification	Regulator
Scoggins Dam	High	Federal
Barney Dam	High	State
Kay Lake Dam	High	State

[12] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[13] U.S. Army Corps of Engineers. (2022). National Inventory of Dams. https://nid.sec.usace.army.mil/#/

Name	State Classification	Regulator
Burkhalter #2 Dam	Significant	State
Cook Reservoir Dam	Significant	State
Raymond Dierickx Dam	Significant	State
Dober Reservoir Dam	Significant	State
Ettinger Pond Dam	Significant	State
Hoefer–Pierson Reservoir Dam	Significant	State
Jesse Enlargement Dam	Significant	State
Lind Reservoir Dam	Significant	State
Maple Headquarters Reservoir Dam	Significant	State
Paul Chobin Dam	Significant	State
Pierson–Upper Dam	Significant	State
Tualatin Park Dam	Significant	State
Unger–Bill Dam	Significant	State
Walters, Glenn #1 - Large Dam	Significant	State
Walters, Glenn #5 Dam	Significant	State

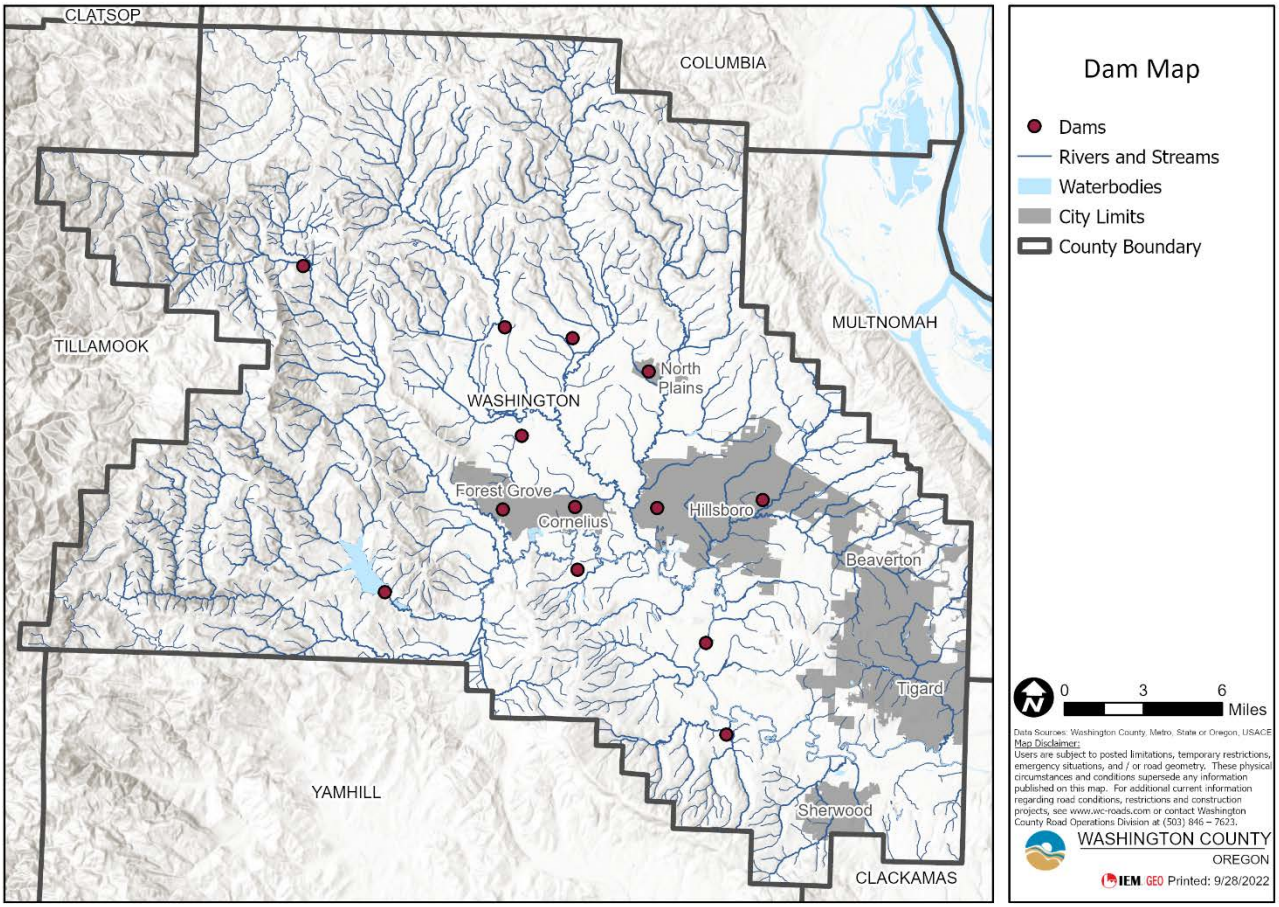


Figure 2: High and Significant Hazard Dams in Washington County

2.7.1.3. History

There have been no recorded dam failure events in the history of the planning area.

2.7.1.4. Probability of Future Events

An engineering risk assessment and analysis of a dam is the best indicator of the probability of failure. Without that, the condition of a dam as determined by Oregon Water Resources Department (OWRD) engineering staff is a helpful indicator of the failure potential of a dam.

Dam safety regulators determine the condition of dams rated as high hazard. A dam's condition is considered public information for state-regulated dams, but the conditions of federally regulated dams are generally not subject to disclosure. State-regulated dams rated as significant hazard do not yet have condition ratings.

Oregon uses FEMA's condition classifications. These classifications are subject to change, and revisions are being considered at the national level. Barney and Kay Lake dams are both classified as satisfactory by OWRD.[14] This means no existing or potential dam safety deficiencies are recognized. Acceptable

[14] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.

Although the condition of Scoggins Dam is not public information because it is federally regulated, the dam has an EAP that was last updated in January 2020 and last inspected in July 2020.[15] This dam is located directly over the Gales Creek Fault and is potentially at risk of damage or failure if an earthquake were to occur. However, because of these recent planning and evaluation activities it is expected that the dam is in good condition and performing as expected.

2.7.1.4.1. Climate Change

Most climate change models indicate there may be more extreme precipitation events in the future. One of the main concerns for dams is the potential for larger floods than experienced in the past. If a flood that is larger than the dam design occurs, spillway capacity may be exceeded and the dam may overtop, or the spillway may erode, causing the reservoir to empty rapidly. This scenario can present real risks to the dams in Washington County; however, the exact degree of risk is currently unknown.

2.7.1.5. Vulnerability Assessment

Failures of some dams can result in loss of life and damage to property, infrastructure, and the natural environment. The impacts of dam failures range from local impacts to the dam owner's property and waters below the dam, to community destruction with mass fatalities.

Barney and Kay Lake dams currently meet state regulations and safety standards, reducing the risk of a dam failure event occurring and vulnerability. Dams in the planning area can face risks from earthquakes, landslides, and wildfire, including the buildup of large woody debris behind dams. Per the 2020 Oregon NHMP, no plan participants are considered "most vulnerable jurisdictions" to dam failure because the County does not have any high hazard dams in poor or unsatisfactory condition.[16]

The Tualatin River and Fanno Creek are susceptible not only to heavy rain but also to the potential failure of Scoggins Dam. At times of heavy rain these rivers, creeks, and lakes can overflow. Fanno Creek is the most susceptible to flooding in these instances, with many bridges vulnerable to high water. There is also the potential for property damage along the river and creek in the event of high water or dam failure.

OWRD is working to complete more in-depth analyses of potential impacts from failure of state-regulated dams. This evaluation will explore more specific impacts to hospitals, major roads, and other critical infrastructure. OWRD's dam safety program personnel do not have specific expertise on the environmental effects of dam breach events, but it is likely failure of a large dam will include serious environmental effects. Failure of the dams undergoing risk analysis could cause extensive local damage to property and infrastructure. Information from OWRD's risk analyses will be included in the 2025 update of the Oregon NHMP.[17]

Impacts from dam failure can vary greatly based on magnitude and extent and can include both direct and indirect consequences.

[15] Army Corps of Engineers. (n.d.). National Inventory of Dams. https://nid.usace.army.mil/#/
[16] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[17] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

The potential direct consequences of dam failure include[18]:

- Injuries and/or loss of life;
- Damage to commercial structures and/or their contents; residential structures and/or their contents; equipment and supplies at industrial sites; and facilities that provide services;
- Flooding of transportation, water, electrical, and communication infrastructure;
- Loss of livestock and agricultural crops;
- Reduction in agricultural output due to loss of irrigation;
- Loss of recreation opportunities;
- Debris and sediment removal; and
- Cost to repair or rebuild dam.

The potential indirect consequences of dam failure include[19]:

- Increased traffic congestion while repairs occur;
- Increased occupancy in nursing homes to accommodate patients from nursing homes in the inundation area;
- Prolonged operations of temporary shelters for residents of the inundation area;
- Closure of industries due to lack of water or wastewater treatment; and
- Loss of tourism.

2.7.1.6. Hazard Risk Score Summary

Based on the hazard analysis methodology described in Section 2.2, plan participants assigned the scores below to their overall risk of dam failure. Additional information is in the participant annexes.

Table 10: Participant Overall Risk of Dam Failure[20]

Participant	Overall Risk of Dam Failure
City of Beaverton	–
City of Cornelius	83
City of Forest Grove	83
City of Hillsboro	81
City of North Plains	56
City of Sherwood	74
City of Tigard	95
Clean Water Services	78

[18] Federal Emergency Management Agency. (2012, March). Assessing the Consequences of Dam Failure. https://damsafety.org/sites/default/files/files/FEMA%20TM%20AssessingtheConsequencesofDamFailure%20March2012.pdf
[19] Federal Emergency Management Agency. (2012, March). *Assessing the Consequences of Dam Failure.* https://damsafety.org/sites/default/files/files/FEMA%20TM%20AssessingtheConsequencesofDamFailure%20March2012.pdf
[20] 2023 NHMP Participant Planning Documentation

Participant	Overall Risk of Dam Failure
Tualatin Hills Park & Recreation District	–
Tualatin Valley Water District	133
Washington County	83

2.7.2. Drought

Significant Changes

- Hazard profile expanded to include ecological drought, cascading hazards and impacts, and measure of drought extent.
- Additional information on hazard history, vulnerabilities, and how climate change may impact the frequency of drought added.

2.7.2.1. Characteristics

A drought is a period of drier than normal conditions creating hydrologic imbalance, shortage of precipitation adversely affecting crops, or a period of below-average water in streams and lakes, reservoirs, aquifers, and soils. Because drought is defined relative to normal conditions for an area, there is no universal measure of precipitation or dryness that signifies drought.

Drought occurs in virtually every climatic zone. Drought is a temporary condition, and the extent of drought events depends on the degree of moisture deficiency and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than one city and county simultaneously. Other climatic factors, such as high temperature, high wind, and low relative humidity, are often associated with drought and can significantly affect its severity.

There are five types of drought[21]:

- **Meteorological:** This type of drought occurs when the degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales. This type of drought usually takes at least three months to develop and can last for years.
- **Hydrological:** This type of drought occurs when precipitation shortfalls, including snowfall, affect subsurface water supplies like stream flows and reservoir, lake, and groundwater levels. The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with, or lag the occurrence of, meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system. such as soil moisture, stream flow, and groundwater and reservoir levels.
- **Ecological:** This type of drought occurs when “a prolonged and widespread deficit in naturally available water supplies, including changes in natural and managed hydrology, that create multiple stresses across ecosystems.”[22] Recent drought mitigation efforts have focused on ecological drought to fully address the ecological dimensions of the hazard, including impacts on vegetation and ecosystems.[23]
- **Agriculture:** This type of drought occurs when various characteristics of meteorological or hydrological drought are linked to agricultural impacts. These characteristics include precipitation shortages, differences between actual and potential evapotranspiration (evaporation combined

[21] National Drought Mitigation Center. (2022). Types of Drought: Fiscal Year 2022. https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx
[22] National Drought Mitigation Center. (2022). Types of Drought: Fiscal Year 2022. https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx
[23] Crausbay, S.D.; Ramirex, A.R.; Carter, S. L; Cross, M.S; Hall, K.R.; Bathke, D.J; Betancourt, J. L; Colt, S.; Cravens, A.E.; Dalton, M.S.; Dunham, J.B.; Hay, L.E.; Hayes, M.J.; McEvoy, J.; McNutt, C.A.; Moritz, M.A.; Nislow, K.H.; Raheem, N.; & Sanford, T. (2017, December 1). *Defining Ecological Drought for the Twenty-First Century.* https://journals.ametsoc.org/view/journals/bams/98/12/bams-d-16-0292.1.xml

with transpiration), soil water deficits, and reduced groundwater or reservoir levels. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil. This type of drought should account for the variable susceptibility of crops during different stages of crop development, from emergence to maturity.

- **Socioeconomic:** This type of drought occurs when the demand for water exceeds the supply as a result of a weather-related supply shortfall, affecting the population individually and collectively. Most definitions of socioeconomic drought associate it with supply, demand, and economic good, as the supply of many goods, such as water, food grains, fish, and hydroelectric power, depends on the availability of water.

There is a link between the different types of drought.

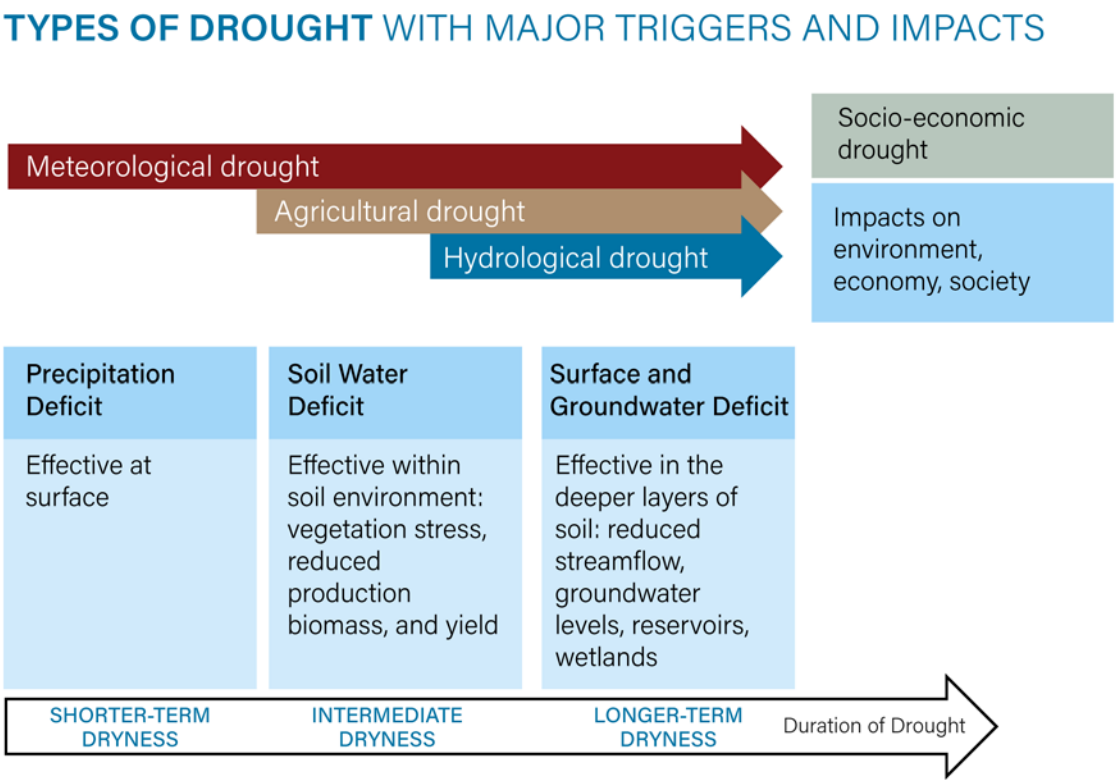


Figure 3: Types of Drought with Major Triggers and Impacts

Drought can also be an institutional phenomenon, resulting from poor management of water supply and reserves—an imbalance in supply and demand—and is often due to a combination of metrological, hydrologic, agricultural, and socioeconomic factors.

2.7.2.2. Location and Extent

Drought may affect the entire Washington County planning area equally. Drought is difficult to measure, due to its diverse geographical and temporal nature and its operation on many scales. Despite that difficulty, various indices for measuring and characterizing drought can be useful to rank event severity. Most federal agencies use the Palmer Method, which incorporates precipitation, runoff, evaporation, and soil moisture. However, the Palmer Method does not incorporate snowpack as a variable. Therefore, it is not believed to provide a fully accurate indication of drought conditions in Oregon and the Pacific

Northwest, although it can be very useful because of its a long-term historical record of wet and dry conditions. Figure 4 shows the Palmer Drought Severity Index (PDSI) for the County as of September 28, 2022.

The Surface Water Supply Index (SWSI) from the Natural Resources Conservation Service is an index of current water conditions throughout the state. The index utilizes parameters derived from snow, precipitation, reservoir, and stream flow data. The data is gathered each month from key stations in each basin. The lowest SWSI value, -4.2, indicates extreme drought conditions (Low Surface Water Supply ranges from -1.6 to -4.2). The highest SWSI value, +4.2, indicates extreme wet conditions (High Surface Water Supply ranges from +1.6 to +4.2). The midpoint is 0.0, which indicates an average water supply (Average Water Supply ranges from +1.5 to -1.5).

El Niño-Southern Oscillation (ENSO) weather patterns can increase the frequency and severity of drought. During El Niño periods, alterations in atmospheric pressure in equatorial regions yield an increase in the surface temperature off the west coast of North America.

This gradual warming sets off a chain reaction affecting major air and water currents throughout the Pacific Ocean. In the North Pacific, the jet stream is pushed north, carrying moisture-laden air up and away from its normal landfall along the Pacific Northwest coast. In Oregon, this shift results in reduced precipitation and warmer temperatures, normally experienced several months after the initial onset of the El Niño phase. These periods tend to last nine to twelve months, after which surface temperatures begin to trend back toward the long-term average. El Niño periods tend to develop between March and June, and peak from December to April. ENSO generally follows a two- to seven-year cycle, with El Niño or La Niña periods occurring every three to five years. However, the cycle is highly irregular, and no set pattern exists.

According to the National Weather Service (NWS) Climate Prediction Center, 22 El Niño episodes have occurred since 1950, with the two most recent strong El Niño episodes occurring in 1997–98 and 2015–16.[24] An El Niño episode occurred in 2019; however, it was classified as “weak” and did not create drought conditions in the County.[25]

2.7.2.2.1. Measuring Drought Extent

The Drought Severity and Coverage Index (DSCI) has possible values from 0 to 500. Zero indicates none of the area is abnormally dry or in drought, and 500 indicates the entire area is exceptionally dry (in D4, exceptional drought).[26]

Drought classifications by category, and corresponding descriptions and potential impacts, are provided in Table 11.

[24] Climate Prediction Center Internet Team. (n.d.). Cold & Warm Episodes by Season. National Weather Service Climate Prediction Center. http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml
[25] Donegan, B. (2019, March 14). *El Niño* El Nino Conditions Strengthen, Could Last Through Summer. The Weather Channel. https://weather.com/news/weather/news/2019-03-14-el-nino-conditions-strengthen-could-last-through-summer
[26] Akyuz, F.A. (2017). Drought Severity and Coverage Index. United States Drought Monitor. https://droughtmonitor.unl.edu/About/AbouttheData/DSCI.aspx

Table 11: Drought Severity and Coverage Index Categories and Potential Impacts[27]

Category	Description	Potential Impacts
D0	Abnormally dry	• Going into drought: short-term dryness slowing planting, growth of crops, or pastures • Coming out of drought: some lingering water deficits and pastures or crops not fully recovered
D1	Moderate drought	• Some damage to crops and pastures • Streams, reservoirs, or wells low and some water shortages are developing or imminent • Voluntary water-use restrictions requested
D2	Severe drought	• Crops or pasture losses likely • Water shortages common • Water restrictions imposed
D3	Extreme drought	• Major crop or pasture losses • Widespread water shortages or restrictions
D4	Exceptional drought	• Exceptional and widespread crop and pasture losses • Shortages of water in reservoirs, streams, and wells are creating water emergencies

[27] National Drought Mitigation Center, University of Nebraska–Lincoln. (2022). Drought Classification. https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx

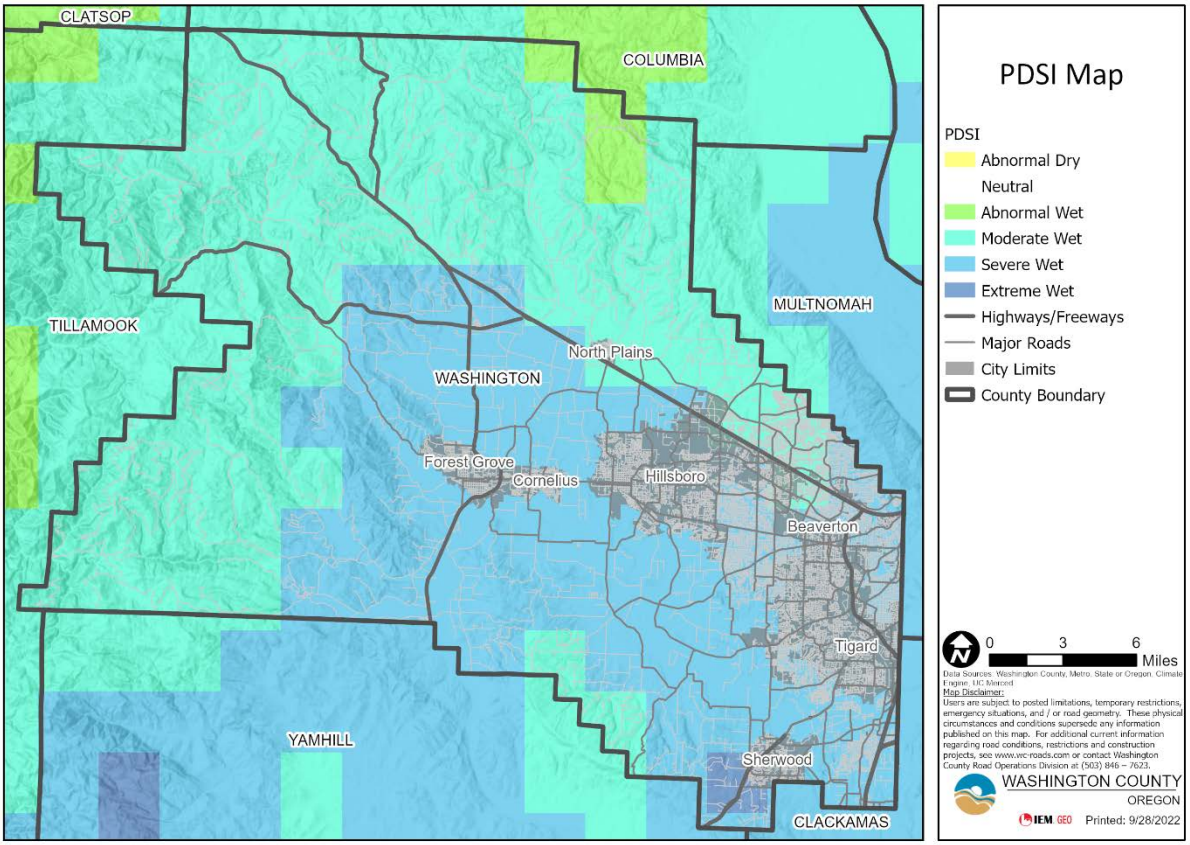


Figure 4: Drought Conditions in Washington County as of September 28, 2022

2.7.2.3. History

Precipitation in Oregon follows a distinct spatial and temporal pattern; it tends to fall mostly in the cool season, from October to April. The Cascades block rain-producing weather patterns, creating a very arid and dry environment east of these mountains. Moist air masses originating from the Pacific Ocean cool and condense when they encounter the mountain range, depositing precipitation primarily on the inland valleys and coastal areas. Because of this weather pattern, significant droughts are typically uncommon in Washington County; however, agriculture drought can occur with relative frequency.

Table 12: Historic Drought Events in Washington County Since November 1, 2016

Date	Declaration
Beginning May 11, 2021	Agricultural drought declaration with corresponding Small Business Association Economic Injury Disaster Loan (SBA EIDL) program implementation. During the week of May 11, the County had a DSCI of 300. The DSCI did not reach 0 until the week of March 22, 2022.
Beginning April 18, 2020	Agricultural drought declaration with corresponding SBA EIDL program implementation. During the week of April 24, the County had a DSCI of 185 and was 220 from the week of May 5 to June 2. The DSCI did not reach 0 until the week of February 2, 2021.

Date	Declaration
Beginning July 24, 2018	Agricultural drought declaration with corresponding SBA EIDL program implementation. During the week of July 24, the County had a DSCI of 300 that was sustained until the week of December 18, 2018. The DSCI did not reach 0 until the week of October 22, 2019.

2.7.2.4. Probability of Future Events

Drought is currently a cyclic part of the climate of Oregon, occurring in both summer and winter, with an average recurrence interval between 8 and 12 years. Short-term, seasonal events are more frequent, while long-term events are less frequent. Although there have been advancements in climatology, estimating drought probability and frequency continues to be difficult. This is because of the many variables that contribute to weather behavior, climate change, and the absence of historical information. Understanding drought as a recurring climate cycle is a first step toward creating management practices that effectively mitigate its effects.

2.7.2.4.1. Climate Change

Climate change forecasts highlight an increased risk for drought conditions in the Pacific Northwest. The U.S. Climate Assessment notes that "changes in the timing of streamflow related to changing snowmelt are already observed and will continue, reducing the supply of water for many competing demands and causing far-reaching ecological and socioeconomic consequences."[28]

Climate models project warmer, drier summers for Oregon. These summer conditions, coupled with projected decreases in mid- to low-elevation mountain snowpack due to warmer winter temperatures, increases the likelihood the County will experience increased frequency of one or more types of drought under future climate change.[29]

Climate change may result in increased frequency of drought due to low spring snowpack (likely, >90%), low summer runoff (likely, >66%), and low summer precipitation and low summer soil moisture (more likely than not, >50%).[30]

In addition, an increase in the frequency of summer drought conditions is predicted due largely to projected decreases in summer precipitation and increases in potential evapotranspiration.[31]

With climate change, snow droughts, the type of drought in which snowpack is low but precipitation is near normal, are expected to occur more often. The 2015 drought in Oregon was a snow drought and serves as a good example of what future climate projections indicate may become commonplace by the mid-twenty-first century.[32]

The 2021 Pacific Northwest Water Year Impacts Assessment shows that the Pacific Northwest region, which includes the planning area, was drier than predicted during the year. The 2021 water year in the

[28] Melillo, J.M., Richmond, T.C., & Yohe, G.W. (Eds.). (2014). *Highlights of Climate Change Impacts in the United States: The Third National Climate Assessment.* U.S. Global Change Research Program, pg. 148 http://s3.amazonaws.com/nca2014/low/NCA3_Highlights_LowRes.pdf?download
[29] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[30] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[31] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[32] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

Pacific Northwest tied as the fifth warmest and seventeenth driest since documentation of records began in 1895.[33]

2.7.2.5. Vulnerability Assessment

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County have the potential to be exposed to and impacted by drought. Additional information about populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County is provided in Volume III, Appendix A and participant annexes in Volume II.

When a drought occurs, it may affect all areas of the County. Historically, urban areas of the County fare much better during a drought than rural, less populated areas of the County. By encouraging or invoking water conservation measures during a drought, public municipal water systems can reduce residential and industrial demand for water. Rural areas are much more dependent on water for irrigation for agricultural production. Landowners in rural or less-populated areas are often reliant on individual, privately owned wells as a drinking water source.[34]

A drought event can cause widespread impacts, depending on its severity.[35]

- **Water:** Ground and surface water quality can be impacted when water is not regularly replenished, and water may not be available for farming, manufacturing, or use in everyday activities like bathing, cooking, and washing dishes.
- **Health:** Negative effects on the quantity and quality of drinking water can occur, and sources of food and nutrition can be compromised, leading to increased incidents of illness and disease. Drought is linked to increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions. Decreases in water during drought can lead to reduced availability of electricity and hospitalized and elderly people can be at increased risk for injury or death.
- **Environmental:** In addition to water quality issues, low water levels resulting from drought have a significant impact on ecosystems. When water levels are low in lakes, rivers, and other water bodies, their ability to flush out contaminants diminishes, causing an increase in waterborne pollutants. Reduced plant growth, local species reduction or extinction, and landscape-level transitions, such as forest conversion to non-forested vegetation, which may in turn reduce water retention in soils, may occur. Additionally, freshwater ecosystems may change flow regimes, increase water temperature, and deteriorate water quality, which may result in fish kills, reduced opportunities for recreation, and decreased hydropower production.[36]
- **Built environment:** While impacts to the built environment aren't as dramatic as those from other hazards, drought has a significant effect on buildings and infrastructure. When buildings are located on expansive soils, for example, the foundation can be compromised as soil moisture decreases and clay-based soils contract. The study of expansive soils in the County is extremely

[33] Bumbaco, K.A., Rogers, M.H., O'Neill, L.W., Hoekema, D.J., & Raymond, C.L. (2022). 2021 Pacific Northwest Water Year Impacts Assessment. A collaboration between the Office of the Washington State Climatologist, Climate Impacts Group, Oregon State Climatologist, Idaho Department of Water Resources, and NOAA National Integrated Drought Information System. https://www.drought.gov/sites/default/files/2022-02/PNW-Water-Year-Impacts-Assessment-2021.pdf

[34] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

[35] American Planning Association. (2019). Falling Dominoes: A Planner's Guide to Drought and Cascading Impacts. https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/Falling-Dominoes-Planners-Guide-to-Drought-and-Cascading-Impacts.pdf

[36] National Oceanic and Atmospheric Administration–National Integrated Drought Information System. (n.d.). Ecological Drought. https://www.drought.gov/what-is-drought/ecological-drought#:~:text=%20Examples%20of%20drought%20impacts%20to%20ecological%20systems,water%20temperature%2C%20and%20deteriorate%20water%20quality%2C...%20More%20

limited. A 1967 DOGAMI study mentions the presence of high plasticity and high groundwater, which are the factors needed to cause shrink swell in expansive soils.[37] Municipal water supply and delivery, municipal wastewater, transportation systems, and parks and recreational facilities are also impacted by drought. There may even be situations where water-intensive industries relocate and agricultural production shifts to different locations due to lack of water.

- **Economic:** Water is essential to the production of goods and services, and when the water supply is depleted or disrupted, reduced productivity or closures can impact supply chains. Industries that are directly affected by drought include agriculture, recreation, energy, tourism, agriculture, timber, and fisheries, among others. Drought can have wide-ranging impacts that include job losses, business failures, and lost investments.

Even though drought may not be declared often in Washington County, when drought conditions do develop, the impacts can be widespread and severe. Reasons for potential broad and significant impacts include the following[38]:

- Higher population density and growing population in the County.
- Dependence on surface water supplies for many municipalities, agriculture, and industries from large flood control reservoirs in the Willamette River system.
- Agriculture is a major industry becoming increasingly dependent on irrigation.
- Increased frequency of toxic algal blooms in the Willamette system reservoirs, resulting in restrictions on use of water from reservoirs for drinking (i.e., for human and animals). Affected waters may not be safe for agricultural irrigation and other uses, necessitating purchasing and transporting water from alternative sources.
- Since drought is typically accompanied by earlier onset of snowmelt (e.g., during flood control or early storage season), little or no snowmelt runoff is stored until later.
- An earlier start to growing season, before the start of the irrigation season, means that crops may not be irrigated until the irrigation season begins.
- Insufficient number of farm workers available because the growing season began before the workers were scheduled to arrive.

When natural hazard events overlap or occur in quick succession, the events can compound and cause detrimental effects. Drought is particularly likely to be part of a cascading hazard because it can cover a large area and go on for a long time.[39]

- **Drought and extreme heat:** Drought and extreme heat often occur simultaneously, and drought can make a hot day hotter, while a heat wave can make dry conditions even drier. Periods of extreme heat increase evaporation, leading to reduced water availability in soils and surface water supplies. Periods of drought can cause extreme heat due to lack of water in the atmosphere, soils, and rivers, where decreased water availability in the system reduces the amount of evaporation happening at the surface, quickly increasing temperatures. Extreme heat can also increase water demands, in which human activities can reduce water supplies, leading to human-caused drought. These hazards occurring together can compound health impacts, reduce energy production, cause loss of aquatic life due to reduced stream and reservoir levels and increased water temperatures, kill vegetation, and create dangerous air quality issues.

[37] Department of Geology and Mineral Industries. (1967). Engineering Geology of the Tualatin Valley Region, Oregon. https://www.oregongeology.org/pubs/B/B-060.pdf
[38] Oregon Natural Hazards Mitigation Plan. (2020, September 24). https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[39] American Planning Association. (2019). Falling Dominoes: A Planner's Guide to Drought and Cascading Impacts. https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/Falling-Dominoes-Planners-Guide-to-Drought-and-Cascading-Impacts.pdf

- **Drought and wildfire:** Decreased soil moisture and increased temperatures stress vegetation and increase plant mortality, providing fuel for fires. Reduced ponds, streams, and reservoir levels can also limit withdrawal sources for fighting wildfires. The extreme conditions can also increase the likelihood of shrub and tree mortality by wildfire in previously fire-adapted ecosystems, in addition to habitat and infrastructure losses and threats to animal and human life. Wildfires, whether located in or outside the County, may also create dangerous air quality issues for residents.
- **Drought and flooding:** Drought, along with wildfires that can stem from drought, increase flood risk. Extended drought and wildfire can stress and reduce the amount of vegetation. When it does rain, the reduction of vegetation can increase flooding due to faster runoff rates, compared to normal conditions when abundant vegetation slows runoff and increases water absorption into the ground. Drought or wildfire conditions prior to flooding can also cause water quality deterioration from the increased soil and ash particles in the runoff. On farmlands, drought conditions prior to flooding may also cause a surge of farm chemicals applied to crops to enter streams through runoff. These factors can affect the water quality for aquatic life, animals, and humans, who are all dependent on the water source. Increased instances of flash flooding may also occur.
- **Drought and landslides:** Droughts can indirectly cause landslides through a cascade of natural hazards. For example, drought can cause dry conditions and increased fuel loads for wildfires that, in turn, can increase the likelihood of flooding. The ash-infused topsoil, which is water repellent, and loss of vegetation can increase runoff and take large amounts of earthen material with them, causing devastating impacts to populations in the path of the landslide event. These Such events could cause the loss of infrastructure and life. From an environmental standpoint, they may also affect the water quality of downstream rivers and streams and the habitat for animals, flora, and fauna. The landslides can also alter the topography of the landscape, which can modify surface and groundwater flow patterns.

2.7.2.6. Hazard Risk Score Summary

Based on the hazard analysis methodology described in Section 2.2, plan participants assigned the scores below to their overall risk of drought. Additional information is in the participant annexes.

Table 13: Participant Overall Risk of Drought[40]

Participant	Overall Risk of Drought
City of Beaverton	198
City of Cornelius	186
City of Forest Grove	186
City of Hillsboro	184
City of North Plains	170
City of Sherwood	175
City of Tigard	172
Clean Water Services	165
Tualatin Hills Park & Recreation District	166
Tualatin Valley Water District	186
Washington County	186

[40] 2023 NHMP Participant Planning Documentation

2.7.3. Earthquake

Significant Changes

- Hazard profile expanded to include information about liquefaction and coseismic landslides.
- Information about the Portland Hills, Gales Creek, and Beaverton fault zones and Hazus®-MH event scenarios with damage data for these faults added to the hazard profile.
- Additional information on vulnerabilities and how climate change may impact the frequency and severity of earthquakes added.

2.7.3.1. Characteristics

An earthquake is a sudden movement of rock on each side of a fault in the earth's crust that abruptly releases strain that has accumulated. The movement along the fault produces waves of shaking that spread in all directions. If an earthquake occurs near populated areas, it may cause casualties, economic disruption, and extensive property damage.[41]

The effects of an earthquake can be felt far beyond the site of its occurrence. Earthquakes usually occur without warning, and after just a few seconds, can cause massive damage and extensive casualties. The most common effect of earthquakes is ground motion, usually felt as shaking and vibrations.

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

[41] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

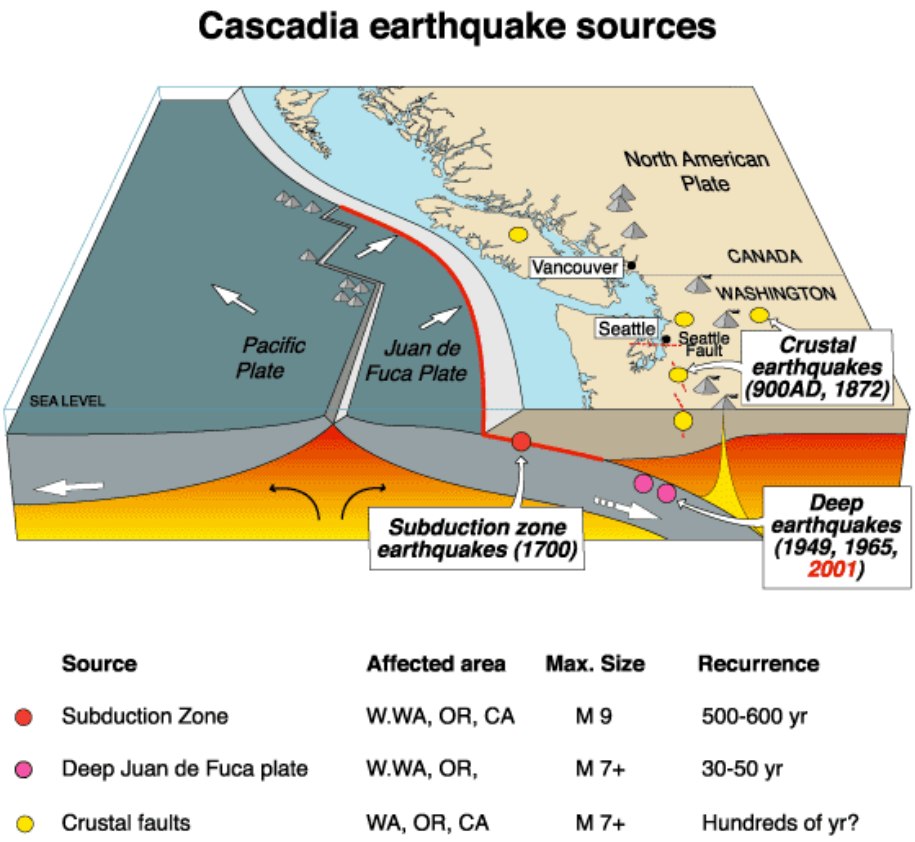


Figure 5: Cascadia Earthquake Sources

Earthquakes from four sources threaten Washington County:

- **Crustal** earthquakes are the most common. They typically occur along faults, or breaks in the earth's crust, at shallow depths of 6 to 12 miles below the surface. When these events occur on faults in or near populated areas, they are a major hazard. All damaging historic earthquakes in the state have been crustal earthquakes.[42] One of the largest events in recent years in Oregon, the magnitude 5.6 Scotts Mills earthquake of 1993 was a crustal earthquake. The epicenter was approximately 30 miles south of the planning area. The incident resulted in a federal disaster declaration; however, it caused limited damage in Washington County.
- **Subduction zone** earthquakes occur in places where the tectonic plates that make up the surface of the earth collide. When these plates collide, one plate slides beneath the other, where it is reabsorbed into the mantle of the earth. This dipping interface between the two plates is the site of some of the most powerful earthquakes ever recorded, often having magnitudes of 8.0 to 9.0 or larger. The greatest earthquake threat to Washington County is the hazard posed by infrequent megathrust earthquakes on the Cascadia Subduction Zone (CSZ) located off the Oregon coast.

[42] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

- **Deeper intraplate** earthquakes occur within the remains of the ocean floor that is being subducted beneath the North American Plate. This type of earthquake could occur beneath much of the Northwest at depths of 25 to 37 miles. Deeper intraplate events may have a higher magnitude but tend to result in less damage than a crustal earthquake of the same caliber, due to the depth at which it occurs.
- **Volcanic** earthquakes can be caused by a slip on a fault near a volcano or by vibrations generated by the movement of magma or other fluids within the volcano.[43] The largest felt volcanic earthquake near the County was a magnitude 5.5 in 1981, under Mount St. Helens. These earthquakes are typically smaller than earthquakes caused by non-volcanic sources, but they have the potential to cause cracks, ground deformation, and damage to structures and infrastructure.[44] These events are an indication of magmatic activity and may be a precursor to a volcanic eruption.[45]

Two earthquake-induced hazards, also called coseismic hazards, also have the potential to impact Washington County:

- **Liquefaction** occurs when saturated soils substantially lose bearing capacity due to ground shaking, causing the soil to behave like a liquid. Liquefied soil will force open ground cracks to escape to the surface. The ejected material often results in flooding and may leave cavities in the soil.[46] This action can be a source of tremendous damage, especially to buildings and underground infrastructure.[47]
- **Coseismic landslides** are mass movement of rock, debris, or soil induced by ground shaking.[48] They may be scattered across a broad area extending tens or more of kilometers from the earthquake epicenter, causing widespread impacts over and above the damage caused by strong ground shaking of the earthquake itself.[49]

2.7.3.2. Location and Extent

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

Intensity is usually reported using the Modified Mercalli (MM) Intensity Scale. This scale has 12 categories ranging from “not felt” to “total destruction.” Different values can be recorded at different locations for the same event depending on local circumstances, such as distance from the epicenter or building construction practices. Peak ground acceleration (PGA) is also used to measure earthquake intensity. It measures the earthquake’s intensity by quantifying how hard the earth shakes in each location. PGA can be measured as a percentage of acceleration due to gravity, noted by “% g.” Table 14 identifies corresponding intensity and magnitude ratings as well as effects associated with each rating.

[43] Pacific Northwest Seismic Network. (n.d.). Volcanic Earthquakes. https://pnsn.org/outreach/earthquakesources/volcanic
[44] Pacific Northwest Seismic Network. (n.d.). Volcanic Earthquakes. https://pnsn.org/outreach/earthquakesources/volcanic
[45] Pacific Northwest Seismic Network. (n.d.). Volcanic Earthquakes. https://pnsn.org/outreach/earthquakesources/volcanic
[46] Pacific Northwest Seismic Network. (n.d.). Liquefaction. https://pnsn.org/outreach/earthquakehazards/liquifaction
[47] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[48] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[49] U.S. Geological Survey. (n.d.). Coseismic Landslides. https://www.usgs.gov/special-topics/big-sur-landslides/science/earthquake-hazards

Table 14: Effects of Intensity and Magnitude Ratings

Magnitude	MM Intensity	PGA (% g)	Perceived Shaking
0-4.3	I	<0.17	Not Felt
	II-III	0.17–1.4	Weak
4.3-4.8	IV	1.4–3.9	Light
	V	3.9–9.2	Moderate
4.8-6.2	VI	9.2–18	Strong
	VII	18–34	Very Strong
6.2-7.3	VIII	34–65	Severe
	IX	65–124	Violent
	X	124+	Extreme

Washington County is at risk from several fault systems, including the CSZ, Portland Hills Fault, and Gales Creek Fault.

2.7.3.2.1. Cascadia Subduction Zone

The CSZ is the boundary between two of the earth's crustal plates. These continent-sized plates are in constant slow motion, and the boundaries between plates are the site of most earthquake activity around the globe. At the CSZ, the Juan de Fuca Plate, located offshore of Oregon and Washington, slides to the northeast and under the North American Plate, which extends from the Oregon coast to the middle of the Atlantic Ocean. The Juan de Fuca Plate slides beneath the continent (subducts) at about 1.5 inches per year, a speed that has been directly measured using high-accuracy GPS. The fault that separates the plates extends from Cape Mendocino in Northern California to Vancouver Island in British Columbia, and slopes down to the east from the seafloor. The fault is usually locked, so that rather than sliding slowly and continuously, the 1.5 inches per year of subduction motion builds tremendous stress along the fault. This stress is periodically released in a megathrust earthquake, which can have a magnitude from 8.3 to 9.3.[50]

2.7.3.2.2. Portland Hills Fault Zone

The Portland Hills Fault Zone lies just east of Washington County. This zone is comprised of three crustal faults that trend roughly northwest to southeast and are about two miles apart: the Oatfield Fault, which runs along and just west of the spine of the Portland Hills; the Portland Hills Fault, which runs directly under downtown Portland; and the East Bank Fault, which runs along the east bank of the Willamette River. Several lines of indirect evidence have led to the conclusion that the Portland Hills Fault Zone appears to be capable of generating a large-magnitude earthquake. These faults are believed to be capable of generating an earthquake of magnitude 6.8 to 7.2 on average, once every 1,000 years.[51]

[50] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[51] Washington County, Oregon. (n.d.). Local Earthquakes. https://www.co.washington.or.us/EmergencyManagement/Hazards/Earthquake/local.cfm

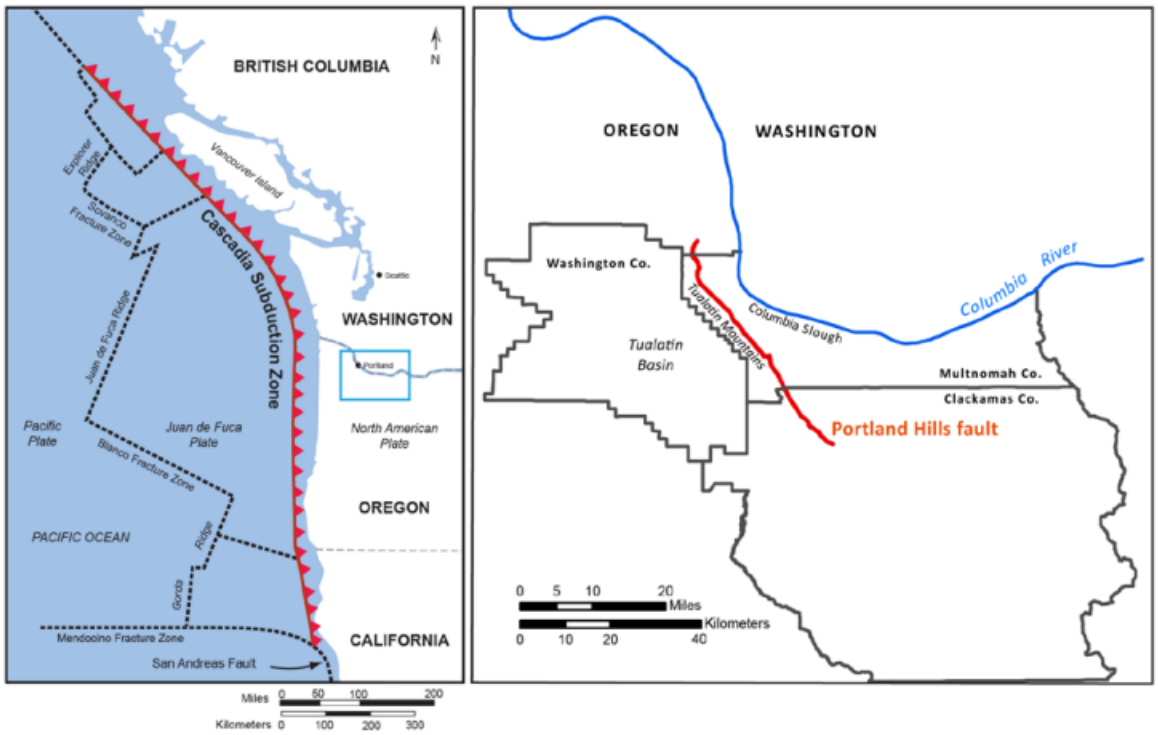


Figure 6: Cascadia Subduction Zone Fault (left) and Portland Hills Fault (right) Locations. Blue Rectangle in Left Figure is Shown in Right Figure.[52]

2.7.3.2.3. Gales Creek Fault Zone

The Gales Creek Fault Zone is in western Washington County and is approximately 45 miles long. If the full length of the fault were to rupture, it would result in a magnitude 7.1 to 7.4 earthquake. It is believed that the fault has the capability of producing an event every 4,000 years. The most recent earthquake along this fault occurred 1,000 years ago.[53]

[52] Bauer, J.M., Burns, W.J., & Madin, I.P. (2018). Open-File Report 0-18-02: Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon. *Oregon Department of Geology and Mineral Industries.* https://www.oregongeology.org/pubs/ofr/O-18-02/O-18-02_report.pdf

[53] Horst, A.E., Streig, A.R., Wells, R.E., & Bershaw, J. (2021). Multiple Holocene Earthquakes on the Gales Creek Fault, Northwest Oregon Fore-Arc. *GeoScience World. 111*(1), 476–489. https://doi.org/10.1785/0120190291

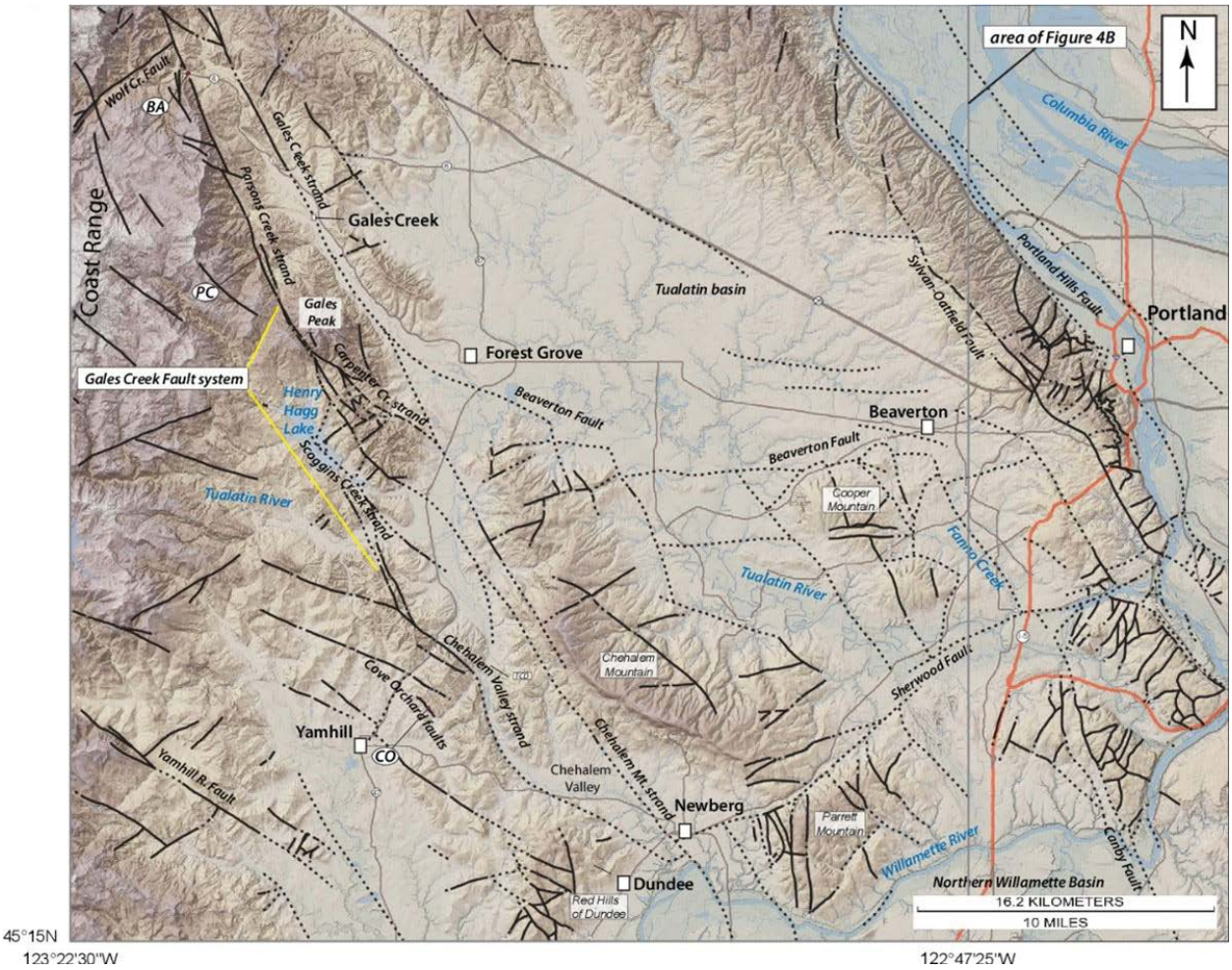


Figure 7: Gales Creek Fault[54]

2.7.3.2.4. Liquefaction and Coseismic Landslides

Whether and where liquefaction will take place depends on many factors. These include the degree of saturation, the grain size distribution and consistency at a site, the strength, duration, and frequency content of the shaking and even the grain shape and depth of soil. Figure 8 shows the areas of Washington County that are susceptible to liquefaction.

Site amplification is the degree to which soil types weaken or strengthen seismic waves produced from an earthquake. The National Earthquake Hazards Reduction Program (NEHRP) classifies these geologic units into soft rock, dense soil or soft rock, stiff soil, and soft clay or soil. NEHRP soils can significantly affect the level of shaking and amount of damage that occurs at a specific location during an earthquake. Figure 9 shows site amplification classes present in Washington County.

[54] Semantic Scholar. (n.d.). *Northwest Migration of the Oregon Forearc on the Gales Creek Fault.* https://www.semanticscholar.org/paper/Northward-migration-of-the-Oregon-forearc-on-the-Wells-Blakely/b7485394d7ed09a7dec3b1e433f5a47e8c157d39/figure/5

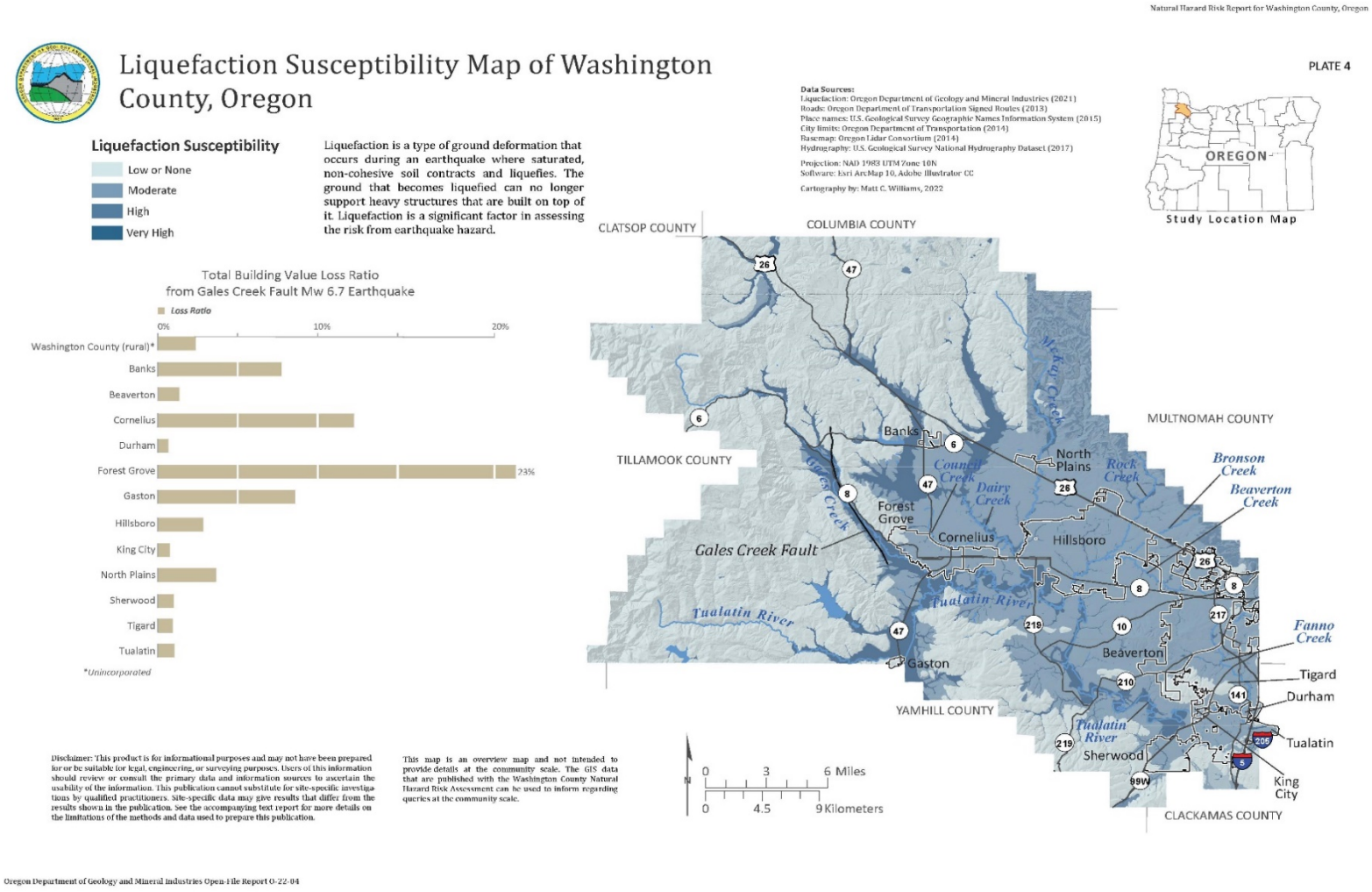


Figure 8: Liquefaction Susceptibility Map of Washington County, Oregon[55]

[55] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

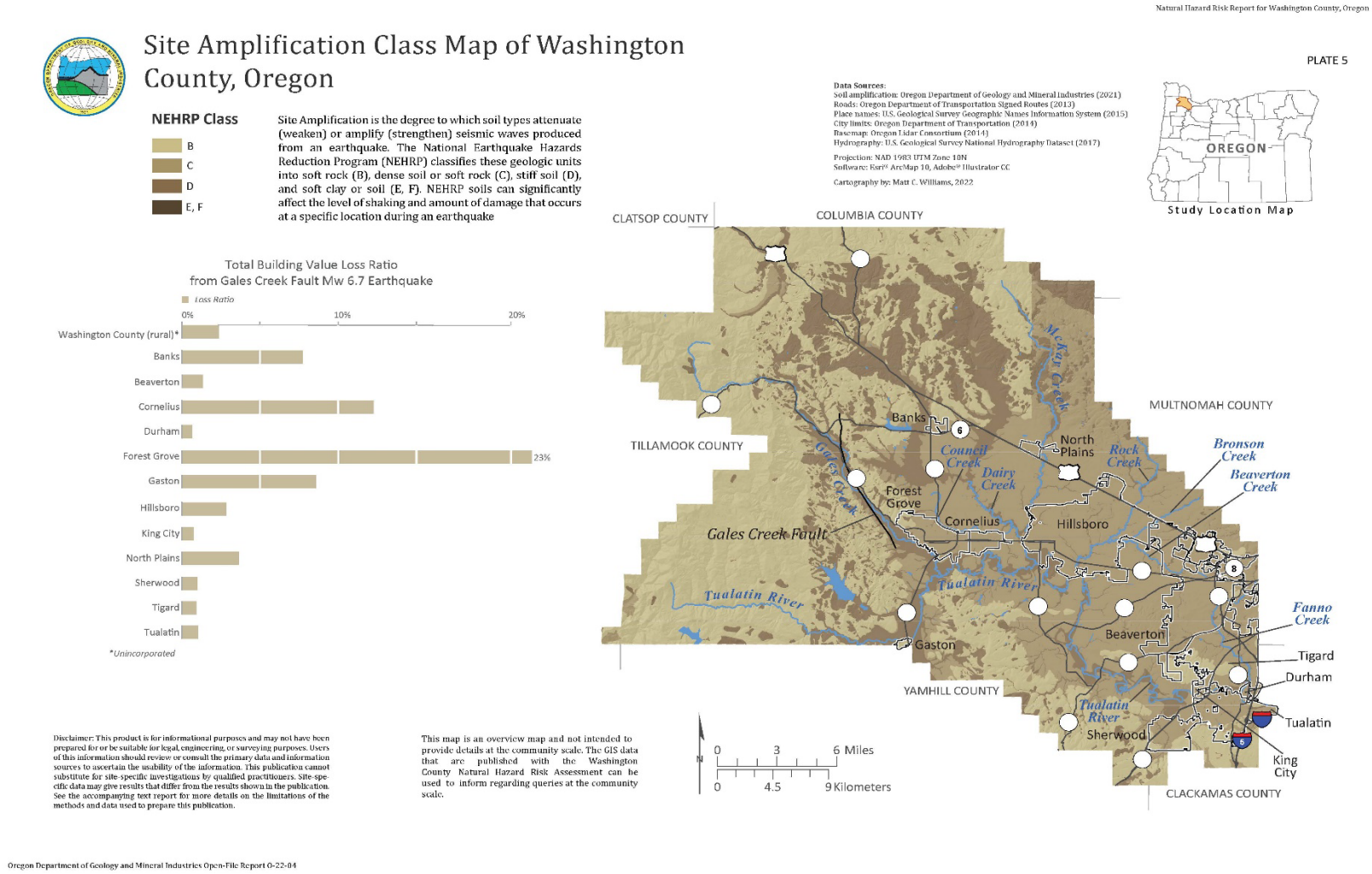


Figure 9: Site Amplification Class Map of Washington County, Oregon[56]

[56] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

Strong ground shaking can also cause new landslides and reactivate dormant landslides. Commonly, slopes that are marginally stable prior to an earthquake can become unstable and fail. Some coseismic landslides result from liquefaction that causes lateral movement of soil, or lateral spread.[57] Coseismic landslides are more likely to occur in the northern portion of Washington County where a threat of non-coseismic landslides also exists.[58] Figure 10 below shows the areas of Washington County that are susceptible to coseismic landslides.

[57] Oregon Department of Geology and Mineral Industries. (n.d.). Open-File Report O-19-09: Coseismic Landslide Susceptibility, Liquefaction Susceptibility, and Soil Amplification Class Maps, Clackamas, Columbia, Multnomah, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-19-09/O-19-09_report.pdf
[58] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

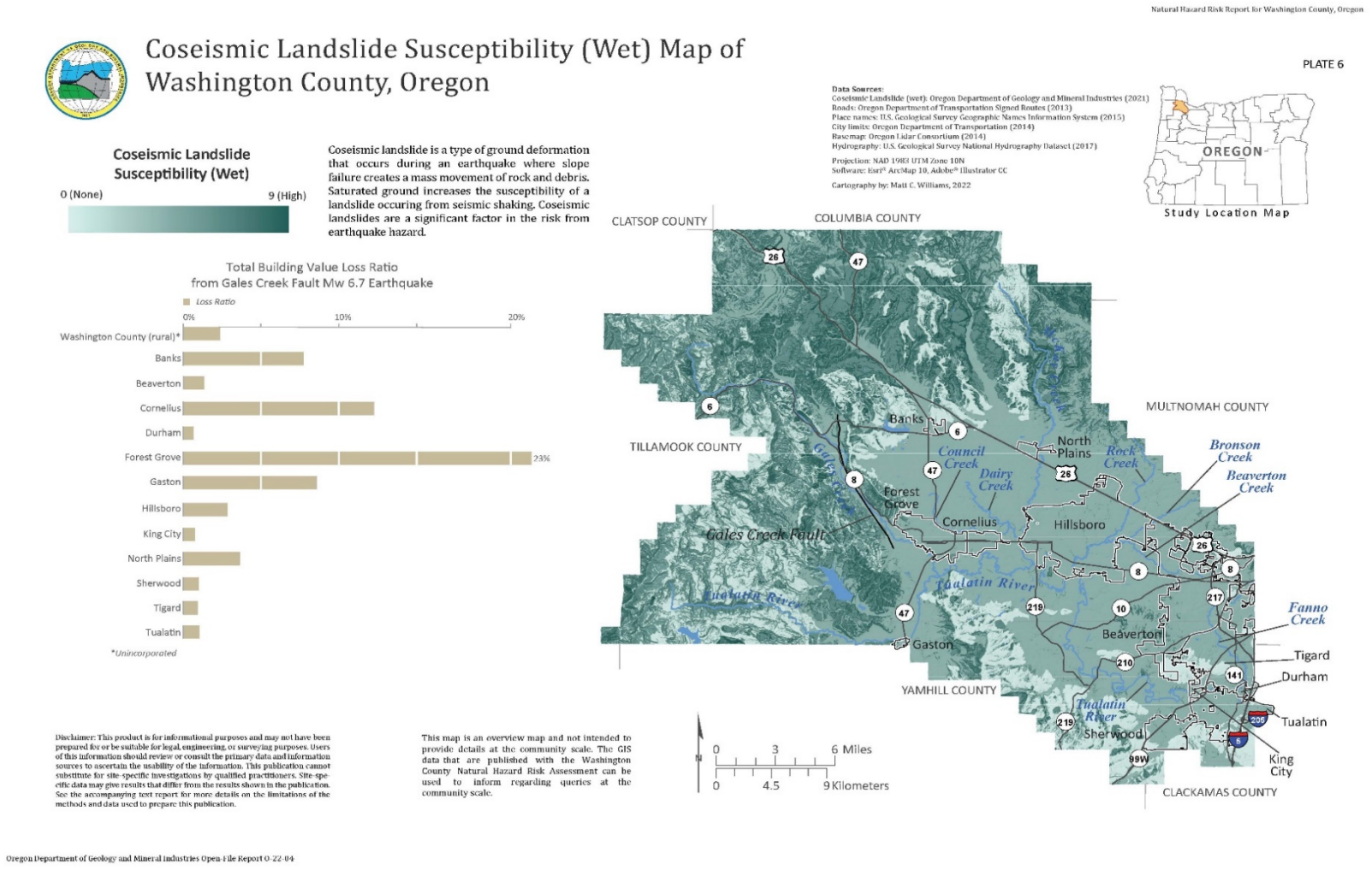


Figure 10: Coseismic Landslide Susceptibility (Wet) Map of Washington County, Oregon[59]

[59] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

2.7.3.3. History

There have been no significant recorded occurrences of earthquakes since the adoption of the 2017 NHMP.

The 2020 Oregon NHMP shows that Region 2, which includes Washington County, has had at least seven crustal earthquakes of magnitude 4.0 or greater since 1877. The region's largest earthquakes were the 1877 magnitude 5.3 and the 1962 magnitude 5.2 earthquakes. In addition, the region has been shaken historically by crustal and intraplate earthquakes and prehistorically by subduction zone earthquakes centered outside the area.[60]

Earthquakes that have been felt in the planning area, including the city of Beaverton, have originated in other areas. The Scotts Mills earthquake on March 25, 1993, was the first significant earthquake in recorded history to originate close enough to the city to be felt. Beaverton experienced only minor damage, but surrounding counties, including Clackamas, incurred significant damage and received a federal disaster declaration. The Nisqually earthquake on February 28, 2001, was felt in the city of Beaverton but did little damage. Numerous small quakes occurred in the Portland Metro area, which is geographically adjacent to Washington County, in 2013, 2014, and 2015. Most of these earthquakes were not strong enough to be felt. In 2003, though too small to be felt, a small quake was detected under Cooper Mountain, in the southern part of the city of Beaverton, on a fault that had been previously designated by geologists as "inactive." The Beaverton fault zone is not shown on most published geologic maps of the area because it is currently minimally active. It is unknown how active it may be in the future. The central part of the Beaverton fault zone is mapped along the northern base of Cooper Mountain in the south-central part of the Tualatin Basin, but the rest of the fault zone has no apparent geomorphic expression.[61]

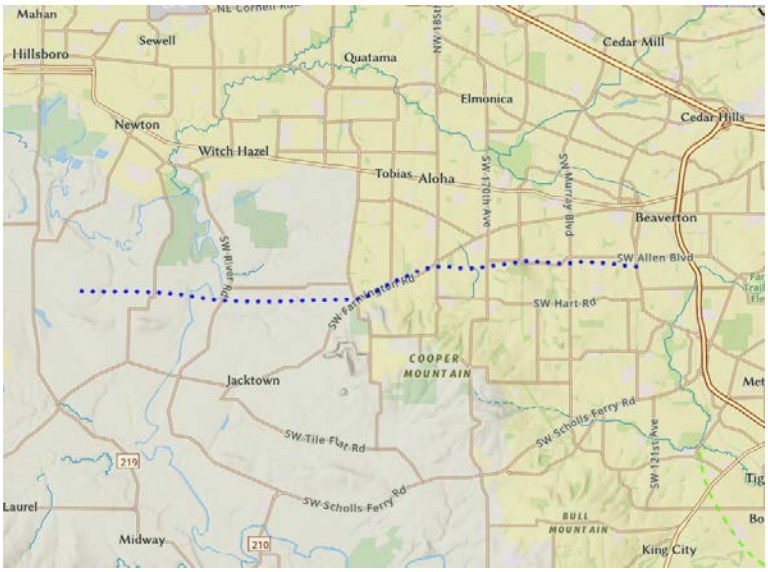


Figure 11: Beaverton Fault[62]

[60] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[61] Personius, S.F. (Compiler). (2002). Fault number 715, Beaverton Fault Zone, in Quaternary fault and fold database of the United States: U.S. Geological Survey website. https://earthquake.usgs.gov/cfusion/qfault/show_report_AB_archive.cfm?fault_id=715&section_id=
[62] U.S. Geological Survey. (n.d.). U.S. Quaternary Faults. https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf

2.7.3.4. Probability of Future Events

As indicated by plan participants, there is a medium probability of an earthquake occurring in Washington County, representing that one incident is likely to occur within 35 to 75 years. There is a higher than 45% probability the County will experience damaging shaking during the next 100 years, which is the highest level of probability possible.[63]

There are different types of earthquakes that could impact the County. The probability of a damaging earthquake, however, is harder to determine. Establishing a probability for crustal earthquakes is difficult given the small number of historic events in the region. Earthquakes generated by volcanic activity in Oregon's Cascade Range are possible, but likewise unpredictable.

The greatest earthquake threat to the County is posed by the CSZ. Although earthquakes can be a highly variable natural phenomenon, the CSZ has a well-understood recurrence history, which makes calculating potential future events easier and highlights the importance of increased mitigation efforts. Washington County is susceptible to deep intraplate events within the CSZ, ruptures of the CSZ, and shallow crustal events within the North American Plate.

The paleoseismic record includes 18 magnitude 8.8–9.1 megathrust earthquakes in the last 10,000 years that affected the entire subduction zone, including the County. The return period for the largest earthquakes is 530 years, and the probability of the next such event occurring in the next 50 years ranges from 7% to 12%. An additional 10 to 20 smaller, magnitude 8.3–8.5, earthquakes affected only the southern half of Oregon and northern California. The average return period for these is about 240 years, and the probability of a small or large subduction earthquake occurring in the next 50 years is 37%–43%.[64]

Although a CSZ event could cause more widespread and catastrophic damage to the planning area, the County is more likely to experience a crustal earthquake event than a CSZ event. Crustal earthquakes are likely to occur more frequently and be smaller events with low to medium impacts compared to CSZ events.

2.7.3.4.1. Climate Change

There is currently insufficient research on potential impacts climate change may have on the frequency, magnitude, and extent of earthquakes.[65]

2.7.3.5. Vulnerability Assessment

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County have the potential to be exposed to and impacted by earthquakes. Due to the natural variability in how earthquake events can occur, it is not likely that all shaking, liquefaction, and coseismic landslides will occur simultaneously or to the same degree. Additional information about populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County is provided in Volume III, Appendix A and participant annexes in Volume II.

[63] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[64] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[65] National Aeronautics and Space Administration. (2019, October 29). *Can Climate Affect Earthquakes, Or Are the Connections Shaky?* Global Climate Change. https://climate.nasa.gov/news/2926/can-climate-affect-earthquakes-or-are-the-connections-shaky/

The Oregon DOGAMI has completed in-depth studies to determine potential impacts of various earthquake scenarios. Scenario-specific vulnerabilities are detailed below. Impacts from earthquakes can vary greatly based on event location, magnitude, and extent. Generally, an earthquake can:

- Cause injury or death;
- Create a need for widespread search and rescue operations;
- Produce mental health impacts, including post-traumatic stress disorder;
- Result in widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation;
- Impact governments economically by reducing future revenues, increasing current costs resulting from response activities, and increasing future costs resulting from recovery and reconstruction activities;
- Interrupt business operations;
- Affect personal and household economics through loss of income, increased medical costs, and property damage that may not be covered by insurance;
- Damage and destroy the built environment, including above- and belowground utility lines, residential, public, and private buildings, and transportation systems;
    - There are many unreinforced masonry (URM) structures throughout the state; however, the currently available default building data does not include any URM structures. Thus, the reported damage and loss estimates may seriously under-represent the actual threat.[66]
- Cause hazardous material releases due to infrastructure and facility damage;
- Harm ecosystems by causing loss of habitat, death and destruction of vegetation and animals, and erosion;
- Change water flows, including paths of rivers and streams; and
- Trigger other hazard events, such as fires, tsunamis, floods, landslides, and sinkholes.

2.7.3.5.1. Cascadia Subduction Zone Magnitude 9.0 Scenario and Portland Hills Fault Magnitude 6.8 Scenarios

DOGAMI completed an analysis of potential impacts that could occur in the County as a result of a CSZ magnitude 9.0 scenario and a Portland Hills Fault magnitude 6.8 scenario. This study provides information that can inform mitigation actions and assist planners in estimating sheltering and public assistance needs in the aftermath of an event.

The study was published in 2018 and covers the counties of Washington, Clackamas, and Multnomah. Because Washington County has experienced population and built-environment growth since the report was created, some data used may not be the most recent information available. Additionally, some data is comprehensive for all three counties; however, the study provides a strong baseline for the planning area and plan participants to utilize.

A magnitude 9.0 CSZ earthquake will result in significant damage to buildings, with collateral casualties, in the tri-county area. Transportation networks may be severely impaired, compromising emergency response. Millions of tons of debris will need to be removed to staging areas for sorting and eventual permanent disposal. Hundreds of thousands of buildings will need timely safety inspections, and thousands to tens of thousands of people will need to find other permanent housing arrangements. In comparison, a magnitude 6.8 Portland Hills Fault earthquake will be devastating to the tri-county area,

[66]Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

primarily due to its position relative to the study area's major assets and population centers, with losses more than double those from a magnitude 9.0 CSZ earthquake.

Scenarios in the report use the best scientific information available on fault placement, rupture frequency, and earthquake magnitude. Because the loss estimate data is used for planning purposes, scenarios incorporate the upper end of predicted magnitude when modeling a specific earthquake. The study focuses on damage to buildings and the people that occupy them and the two key infrastructure sectors of electric power transmission and transportation routes.

Each earthquake scenario was modeled with a wet (saturated) and a dry soil condition, and each earthquake was modeled at two different times of the day, at 2 a.m. and at 2 p.m. In western Oregon, soil moisture conditions vary widely throughout the calendar year. Soil moisture conditions influence the likelihood of an earthquake-triggered landslide or liquefaction. An earthquake occurring during wet (saturated) soil conditions is much more likely to induce landslides and liquefaction. Some earthquake-induced landslides may occur in dry soil conditions, but liquefaction is much less likely. Throughout a typical day, people move between various buildings, such as residences, schools, work facilities, and commercial facilities. Some buildings, due to their basic structural system, are more likely to sustain significant damage from an earthquake and, thus, depending on how many people are occupying the building at the time of the earthquake, cause more casualties.

The Hazus Advanced Engineering Building Module model estimate used in the study identifies each building's probability of being in one of five damage states: None, Slight, Moderate, Extensive, and Complete.[67] Damage state descriptions are provided below.

- **None:** No damage.
- **Slight:** Small plaster cracks at corners of door and window openings and wall and ceiling intersections; small cracks in masonry chimneys and masonry veneers. Small cracks are assumed to be visible, with a maximum width of less than 1/8 inch (cracks wider than 1/8 inch are referred to as large cracks).
- **Moderate:** Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.
- **Extensive:** Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates and/or slippage of structure over foundations.
- **Complete:** Structures may have large permanent lateral displacement or be in imminent danger of collapse due to cripple wall failure or failure of the lateral load resisting system; some structures may slip and fall off the foundation; large foundation cracks. Three percent of the total area of buildings with a damage state of Complete is expected to be collapsed, on average.

[67] Federal Emergency Management Agency. (2020). Earthquake Loss Estimation Methodology. Hazus-MH 2.1 Advanced Engineering Building Module (AEBM) Technical and User's Manual. https://www.fema.gov/sites/default/files/2020-09/fema_hazus_advanced-engineering-building-module_user-manual.pdf

2.7.3.5.2. Study Results[68]

2.7.3.5.2.1. Cascadia Subduction Zone Magnitude 9.0 Scenario

Table 15: Number of Buildings Per Damage State and Soil Moisture Conditions for Cascadia Subduction Zone Magnitude 9.0 Earthquake Scenario

Building Damage State	"Dry" Soil	Building Percent	"Wet" Saturated Soil	Building Percent
Slight	44,673	25%	41,807	23%
Moderate	20,381	11%	19,012	11%
Extensive	6,303	3%	5,892	3%
Complete	2,784	2%	14,026	8%
Total Damaged Buildings	**74,141**	**41%**	**80,737**	**45%**

Table 16: Buildings Per Damage Category, "Dry" Soil Moisture Conditions for Cascadia Subduction Zone Magnitude 9.0 Earthquake Scenario

Building Category	Total Number of Buildings	Building Square Footage	Building Value	Building Repair Costs	Building Loss Ratio
Agriculture	10,753	26,823,000	$2,855,000,000	$368,000,000	13%
Commercial	5,863	104,377,000	$15,815,000,000	$2,310,000,000	15%
Industrial	1,399	50,567,000	$8,548,000,000	$1,350,000,000	16%
Institutional	1,931	28,098,000	$4,856,000,000	$790,000,000	16%
Multi-Family Residential	18,475	98,385,000	$15,671,000,000	$1,155,000,000	7%
Single-Family Residential	138,117	289,198,000	$34,755,000,000	$990,000,000	3%
Manufactured Housing	4,573	5,523,000	$232,000,000	$49,000,000	21%

[68] Oregon Department of Geology and Mineral Industries. (2018). Open-File Report O-18-02: *Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon.* https://www.oregongeology.org/pubs/ofr/O-18-02/O-18-02_report.pdf

Table 17: Buildings Per Damage Category, "Wet" Soil Moisture Conditions for Cascadia Subduction Zone Magnitude 9.0 Earthquake Scenario

Building Category	Total Number of Buildings	Building Square Footage	Building Value	Building Repair Costs	Building Loss Ratio
Agriculture	10,753	26,823,000	$2,855,000,000	$558,000,000	20%
Commercial	5,863	104,377,000	$15,815,000,000	$3,031,000,000	19%
Industrial	1,399	50,567,000	$8,548,000,000	$1,799,000,000	21%
Institutional	1,931	28,098,000	$4,856,000,000	$1,039,000,000	21%
Multi-Family Residential	18,475	98,385,000	$15,671,000,000	$2,016,000,000	13%
Single-Family Residential	138,117	289,198,000	$34,755,000,000	$3,144,000,000	9%
Manufactured Housing	4,573	5,523,000	$232,000,000	$61,000,000	26%

Table 18: Collapsed Buildings by Soil Moisture Conditions for Cascadia Subduction Zone Magnitude 9.0 Earthquake Scenario

Total Number of Buildings	"Dry" Soil	"Wet" Saturated Soil
181,111	158	313

Table 19: Number of Permanent Residents Buildings Per Damage Category and Soil Moisture Conditions for Cascadia Subduction Zone Magnitude 9.0 Earthquake Scenario

Building Damage State	"Dry" Soil	"Wet" Saturated Soil
Slight	133,418	125,169
Moderate	66,488	62,313
Extensive	16,055	15,165
Complete	5,185	37,657
Total Permanent Residents	**221,146**	**240,304**

2.7.3.5.2.2. Portland Hills Fault Magnitude 6.8 Scenario

Table 20: Number of Buildings Per Damage Category and Soil Moisture Conditions for Portland Hills Fault Magnitude 6.8 Earthquake Scenario

Building Damage State	"Dry" Soil	Building Percent	"Wet" Saturated Soil	Building Percent
Slight	57,184	32%	49,602	27%
Moderate	44,766	25%	38,807	21%
Extensive	15,892	9%	14,519	8%
Complete	6,492	4%	28,194	16%
Total Damaged Buildings	**124,334**	**70%**	**131,122**	**72%**

Table 21: Buildings Per Damage Category, "Dry" Soil Moisture Conditions for Portland Hills Fault Magnitude 6.8 Earthquake Scenario

Building Category	Total Number of Buildings	Building Square Footage	Building Value	Building Repair Costs	Building Loss Ratio
Agriculture	10,753	26,823,000	$2,855,000,000	$309,000,000	11%
Commercial	5,863	104,377,000	$15,815,000,000	$4,917,000,000	31%
Industrial	1,399	50,567,000	$8,548,000,000	$2,412,000,000	28%
Institutional	1,931	28,098,000	$4,856,000,000	$1,258,000,000	26%
Multi-Family Residential	18,475	98,385,000	$15,671,000,000	$2,831,000,000	18%
Single-Family Residential	138,117	289,198,000	$34,755,000,000	$3,582,000,000	10%
Manufactured Housing	4,573	5,523,000	$232,000,000	$52,000,000	23%

Table 22: Buildings Per Damage Category, "Wet" Soil Moisture Conditions for Portland Hills Fault Magnitude 6.8 Earthquake Scenario

Building Category	Total Number of Buildings	Building Square Footage	Building Value	Building Repair Costs	Building Loss Ratio
Agriculture	10,753	26,823,000	$2,855,000,000	$525,000,000	18%
Commercial	5,863	104,377,000	$15,815,000,000	$6,424,000,000	41%
Industrial	1,399	50,567,000	$8,548,000,000	$3,270,000,000	38%
Institutional	1,931	28,098,000	$4,856,000,000	$1,707,000,000	35%
Multi-Family Residential	18,475	98,385,000	$15,671,000,000	$4,687,000,000	30%

Building Category	Total Number of Buildings	Building Square Footage	Building Value	Building Repair Costs	Building Loss Ratio
Single-Family Residential	138,117	289,198,000	$34,755,000,000	$7,614,000,000	22%
Manufactured Housing	4,573	5,523,000	$232,000,000	$70,000,000	26%

Table 23: Collapsed Buildings by Soil Moisture Conditions for Portland Hills Fault Magnitude 6.8 Earthquake Scenario

Total Number of Buildings	"Dry" Soil	"Wet" Saturated Soil
181,111	387	1,155

Table 24: Number of Permanent Residents Per Building Damage Category and Soil Moisture Conditions for Portland Hills Fault Magnitude 6.8 Earthquake Scenario

Building Damage State	"Dry" Soil	"Wet" Saturated Soil
Slight	168,428	145,320
Moderate	137,364	118,446
Extensive	48,269	43,868
Complete	19,582	86,010
Total of Permanent Residents	**373,643**	**393,644**

2.7.3.5.2.3. Gales Creek Fault Magnitude 6.7 Scenario

DOGAMI ran a Gales Creek Fault deterministic scenario with a magnitude of 6.7 using the Hazus®-MH database. This report provides specific potential impacts and vulnerabilities for this scenario.[69]

The results indicate that Washington County will incur losses of approximately $2 billion or 2.7% of total building assets due to a Gales Creek Fault magnitude 6.7 earthquake. These results are strongly influenced by proximity to the Gales Creek Fault and ground deformation from liquefaction. Moderate to high liquefaction susceptibility exists throughout the County, which increases the risk of earthquake. There are some developed areas in the cities of Forest Grove and Hillsboro that are built on highly liquefiable soils and have higher estimates of damage from this earthquake scenario than other communities in the study area. Loss estimates from an earthquake scenario described in this report vary widely by community in Washington County.

[69] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

The results of the Washington County Gales Creek Fault magnitude 6.7 earthquake scenario are as follows:

- Number of red-tagged buildings: 1,807
- Number of yellow-tagged buildings: 6,049
- Loss estimate: $2,018,269,000
- Loss ratio: 2.7%
- Non-functioning critical facilities: 31
- Potentially displaced population: 6,160

Red-tagged buildings correspond to a Hazus®-MH damage state of “complete,” which means the building is uninhabitable. Yellow-tagged buildings are in the “extensive” damage state, indicating limited habitability. These damage states are correlated to loss ratios that are then multiplied by the building dollar value to obtain a loss estimate.

Although the impacts of coseismic landslides were included in the Hazus®-MH earthquake results, DOGAMI did not perform an analysis that specifically isolated damage caused by coseismic landslides. These landslides likely contribute to a small percentage of the overall estimated damage from the earthquake hazard in Washington County. Landslides exist in the northern portion of Washington County where coseismic landslides are more likely to occur.

Building vulnerabilities, such as the age of the building stock and occupancy type, are also contributing factors in damage estimates. The first seismic buildings codes were implemented in Oregon in the 1970s, and by the 1990s, modern seismic building codes were being enforced. Nearly 70% of Washington County’s buildings were built before this time. Certain building types are known to be more vulnerable than others in earthquakes, such as the manufactured homes. In Hazus®-MH , manufactured homes are one occupancy type that performs poorly in earthquake damage modeling. Communities that are composed of an older building stock and more vulnerable occupancy types are expected to experience more damage from earthquake than communities with fewer of these vulnerabilities.

The report identifies the following locations within the study area that are comparatively at greater risk of earthquake hazard[70]:

- Areas near the epicenter of the simulated earthquake scenario are likely to incur a significant amount of damage. The communities of Banks, Cornelius, Forest Grove, and Gaston have higher estimated loss ratios compared to other communities in the study due to the level of shaking likely to occur.
- Buildings in areas with relatively high liquefaction susceptibility along Dairy Creek, Gales Creek, and the Tualatin River are at higher risk of damage from coseismic liquefaction induced ground deformation.
- Unreinforced masonry buildings in the older downtown portions of Forest Grove and Hillsboro are more vulnerable to potentially substantial damage during an earthquake compared to other nearby structures built to modern standards.
- Twenty-eight of the 269 critical facilities in the study area are estimated to be non-functioning due to an earthquake like the one simulated in this study.[71]

[70] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[71] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

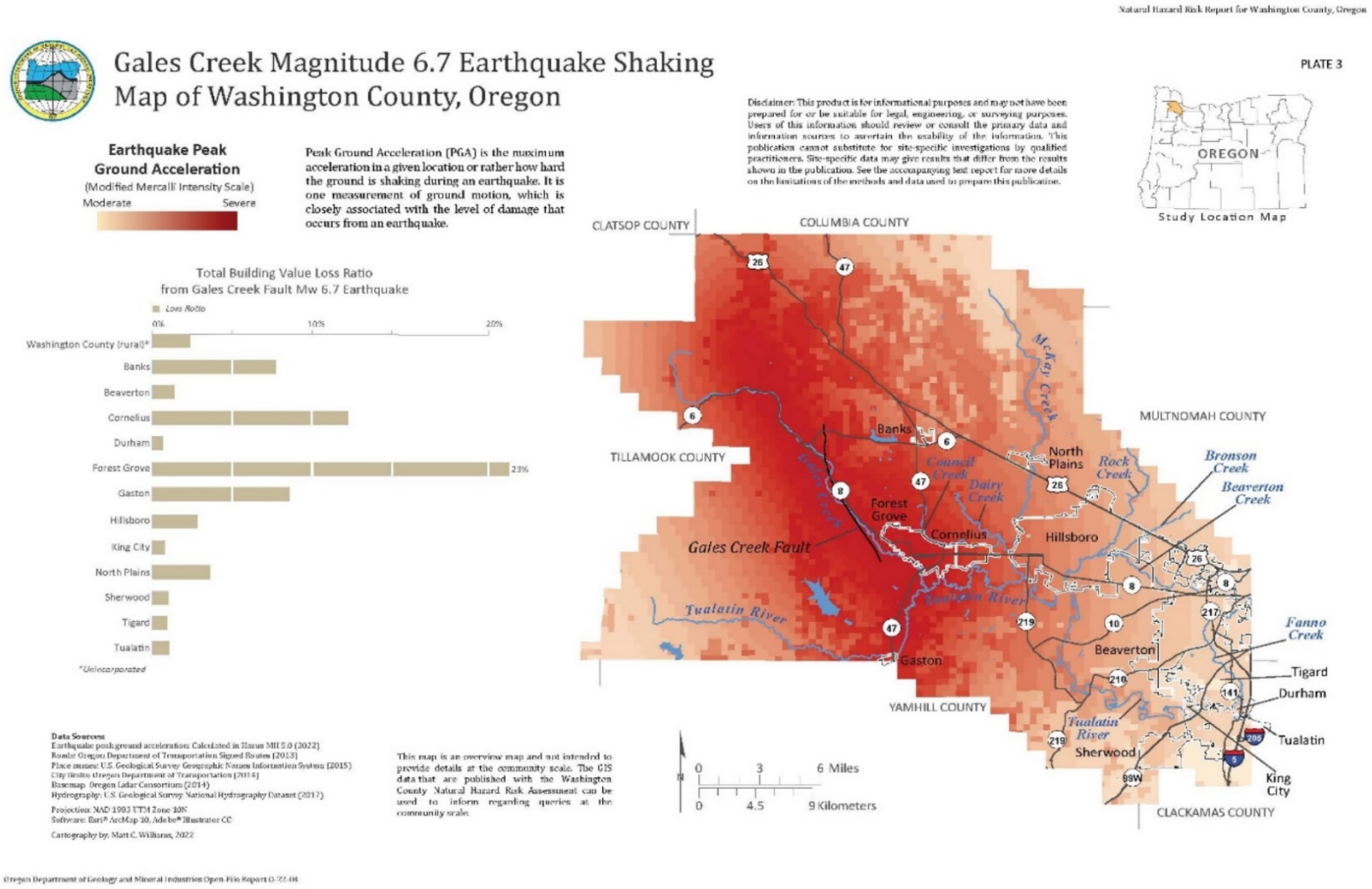


Figure 12: Gales Creek Magnitude 6.7 Earthquake Shaking Map of Washington County, Oregon[72]

[72] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

2.7.3.6. Hazard Risk Score Summary

Based on the hazard analysis methodology described in Section 2.2, plan participants assigned the scores below to their overall risk of a 3- to 5-minute Cascadia earthquake event and 1-minute crustal earthquake event. Additional information is in the participant annexes.

Table 25: Participant Overall Risk of Earthquake[73]

Participant	Risk of Earthquake: Cascadia (3–5-minute event)	Risk of Earthquake: Crustal (1-minute event)
City of Beaverton	196	196
City of Cornelius	173	159
City of Forest Grove	173	159
City of Hillsboro	201	201
City of North Plains	201	71
City of Sherwood	186	158
City of Tigard	203	203
Clean Water Services	148	155
Tualatin Hills Park & Recreation District	161	161
Tualatin Valley Water District	201	159
Washington County	201	201

[73] 2023 NHMP Participant Planning Documentation

2.7.4. Extreme Heat

Significant Changes
- Added as a hazard that impacts the planning area. Not included in previous versions of the NHMP.

2.7.4.1. Characteristics

Extreme heat events occur from time to time as a result of natural variability, and Washington County usually experiences warm, dry summers. Historically, extreme heat and heat waves have not been common, but days above 90 degrees Fahrenheit (°F) occur nearly every year.[74]

There are several ways to measure extreme heat, and it is typically defined relative to normal conditions for an area. Per the 2020 Oregon NHMP, one common way to measure extreme heat is to count the number of days with temperatures above a certain threshold, such as days with temperatures above 90 °F.

Due to a rise in frequency, severity, and impacts from extreme heat events, the Steering Committee chose to include this hazard for the first time in the 2023 Washington County NHMP. Extreme heat events are expected to increase in frequency, duration, and intensity in the County due to continued warming temperatures, so it is important to continue and enhance current mitigation efforts and prepare for the implementation of enhanced mitigation actions as future conditions change.

2.7.4.2. Location and Extent

Recent extremely hot temperatures have impacted the entire planning area. Although the temperatures experienced among NHMP participants may vary slightly due to geographic, vegetation, and built environment variations, the entire County will experience extreme heat simultaneously.

The NWS office that covers Washington County issues heat warnings based on the National Oceanic and Atmospheric Administration (NOAA) NWS Experimental HeatRisk forecast categories.

Figure 13 shows the NOAA NWS Experimental HeatRisk forecast categories, which are used as a guide for the issuance of excessive heat advisories, watches, and warnings.

The Experimental HeatRisk forecast provides a color and numeric value that places forecast heat for a specific location into an appropriate level of heat concern, along with identifying groups potentially most at risk at that level. The HeatRisk is accompanied by recommendations for heat protection and is a useful tool for planning for upcoming heat and its associated potential risk.[75]

Based on the high-resolution NWS national gridded forecast database, a daily HeatRisk value is calculated for each location from the current date through seven days in the future. Currently, HeatRisk is adopted for use in the NWS Western Region and is being introduced and tested in other NWS regions. Once it is nationally adopted, “experimental” will be removed from the product’s name. It is anticipated this will occur in one to two years. It has been available in the western United States since 2014.

Heat watches, advisories, and warnings remain the official nationally recognized heat products from the NWS. The HeatRisk represents additional information that can be used to better identify those days of the year when heat may be at levels that pose a risk to certain populations or economic sectors.[76] HeatRisk

[74] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[75] National Weather Service. (n.d.). HeatRisk-Overview. https://www.wrh.noaa.gov/wrh/heatrisk/?wfo=pqr
[76] National Weather Service. (n.d.). HeatRisk-Overview. https://www.wrh.noaa.gov/wrh/heatrisk/?wfo=pqr

ensures communities have the right information at the right time to be better prepared for upcoming heat events.

The biggest difference between the HeatRisk approach and other approaches is that it identifies unusual heat specifically for that date and location, rather than only using a single threshold value applied across a large area. This allows the approach to better account for acclimation and the variation in climatology that we know exists across most regions. To do this, the NWS uses high-resolution gridded climatology to put the forecast into context. HeatRisk also incorporates heat-health data from the Centers for Disease Control and Prevention into the thresholds, essentially applying direct impact information into the approach.[77]

Category	Level	Meaning
GREEN	0	No Elevated Risk
YELLOW	1	Low Risk for those extremely sensitive to heat, especially those without effective cooling and/or adequate hydration
ORANGE	2	Moderate Risk for those who are sensitive to heat, especially those without effective cooling and/or adequate hydration
RED	3	High Risk for much of the population, especially those who are heat-sensitive and those without effective cooling and/or adequate hydration
MAGENTA	4	Very High Risk for entire population due to long duration heat, with little to no relief overnight

Figure 13: National Weather Service Experimental HeatRisk Categories[78]

The Portland office of the NWS, which covers Washington County, issues a range of watches and advisories associated with extreme heat. These NWS products are supplemented by the Experimental HeatRisk forecast, shown in Figure 14.[79, 80]

- **Excessive Heat Outlook—Be Aware!** The potential exists for an excessive heat event in the next three to seven days. An outlook is used to provide information to those who need considerable lead time to prepare for the event, such as public utilities, emergency management, and public health officials.
- **Excessive Heat Watch—Be Prepared!** Conditions are favorable for an excessive heat event in the next 24 to 72 hours. A watch is used when the risk of a heat wave has increased, but its occurrence and timing is still uncertain. It is intended to provide enough lead time so those who

[77] National Weather Service. (n.d.). NWS Experimental HeatRisk. https://www.wrh.noaa.gov/wrh/heatrisk/?wfo=pqr
[78] National Weather Service. (n.d.). NWS Experimental HeatRisk. https://www.wrh.noaa.gov/wrh/heatrisk/?wfo=pqr
[79] National Weather Service. (n.d.). Heat Watch vs. Warning. https://www.weather.gov/safety/heat-ww
[80] National Oceanic and Atmospheric Administration National Weather Service, Portland Oregon Office. (2022, July 14). Personal communication with Treena Jensen, Warning Coordination Meteorologist.

need to set preparation plans in motion can do so, such as established local excessive heat event plans.

  - This heat watch is issued when there is a HeatRisk of 2.66–3.9 (red) to 4 (magenta). A watch is issued 12–48 hours ahead of the anticipated event, when there is a more than 50% chance of warning criteria being met.

- **Excessive Heat Warning—Take Action!** This warning is issued within 12 hours of the onset of extremely dangerous heat conditions. The warning is used when the HeatRisk is 2.66–3.9 (red) to 4 (magenta). A warning is issued up to 36 hours ahead of the event when imminent threat or there is a more than 80% chance of warning criteria being met.
- **Heat Advisory—Take Action!** This advisory is issued within 12 hours of the onset of extremely dangerous heat conditions, when the HeatRisk is 2–2.38 (low orange) to 2–2.65 (high orange). A warning is issued up to 36 hours ahead of the anticipated event when there is an 80% chance of advisory criteria being met.

NWS Watch Heat Warning and Advisories

Product	*Timeframe*	*Threat/Action*	*NWS Heat Threshold*	*EAS/WEA/ NAWAS?**
Excessive Heat Warning	• Up to 36 hours ahead of event. • When imminent threat or >80% chance of warning criteria being met.	• Threat to life—much of the population. • Take protective action.	• HeatRisk 4 (Magenta) • HeatRisk 2.66–3.9 (Red)	No
Heat Watch	• 12–48 hours ahead of event. • When >50% chance of warning criteria being met.	• Threat to life—much of the population. • Have a plan for action.	• HeatRisk 4 (Magenta) • HeatRisk 2.66–3.9 (Red)	No
Heat Advisory	• Up to 36 hours ahead of event. • When 80% chance of advisory criteria being met.	• Moderate risk to vulnerable. • Take protective action/message to vulnerable communities.	• HeatRisk 2.4–2.65 (High Orange) • Consider for 2–2.38 (Low Orange)	No

* Emergency Alert System (EAS); Wireless Emergency Alert (WEA); and National Warning System (NAWAS)

Figure 14: National Weather Service Portland Heat Warnings and Advisory Thresholds[81]

[81] National Oceanic and Atmospheric Administration National Weather Service, Portland Oregon Office. (2022, July 14). Personal communication with Treena Jensen, Warning Coordination Meteorologist.

2.7.4.3. History

Historically, Washington County does not have a record of consistent extreme heat events. However, as can be seen in the detailed history below, the frequency, duration, and intensity of events has been increasing rapidly. Typical average temperatures range from 65 °F to 71 °F in May; 71 °F to 78 °F in June, 78 °F to 84 °F in July, and 81 °F to 84 °F in August.[82]

The heat index is a measure of how hot it feels, combining temperature and relative humidity. As relative humidity increases, a given temperature can feel even hotter. The body cools itself through the evaporation of perspiration or sweat. However, when the relative humidity is high, the increased moisture content in the air decreases the evaporation of perspiration or sweat. Therefore, the body feels warmer when it is humid. This is why the combination of temperature and relative humidity is used to determine the heat index and likelihood of heat disorders with prolonged exposure or strenuous activity.[83]

Table 26: Historic Extreme Heat Events in Washington County[84]

Date	Event
May 22–23, 2017	A ridge of high pressure brought a couple of days of warm weather. Temperatures climbed up into the upper 80s to low 90s, with a heat index of 88 °F in many locations across the area. Early season heat led people to seek relief in local rivers and lakes. While air temperatures were warm, river and lake temperatures were still cold, leading to two drownings across the area.
June 2017	June brought high heat of sufficient duration to warrant activation of cooling shelters. Temperatures at Hillsboro Airport reached 99 °F with a heat index of 98 °F on June 25.
August 1–4, 2017	**Excessive Heat Event:** Strong high pressure brought record-breaking heat to many parts of northwest Oregon. The heat led people to seek relief at local rivers. Two people drowned while swimming. Cooling shelters were opened in the County. The maximum temperature reached 104 °F with a heat index of 109 °F.
July 12–17, 2018	High pressure over the region led to a stretch of hot days, and hot temperatures led people to cool off in local rivers. There were two drownings recorded. Cooling shelters were opened in the County. The maximum temperature reached 96 °F with a heat index of 95 °F.
August 2019	August brought high heat of sufficient duration to warrant activation of cooling shelters. Temperatures at Hillsboro Airport reached 97 °F with a heat index of 99 °F on August 28.

[82] Weather Spark. (n.d.). August Weather at Portland-Hillsboro Airport. https://weatherspark.com/m/145224/8/Average-Weather-in-August-at-Portland-Hillsboro-Airport-Oregon-United-States
[83] National Weather Service. (n.d.) Excessive Heat. https://www.weather.gov/phi/heat
[84] National Centers for Environmental Information Storm Events Database, Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx; Washington County Planning Documentation; Weather Spark. (n.d.). August Weather at Portland-Hillsboro Airport. https://weatherspark.com/m/145224/8/Average-Weather-in-August-at-Portland-Hillsboro-Airport-Oregon-United-States

Date	Event
June 26–29, 2021	A high-pressure heat dome over the region led to stretch of extreme heat, shattering records from June 26 through June 29. All-time maximum temperatures were broken by 8 °F to 10 °F. The maximum temperature reached 108 °F with a heat index of 115 °F. Widespread fatalities (123 total) occurred due to the heat, as many were without air-conditioning, and there was an increase in the number of drownings. Widespread closures and postponements of businesses and events, respectively, also occurred. There were reports of roads buckling due to heat, and cooling shelters were opened.
August 11–14, 2021	Hot weather began to develop August 9, peaking August 11–12, and temperatures continued above normal for several days. The high temperature at Hillsboro Airport was 103 °F with a heat index of 109 °F on August 11 and August 12. Peak afternoon temperatures of 100 °F to 105 °F drove people to seek relief in or near bodies of water. A 61-year-old man drowned while swimming. Some businesses closed due to the heat, and cooling shelters were opened.

2.7.4.4. Probability of Future Events

Washington County does not have a consistent history of extreme heat events; however, the area has recently experienced unprecedentedly hot summers. It is anticipated that the County will continue to experience more frequent and more intense extreme heat events in the future due to warming temperatures. Washington County is anticipated to experience fewer days with extreme heat than other areas of the state; however, it is expected the County will experience at least an additional 30 hot days per year.[85]

Extreme heat events can often lead to or be accompanied by drought and wildfire. Washington County is expected to experience increased frequency of extreme heat, drought, and wildfire events, and these events may occur independent of each other or concurrently.

- Extreme heat and drought often occur simultaneously, and drought can make a hot day hotter, while a heat wave can make dry conditions even drier. Periods of drought can quickly increase temperatures. Extreme heat can also increase water demands, in which human activities can reduce water supplies, leading to human-caused drought.[86]
- Extreme heat can also intensify wildfire occurrences and impacts. Research has found that a 1.8 °F increase in mean summer temperature increased the risk of a fire starting on a given day—either by human activity or a lightning strike—by 19% to 22% and increased the burned area by 22% to 25%.[87]

2.7.4.4.1. Climate Change

The frequency, duration, and intensity of extreme heat events is expected to increase, with days becoming hotter and overnight lows becoming warmer. If greenhouse gas emissions continue at current

[85] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[86] American Planning Association. (2019). Falling Dominoes: A Planner's Guide to Drought and Cascading Impacts. https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/Falling-Dominoes-Planners-Guide-to-Drought-and-Cascading-Impacts.pdf
[87] Fountain, H. (2021, November 17). Hotter Summer Days Mean More Sierra Nevada Wildfires, Study Finds. *The New York Times.* https://www.nytimes.com/2021/11/17/climate/climate-change-wildfire-risk.html#:~:text=Over%20the%20past%2020%20years,by%2022%20to%2025%20percent. (login required)

levels, temperatures in Oregon is projected to increase on average by 5 °F by the 2050s and 8.2 °F by the 2080s, with the greatest seasonal increases in summer.[88]

Extreme heat can include days with maximum temperatures over a threshold, seasons with temperatures well above average, and heat waves, or multiple days with temperature above a threshold. An increase in the frequency and magnitude of extreme heat events could significantly impact the planning area, as most infrastructure, critical facilities, and structures are not currently built to operate or withstand sustained higher temperatures. Additionally, the population in the planning area is not acclimated to higher temperatures and not adequately prepared to live and work in such conditions.

The degree to which future changes in warm temperature extremes in Oregon will be affected by changes in weather patterns is still an active area of research.[89]

2.7.4.5. Vulnerability Assessment

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County have the potential to be exposed to and impacted by extreme heat. When extreme heat occurs, the impacts are typically population heavy.[90]

Additional information about populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County is provided in Volume III, Appendix A and participant annexes in Volume II.

2.7.4.5.1. Populations

Extreme heat is associated with more fatalities than any other severe weather event in the United States.[91] Heat-related deaths increased by 74% from 1980 to 2016 worldwide,[92] and heat-related mortality is expected to increase as the severity and duration of extreme heat events increase. Increases in the frequency of extreme heat events, and even small increases in average summer temperatures, are expected to increase the incidence of heat-related illnesses and deaths.[93]

With respect to extreme heat, vulnerability is defined as the combination of the probability of extreme heat events, sensitivity to extreme heat, and level of adaptive capacity in response to extreme heat.[94]

Sensitivity is the degree to which people or communities are negatively affected by extreme heat exposures. Certain populations are more sensitive than others. Older adults, infants and children, pregnant women, people with preexisting diseases, and those who take certain medications that affect thermoregulation or block nerve impulses are some of the populations with higher sensitivity.

Heat exposure can lead to heat rashes, heat cramps, heat exhaustion, and heat stroke. Although all these illnesses can cause issues, the two most deadly are heat stroke and heat exhaustion. Indirect

[88] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://www.cakex.org/sites/default/files/documents/OCAR5.pdf
[89] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://www.cakex.org/sites/default/files/documents/OCAR5.pdf
[90] United States Environmental Protection Agency. (2006). Excessive Heat Events. https://www.epa.gov/heatislands/excessive-heat-events-guidebook
[91] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[92] Fernandez, M. (2021, August 20). Study: Extreme Heat is Becoming an Unignorable Global Health Issue. (https://www.axios.com/extreme-heat-killed-nearly-400000-people-globally-e498118e-ca29-4360-b7c9-9d2080e09240.html)
[93] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://www.cakex.org/sites/default/files/documents/OCAR5.pdf
[94] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

impacts include the exacerbation of existing renal, cardiovascular, and respiratory conditions. Heat waves can result in increased deaths and illness among vulnerable human populations. Older adults, children, infants, people with existing medical conditions or disabilities, low-income communities, and outdoor workers are among the groups most threatened by heat waves.[95] People who work outside (including construction workers, farmworkers, and foresters), as well as outdoor athletes face higher exposures to extreme heat. People who live in social isolation, including linguistic isolation or those living alone with few social relationships, are also at higher risk. Social factors, including race and ethnicity, income, and educational attainment, are correlated to numerous health outcomes, including heat-related illness.

Young children and infants are particularly vulnerable to heat-related illness and death, as their bodies are less able to adapt to heat than are adults' bodies. Older adults who are exposed to extreme heat, particularly those who have preexisting diseases, take certain medications, live alone, or have limited mobility, can experience multiple adverse effects. People with chronic medical conditions are more likely to have a serious health problem during a heat wave than healthy people. Pregnant women are also at higher risk. Extreme heat events have been associated with adverse birth outcomes, such as low birth weight, preterm birth, and infant mortality, as well as congenital cataracts.[96]

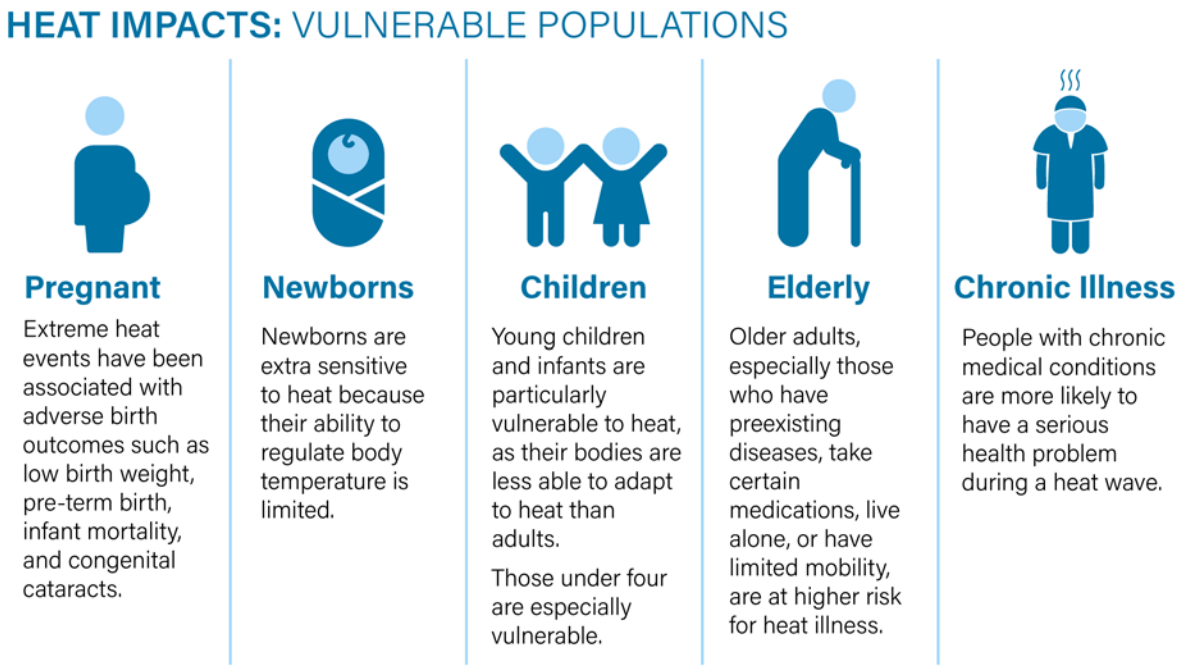


Figure 15: Heat Impacts on Vulnerable Populations[97]

Mental health can also be affected by extreme heat.[98] There is evidence that extreme heat is associated with higher levels of aggression, violence, and suicidal behavior. Heat-related impacts on health may be immediate or delayed. Even small increases in average summer temperatures can lead to increases in heat-related deaths, especially among those with underlying medical conditions. A threefold increase in

[95] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[96] National Weather Service. (n.d.). Heat Safety Tips and Resources. https://www.weather.gov/safety/heat
[97] National Weather Service. (n.d.). Heat Safety Tips and Resources. https://www.weather.gov/safety/heat
[98] Thompson, R., Hornigold, R., Page, L., & Waite, T. (2018, July 12). *Associations Between High Ambient Temperatures and Heat Waves with Mental Health Outcomes: A Systematic Review.* https://www.ncbi.nlm.nih.gov/pubmed/30007545

heat-related illness with each 10 °F rise in daily maximum temperature has been documented in Oregon.[99]

Adaptive capacity is the ability of communities, institutions, or people to adjust to potential hazards, to take advantage of opportunities, or to respond to consequences in ways that reduce harmful exposures (i.e., the ability to prepare for, respond to, and cope with heat events). Health outcomes are strongly influenced by adaptive capacity factors, including those related to the natural and built environments, government regulations, and response. Increasing access to air-conditioning often is touted as a means of increasing resilience to extreme heat events. At present, about 68% of single-family homes and manufactured homes in Oregon have cooling systems, and about 25% of multi-family residences have cooling systems.[100] However, air-conditioning also can increase emissions of greenhouse gases that contribute to climate change, and not all populations, especially the most vulnerable, have access to air-conditioning. Therefore, more comprehensive mitigation actions should be taken to reduce population vulnerability to extreme heat.[101, 102, 103]

2.7.4.5.2. Economy

Extreme heat events can have negative impacts on worker productivity across all economic sectors. This includes time lost on the job when people need to take more frequent or longer breaks to avoid overheating, less overall worker efficiency and effectiveness, and time lost when it is too hot for people to work at all. Workers who spend significant time outside, including agriculture and construction workers, are more likely to suffer impacts.[104] Oregon Occupational Safety and Health instituted a heat illness prevention program on June 15, 2022, to mitigate the health impacts of this emerging hazard. This program applies to outdoor and indoor work activities, where the heat index equals or exceeds 80 °F.[105] The rules of the program include making shade immediately and readily available to outdoor employees, providing an adequate supply of drinking water for exposed employees, implementing a rest-break schedule for preventive cool-down periods, and creating a heat illness prevention plan, including supervisor and employee training.[106]

Additionally, extreme heat can affect crops and livestock health and yields, although these impacts are limited in Washington County because there are not high numbers of agriculture areas or activities. Because it is anticipated the entire United States is likely to experience a rise in extreme heat occurrences, impacts to agriculture in other sectors may impact the County's population via more expensive food, goods, and services, including energy and healthcare costs. Tourism can also be impacted.

2.7.4.5.3. Structures, Improved Property, Critical Facilities, and Infrastructure

Heat waves can damage transportation infrastructure and pose challenges for maintenance and construction. Higher temperatures can put stress on bridge infrastructure through thermal expansion of

[99] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[100] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://www.cakex.org/sites/default/files/documents/OCAR5.pdf
[101] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://www.cakex.org/sites/default/files/documents/OCAR5.pdf
[102] Hawkins, M., McMahon, K., Nagele, D., & Pearce, V. (2020, November 18). Heat Workshop. https://www.weather.gov/media/safety/heat/Heat%20Workshop%20Day%202%20PDF.pdf
[103] National Weather Service. (n.d.). Social Media: Heat (Summer). https://www.weather.gov/wrn/summer-heat-sm
[104] McLeod K.B. (2021, September 7). Heat is Killing Us—and the Economy Too. https://www.atlanticcouncil.org/content-series/the-big-story/heat-is-killing-us-and-the-economy-too/#:~:text=The%20economic%20costs%20of%20extreme%20heat%20are%20already%20huge.&text=The%20losses%20will%20increase%20as,and%20%24500%20billion%20by%202050
[105] Oregon Occupational Safety and Health. (n.d.). Heat and Wildfire Smoke Rules—Summary. https://osha.oregon.gov/OSHARules/adopted/2022/heat-wildfire-smoke-rule-summary-2022.pdf
[106] Oregon Occupational Safety and Health. (n.d.). Heat and Wildfire Smoke Rules—Summary. https://osha.oregon.gov/OSHARules/adopted/2022/heat-wildfire-smoke-rule-summary-2022.pdf

bridge joints and paved surfaces, and deterioration of steel, asphalt, protective cladding, coats, and sealants. Extreme heat can accelerate the deterioration or threaten the integrity of some types of asphalt pavement through softening, rutting, and migration of liquid asphalt. Hotter summer days can pose risks to the health and safety of maintenance and construction crews, limiting working hours. Vehicle overheating and tire deterioration can also occur during extreme heat events.[107]

Additionally, buildings can incur such damage as cracked foundations, broken or melted siding, and overheated air-conditioning units sparking, potentially causing fires. Infrastructure impacts can include overheated and damaged utilities, including power, water, and communication systems.

During the 2021 extreme heat events, the city of Portland, which is located directly northeast from Washington County, experienced power outages, street buckling, and melted streetcar cables.[108] TriMet had to temporarily suspend all MAX Light Rail services due to temperatures over 100 °F causing the overhead copper wires to expand and sag, forcing the trains to slow.[109] Although the system is designed to operate up to 110 °F, overhead wires reached 120 °F, and the rail was at 140 °F.[110]

Extreme heat in urban areas poses risk to human health and safety, especially for those living and working in urban heat islands. People living outdoors or in the upper floors of multifamily housing units may be particularly vulnerable. In cities, non-white populations are more likely to live in urban heat islands, neighborhoods with impervious surfaces and low tree coverage, and areas with limited access to green space. Urban areas also may face increased energy and water demand and increased risk of disruption to civic and economic activity.[111]

Urban heat islands are defined by the average difference between the temperatures of a city and its more rural surroundings. Urban heat islands are created by the concentration of heavy, dense materials in cities that absorb heat well and become warmer themselves in response, primarily the asphalt and concrete of roadways and rooftops and the brick, stone, and concrete of buildings. Solar radiation accounts for much of the energy these materials absorb, but the heat emitted by vehicles, air conditioners, refrigeration equipment, and industrial machinery also contributes substantially. Once warm, buildings and roadways slowly re-emit this energy, causing densely built and paved areas to remain many degrees warmer than their surroundings, even during cool nights.[112]

Urban heat effects tend to be concentrated in certain areas. The cities in Washington County tend to experience surface urban heat island effect of one to more than three degrees hotter than other areas of the County on a summer day.[113] This temperature difference represents the difference in surface temperature between the built-up and non-built-up urbanized areas.[114] Such areas are typically occupied by communities in which education is limited, income is low, and the proportion of children and elderly residents is high. Urban heat island effects therefore are greatest in neighborhoods where people are

[107] The American Association of State Highway and Transportation Officials. (n.d.). Extreme Weather & the Transportation System. http://climatechange.transportation.org/pdf/extreme_weather_briefings/AASHTO_Heat_Waves.pdf
[108] Parks, B.W. (2021, July 1). Oregon's Built Environment Faces New Tests with Extreme Heat. https://www.opb.org/article/2021/07/01/heat-oregon-air-conditioning-infrastructure/
[109] Singer, M. (2021, June 27). TriMet is Temporarily Suspending All MAX Service Due to Extreme Heat. https://www.wweek.com/news/city/2021/06/27/trimet-is-temporarily-suspending-all-max-service-due-to-extreme-heat/
[110] Singer, M. (2021, June 27). TriMet is Temporarily Suspending All MAX Service Due to Extreme Heat. https://www.wweek.com/news/city/2021/06/27/trimet-is-temporarily-suspending-all-max-service-due-to-extreme-heat/
[111] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[112] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://www.cakex.org/sites/default/files/documents/OCAR5.pdf
[113] Chakraborty, T., Hsu, A., Manya, D., & Sheriff, G. (2020). A spatially explicit surface urban heat island database for the United States: Characterization, uncertainties, and possible applications. *ISPRS Journal of Photogrammetry and Remote Sensing.* https://doi.org/10.1016/j.isprsjprs.2020.07.021
[114] Chakraborty, T., Hsu, A., Manya, D., & Sheriff, G. (2020). A spatially explicit surface urban heat island database for the United States: Characterization, uncertainties, and possible applications. *ISPRS Journal of Photogrammetry and Remote Sensing.* https://doi.org/10.1016/j.isprsjprs.2020.07.021

most susceptible to heat stress. Compounding urban heat island effects, homes in low-income neighborhoods often are less able to manage excessive heat, with less-insulated roofs, limited access to cross-ventilation, and inability to afford air-conditioning. Urban heat island effects can be addressed through strategies that focus on materials, vegetation, transportation, or buildings.[115]

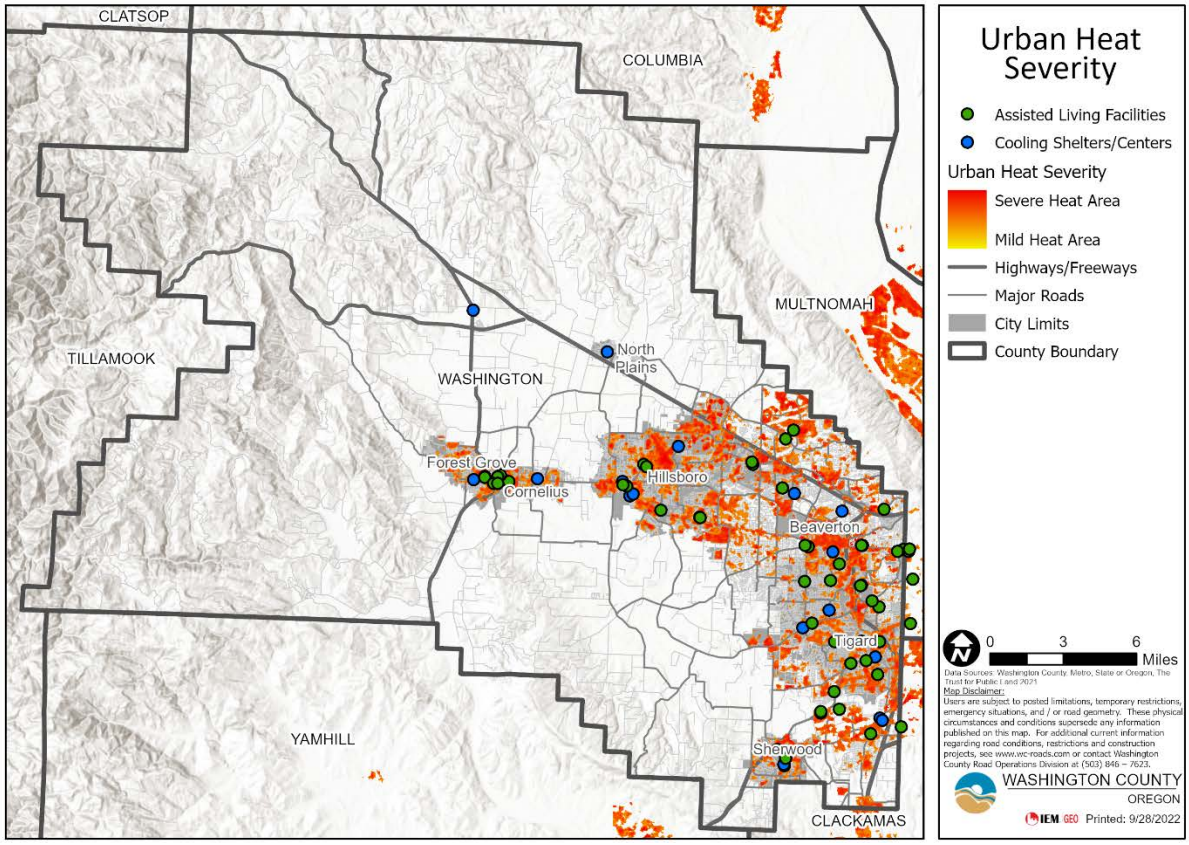


Figure 16: Urban Heat Severity in Washington County

2.7.4.5.4. Natural Environments

Plants, animals, ecosystems, and natural environments have experienced increased negative impacts and mortality during extreme heat events of the early twenty-first century. Summer heat-wave mortality of animal populations is making summer a season of stress and survival, altering populations and ecosystems.[116]

Extreme heat can kill organisms outright, especially if they are also exposed to intense sunlight. Dehydration sets in and organs fail as enzymes stop working and proteins sustain damage. The trauma can make survivors more susceptible to disease and predation and reduce or delay reproduction. Hot weather can also cost animals by discouraging them from foraging or hunting. During the 2021 “heat dome” experienced by the Pacific Northwest, a billion shellfish and other intertidal animals baked to death, scores of hawks became sick or injured, tens of thousands of bottom-dwelling fish died, and trees

[115] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://www.cakex.org/sites/default/files/documents/OCAR5.pdf
[116] Stillman, J.H. (2019, February 6). *Heat Waves, the New Normal: Summertime Temperature Extremes Will Impact Animals, Ecosystems, and Human Communities.* https://journals.physiology.org/doi/full/10.1152/physiol.00040.2018

suffered root and vascular system damage, leading to scorched leaves, and prematurely dropped needles. The overall impacts of these losses are yet to be seen and may take years to develop.[117]

Droughts and wildfires that can occur independent of extreme heat or concurrently can also have detrimental impacts on natural environments.

2.7.4.6. Hazard Risk Score Summary

Based on the hazard analysis methodology described in Section 2.2, plan participants assigned the scores below to their overall risk of extreme heat. Additional information is in the participant annexes.

Table 27: Participant Overall Risk of Extreme Heat[118]

Participant	Overall Risk of Extreme Heat
City of Beaverton	212
City of Cornelius	148
City of Forest Grove	148
City of Hillsboro	179
City of North Plains	177
City of Sherwood	162
City of Tigard	162
Clean Water Services	152
Tualatin Hills Park & Recreation District	199
Tualatin Valley Water District	177
Washington County	177

[117] Rosen, J. (2021, November 22). *How Heat Waves Warp Ecosystems.* https://www.hcn.org/issues/53.12/north-climate-change-how-heat-waves-warp-ecosystems
[118] 2023 NHMP Participant Planning Documentation

2.7.5. Flooding

Significant Changes

- Additional information on hazard history, vulnerabilities, and how climate change may impact the frequency of flooding added.
- Hazard profile expanded to include streambank and riverbed erosion and channel migration.

2.7.5.1. Characteristics

Flooding results when rain and snowmelt create water flow that exceeds the carrying capacity of rivers, streams, channels, ditches, and other watercourses. The primary types of flooding that occur in Washington County are riverine floods and urban floods. In addition, any low-lying area has the potential to flood, and dam failure can cause flooding in inundation zones.

Urban flooding occurs in developed areas where the amount of water generated from rainfall and runoff exceeds the storm water systems' capacity. Urbanization of the watershed changes the hydrologic systems of the basin. As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb and slowly release rainfall. Rain flows over impervious surfaces such as concrete and asphalt and into nearby storm sewers and streams. This runoff can result in the rapid rise of flood waters because the water moves from the ground and in to streams at a much faster rate in urban areas. Adding these elements to the hydrological systems can result in flood waters that rise very rapidly and peak with violent force. The resulting high water volume and turbidity contribute to erosion of streambanks.

Riverine flooding occurs when rivers and streams flow over their banks. Flooding in large river systems typically happens due to large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing flooding in hundreds of smaller streams, which then drain into the major rivers. A common Willamette Valley phenomenon involves tributary stream backup during periods of high water. When tributary streams cannot enter swollen main stem rivers during periods of high water, tributary streams are forced out of their banks.[119]

The most severe flooding conditions occur, however, when heavy rainfall is augmented by rapid snowmelt. These events make more water available for runoff than does precipitation alone by melting the snowpack and by adding a small amount of condensate to the snowpack. If the ground is frozen, stream flow can be increased even more by the inability of the soil to absorb additional runoff. Significant rain-on-snow events occur in years that are colder and wetter than normal because snow accumulates at lower elevations, and then is melted off during subsequent rain events.[120]

2.7.5.1.1. Channel Migration in Association with Flooding

Channel migration is the process by which streams move laterally over time. It is typically a gradual phenomenon that takes place over many years due to natural processes of erosion and deposition. In some cases, usually associated with flood events, significant channel migration can happen rapidly. In high- flow flood events, stream channels can avulse and shift to occupy a completely new channel.

Areas most susceptible to channel migration are transitional zones where steep channels flow from foothills into broad, flat floodplains. The most common physiographic characteristics of a landscape prone to channel migration include moderate channel steepness, moderate to low channel confinement (i.e., valley broadness), and erodible geology. Channel migration is not a standard consideration of the NFIP.

[119] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[120] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

The Oregon DOGAMI completed a study on channel migration zones for 225 river miles in Washington County in 2021.[121] The study area included the main stem of the Tualatin River, seven tributaries to the Tualatin River (Beaver Creek, Beaverton Creek, Dairy Creek, Fanno Creek, Gales Creek, McKay Creek, and Rock Creek) and two tributaries to Dairy Creek (East Fork Dairy Creek and West Fork Dairy Creek). These streams originate in the forested Tualatin Mountains and Oregon Coastal Range. They collectively flow towards the center of Washington County, eventually joining the Tualatin River, which flows east into the Willamette River. These rivers flow through wetlands and forested, agricultural, and urbanized lands, including the communities of Gaston, Forest Grove, Hillsboro, Beaverton, Tigard, and Tualatin. Figure 17 through Figure 22 show the river and creek segments and channel migration zones for the study area.

[121] Oregon Department of Geology and Mineral Industries. (2015). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Marrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

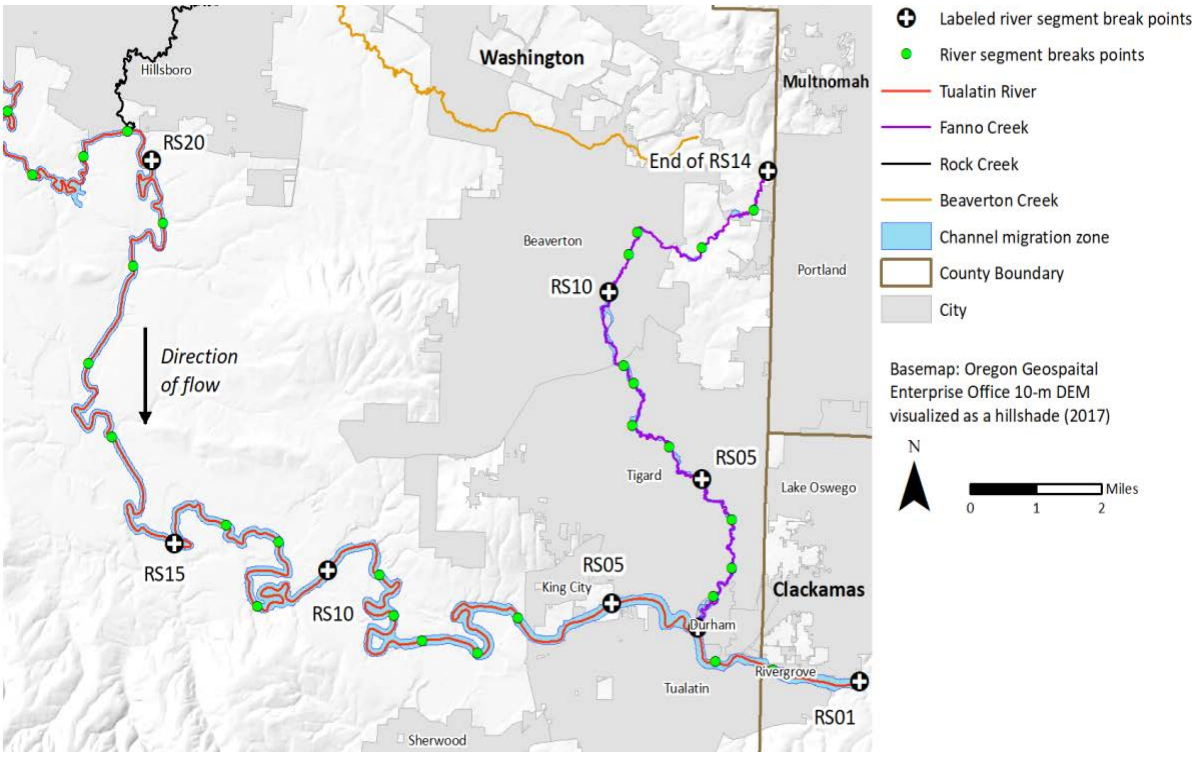


Figure 17: Tualatin River and Fanno Creek Segments and Channel Migration Area[122]

[122] Oregon Department of Geology and Mineral Industries. (2015). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Marrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

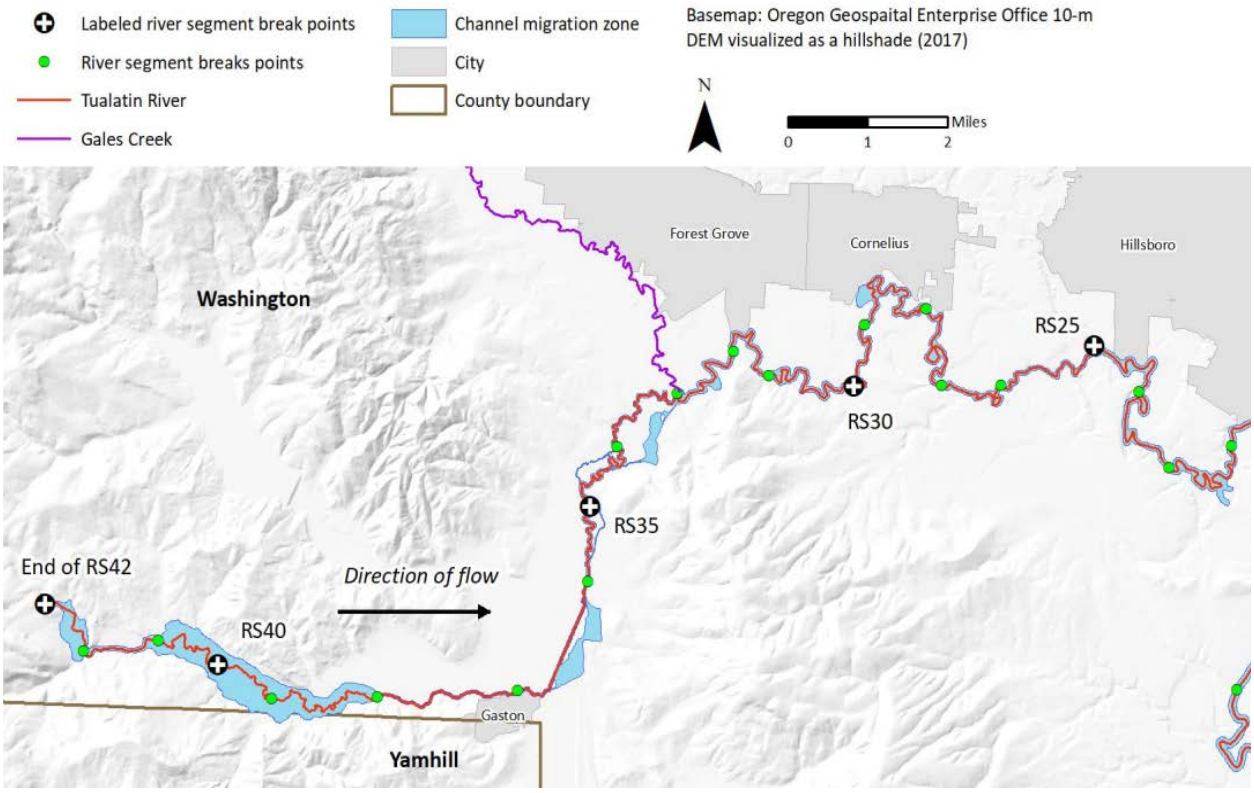


Figure 18: Tualatin River Segments, Channel Migration Zone Area, and Labeled Counties[123]

[123] Oregon Department of Geology and Mineral Industries. (2015). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Marrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

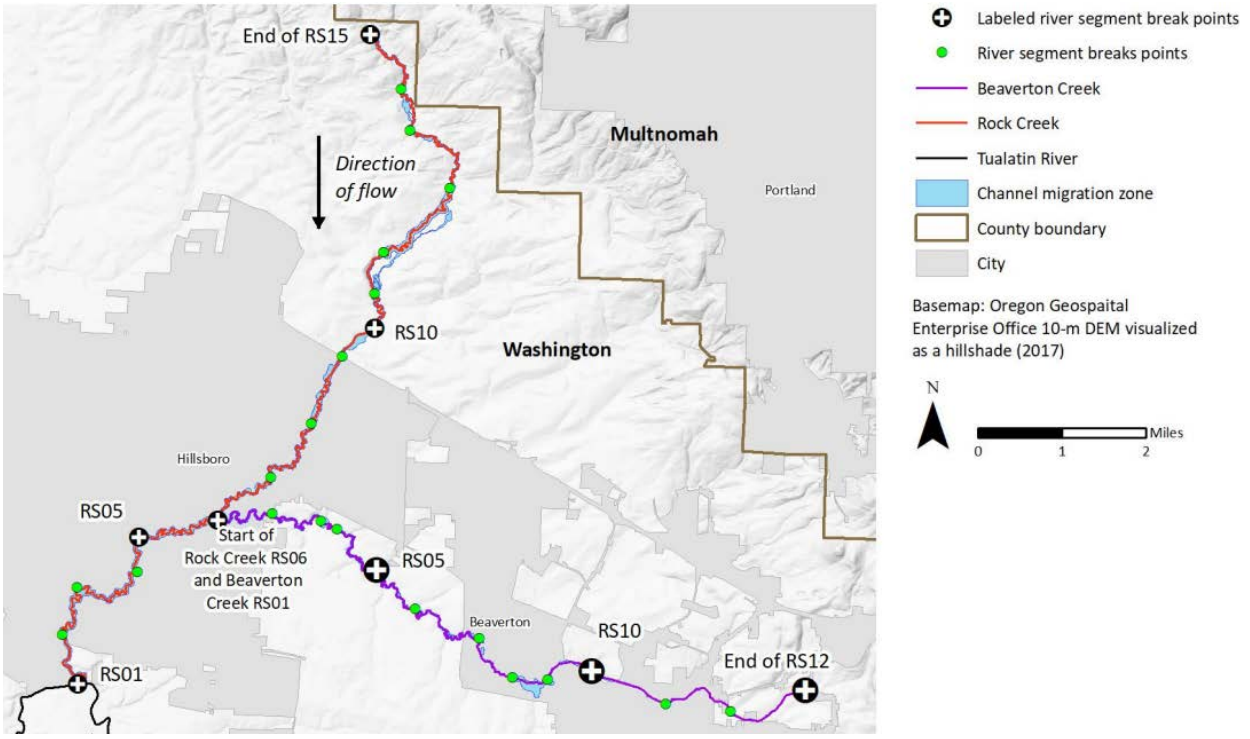


Figure 19: Beaverton and Rock Creek Segments, Channel Migration Zone Area, and Labeled Counties[124]

[124] Oregon Department of Geology and Mineral Industries. (2015). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Marrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

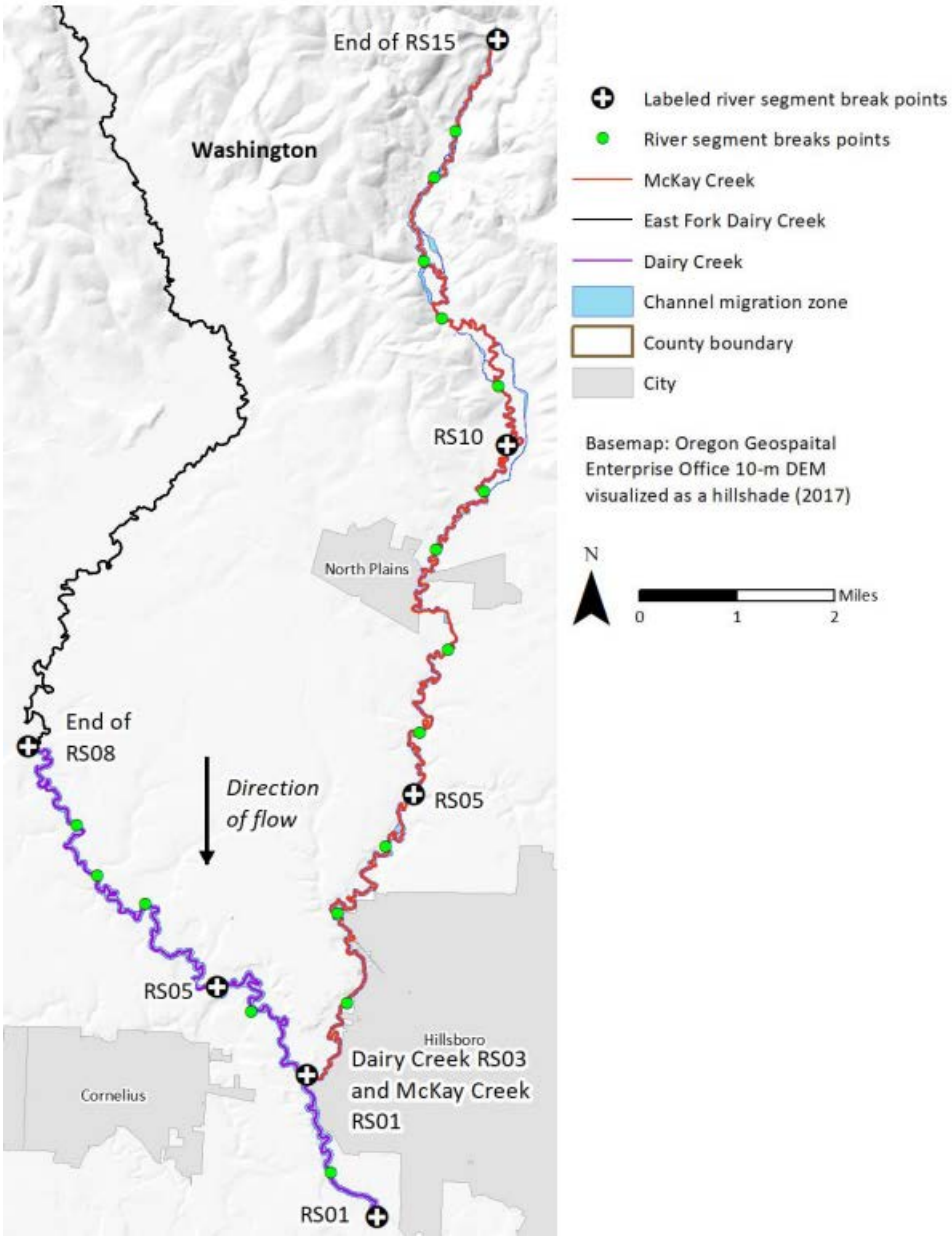


Figure 20: McKay Creek, Dairy Creek, Channel Migration Zone Area, and Labeled Counties[125]

[125] Oregon Department of Geology and Mineral Industries. (2015). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Marrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

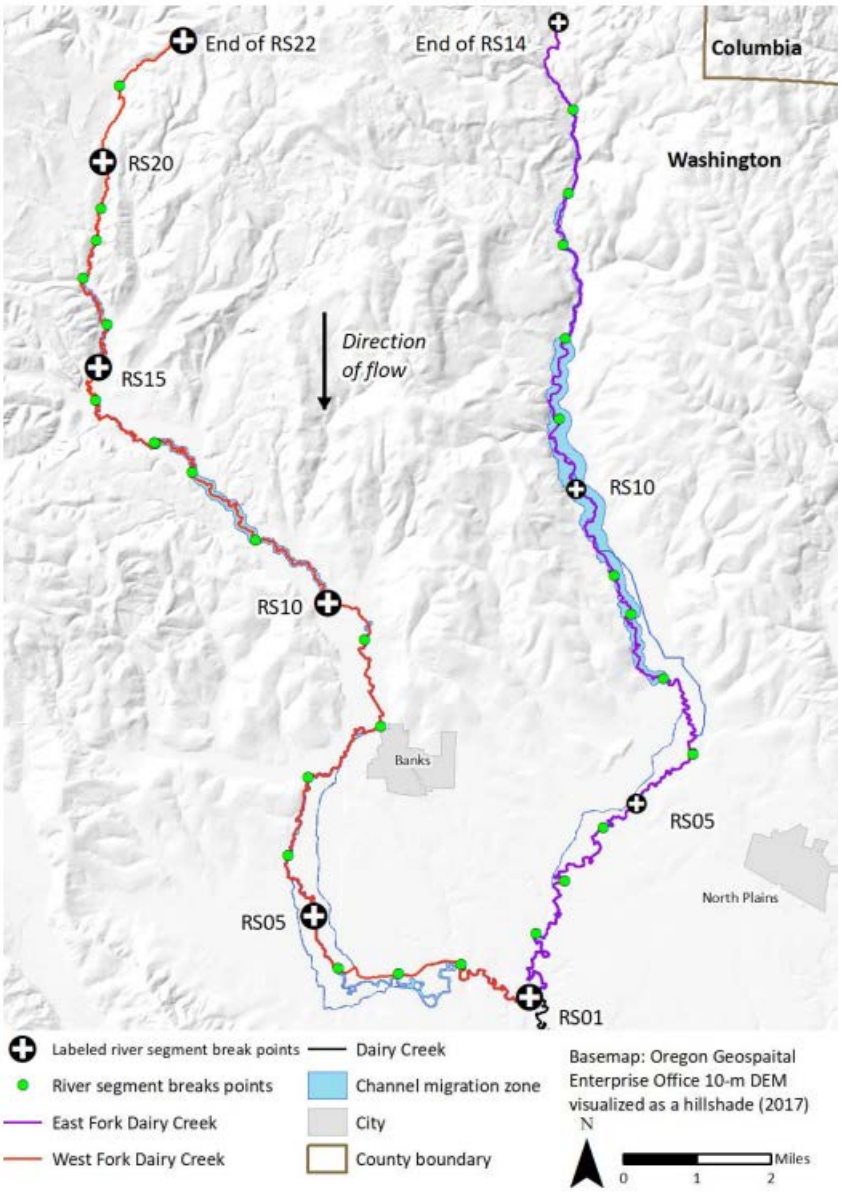


Figure 21: East and West Fork Dairy Creek Segments, Channel Migration Zone Areas, and Labeled Counties[126]

[126] Oregon Department of Geology and Mineral Industries. (2015). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Marrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

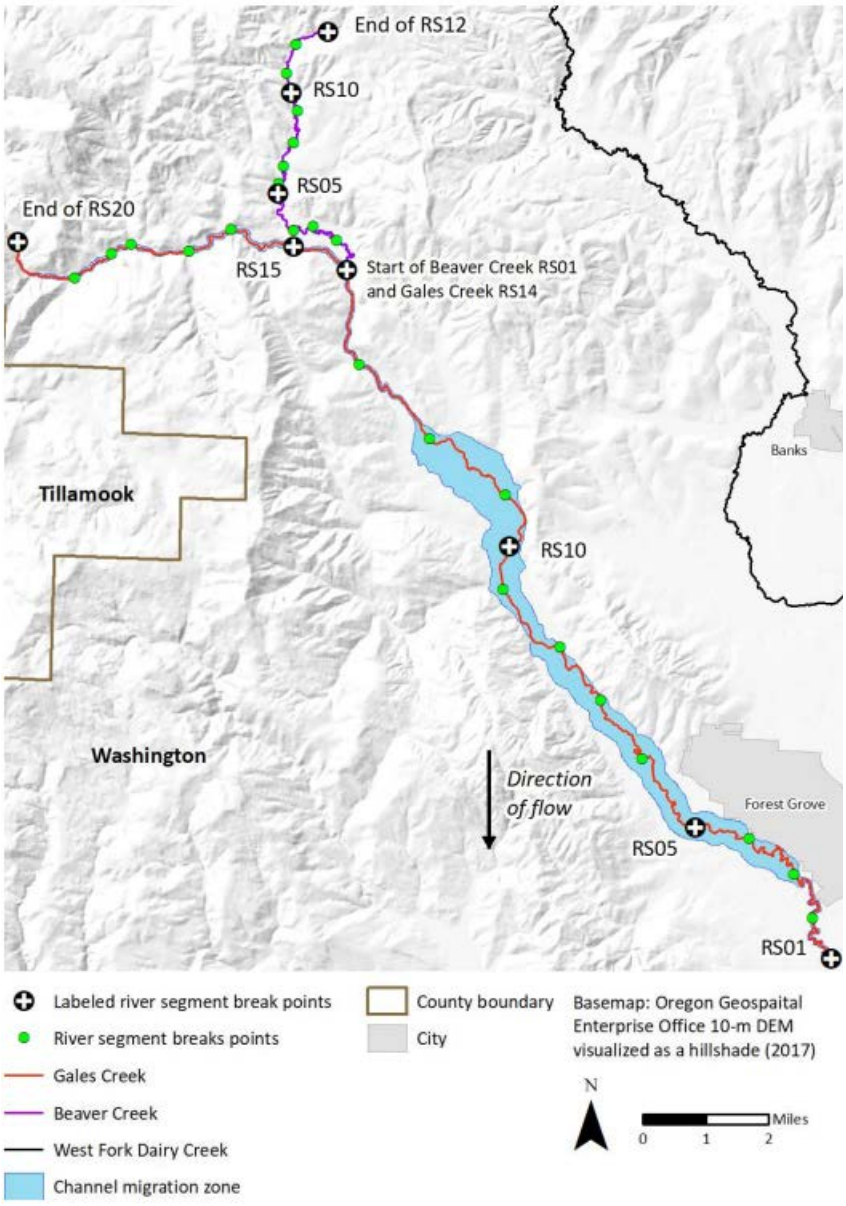


Figure 22: Beaver and Gales Creek Segments, Channel Migration Zone Area, and Labeled Counties[127]

[127] Oregon Department of Geology and Mineral Industries. (2015). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Marrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

Channel migration is a geomorphic process by which a stream moves laterally across its floodplain over time. This process includes bed and bank erosion, sediment deposition, and channel avulsion, a process in which the stream abruptly moves to an entirely new location on the floodplain.[128] Channel migration can undermine buildings, roads, levees, and other infrastructure; it can rapidly redirect flooding to new areas, erode land, cut off evacuation routes during a flood, and, in rare cases, endanger lives.[129]

Channels migrate and change as a function of sediment supply, discharge, channel bed and bank geology, climate, riparian vegetation, basin physiography, and human modifications.[130] While bedrock-controlled channels migrate very gradually across centuries, alluvial channels with braided, meandering, and anastomosing channel forms commonly migrate across the landscape over years or decades.[131] Channel morphology may change in both horizontal and vertical directions. Horizontal movement is often observed as lateral migration, avulsions, widening, or narrowing. Vertical movement includes channel bed incision and sediment aggradation, both of which can trigger lateral migration.

Channel migration zone mapping seeks to identify the area the channel is most likely to occupy in the future based on historical channel behavior and current geomorphic conditions. These maps include the areas on the floodplain previously occupied by the channel, as these areas create a high potential for channel reoccupation. Areas susceptible to future erosion are mapped based on the past rate of erosion observed in historical aerial photographs. Potential avulsion areas are also included in the maps and are based on interpretations of lidar topography, with a focus on low-lying areas near the active channel. Maps define the area in which a given stream is likely to move laterally and change its channel course within the next 30 and 100 years.

[128] Oregon Department of Geology and Mineral Industries. (2021). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Morrow and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

[129] Oregon Department of Geology and Mineral Industries. (2021). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Morrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

[130] Oregon Department of Geology and Mineral Industries. (2021). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Morrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

[131] Oregon Department of Geology and Mineral Industries. (2021). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Morrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

Table 28: Streams Studied in Washington County for Channel Migration Zone Mapping[132, 133]

River Name	Drainage Area (sq. miles)	Average Slope (%)	Average Active Channel Width (feet)	Studied Stream Length (miles)	Total Stream Length (miles) from National Hydrography Dataset, U.S. Geological Survey, 2020	50-Year Annual Exceedance Probability (2-year flood), Stream Stats (Cooper, 2005) (cubic feet per second)
Beaver Creek	10	0.57%	24	7.5	11.4	541
Beaverton Creek	38	0.20%	25	11	11.4	735
Dairy Creek	20	0.04%	50	11.2	15	5,890
East Fork Dairy Creek	64	0.64%	35	22.2	35.8	2,110
Fanno Creek	32	0.18%	28	14	21.1	669
Gales Creek	75	0.67%	66	25.9	42.7	3,400
McKay Creek	67	0.33%	33	20.8	36.6	1,740
Rock Creek	76	0.16%	35	17.1	28.7	1,490
Tualatin River	694	0.05%	88	68.6	121.3	16,000
West Fork Dairy Creek	80	0.89%	25	26.5	40	2,480

The results of this study should be used to identify people, places, buildings, and infrastructure most vulnerable to floods and channel migration at a neighborhood scale. The information can be used by local emergency managers, planners, community leaders, residents, and other stakeholders to make informed decisions about flood hazards, including their mitigation, land use, and environmental management.

2.7.5.1.2. Streambank and Riverbank Erosion

Streambank erosion naturally occurs when the forces exerted by flowing water exceed the resisting forces of bank materials and vegetation. Erosion occurs in many natural streams that have vegetated banks. However, land use changes or natural disturbances can cause the frequency and magnitude of water forces to increase. Loss of streamside vegetation can reduce resisting forces, thus streambanks become more susceptible to erosion. Channel realignment often increases stream power and may cause streambeds and banks to erode. Streambank erosion is an important source of the sediment and pollutants that enter area lakes, ponds, and stream channels.

[132] Oregon Department of Geology and Mineral Industries. (2021). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Morrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

[133] Oregon Department of Geology and Mineral Industries. (2021). Open File Report O-21-15: Flood Depth and Channel Migration Zone Maps, Benton, Marion, Morrow, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-21-15/DOGAMI%20Open-File%20Report%20O-21-15,%20Flood%20depth%20and%20channel%20migration%20zone%20maps,%20Benton,%20Marion,%20Morrow,%20and%20Washington%20Counties,%20Oregon.pdf

The principal causes of streambank erosion may be classed as geologic, climatic, vegetative, and hydraulic. These causes may act independently, but normally work in an interrelated manner. Direct human activities, such as channel confinement or realignment and damage to or removal of vegetation, are major factors in streambank erosion.

Protective measures for streambanks can be grouped into three categories and are often used in combination[134]:

- **Vegetative plantings:** Conventional vegetation may be used to stabilize streambanks.
- **Soil bioengineering systems:** These systems use living plant materials as structural components. Adapted types of woody vegetation, such as trees and shrubs, are installed in configurations that offer immediate soil protection and reinforcement.
- **Structural measures:** These measures include rock riprap and other relatively permanent measures to protect streambanks.

The method of streambank stabilization chosen depends on site conditions, cost, and materials and labor availability.

Riverbank erosion often occurs during flood events. The level and severity of bank erosion depends on flow velocity, the soil profile, vegetation type, and whether there are blockages in the river, such as large fallen trees and other debris. Bed lowering can move in both an upstream and/or downstream direction, influencing channel stability over an extensive length of the river or stream system.

Bed lowering can initiate extensive bank erosion because the height of the banks relative to the bed are effectively increased, leaving them more susceptible to collapse. Riverbed lowering can[135]:

- Undermine riverbanks, resulting in overall channel enlargement with all the associated adverse impacts of bank erosion on economic and environmental values.
- Cause lowering of river water level. This may deny water to pumps for irrigation and/or domestic supplies. It may also decrease the viability of in-stream habitats.
- Cause lowering of groundwater level in the adjacent floodplain. This may deny water to bore wells and adversely affect the aquifer.
- Cause downstream siltation, which can destroy aquatic habitats and adversely impact water quality, water availability, flooding, and navigation and recreational pursuits.
- Result in damage to infrastructure, including bridge sand pumps.

Most waterways experience sediment movement during floods. The quantity of sediment usually increases with the size of the catchment and is influenced by surrounding land use. Sediment appears as murky, muddy water flowing through the water during floods. When sediment moves downstream, it can increase erosion and settle on the lower banks of the creek. As sediment is typically high in nutrients, this can result in rapid weed growth, which in turn stabilizes the sediment and changes the shape of the creek bed. This can create a narrower flow channel that can lead to bank undercutting and potential slumping. If slumping occurs, this can result in the bank being washed away, creating a near vertical wall, which can further increase the effects of shading and make it difficult for vegetation to establish.[136]

[134] Klausmeyer, K. J. (n.d.). Streambank Erosion. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ks/newsroom/features/?cid=nrcs142p2_033508
[135] Queensland Government Department of Environment and Resource Management. (2009, May). What Causes Streambed Erosion? https://www.qld.gov.au/__data/assets/pdf_file/0033/67677/what-causes-stream-bed-erosion.pdf
[136] Land for Wildlife. (n.d.). Creek and Riverbed Erosion. https://www.lfwseq.org.au/creek-and-riverbed-erosion/

Four main processes contribute to bed erosion[137]:

- **Decrease in sediment supply:** This can occur when the natural passage of sediment through the system is interrupted by upstream dams, catchment erosion control works, or excavations in the streambed.
- **Increase in bed slope:** This can be a result of straightening the river, removing a bed control such as rock riprap, or excavating the bed of the river for extractive industries or recreation reasons.
- **Increase in velocity, not associated with an increase in slope:** This can be a result of a channel constriction such as debris, fill, vegetation on the riverbed, or bridge abutments.
- **Increase in discharge:** This can be a result of increased urban runoff, catchment clearing, or increases in rainfall.

2.7.5.2. Location and Extent

The extent of flood events is described in terms of the horizontal area affected, the vertical depth of flood waters, and related probability of occurrence. Flood studies often use historical records, such as streamflow gages, to determine the probability of occurrence for floods of different magnitudes. The probability of occurrence is expressed in percentages as the chance of a flood of a specific extent occurring in any given year. Probability of flooding is measured as the average recurrence interval of a flood of a given size and place. It is stated as the percent chance that a flood of a certain magnitude or greater will occur at a particular location in any given year.

The annual probabilities calculated for flood hazard fall into the following categories[138]:

- A **10-year flood** has a 10% chance of occurring in any given year.
- A **50-year flood** has a 2% chance of occurring in any given year.
- A **100-year flood** has a 1% chance of occurring in any given year. This category is used as the standard for floodplain management in the United States and is referred to as a base flood.
- A **500-year flood** has a 0.2% chance of occurring in any given year.

The areas most at risk of flooding within Washington County are within Tualatin floodplain areas in the unincorporated county; in many commercial areas in Beaverton along Beaverton Creek and Fanno Creek; and in a significant portion of commercial areas in the city of Tualatin. Many other communities in Washington County have little to no risk of flooding. There are few areas of concentrated flood damage; however, the small amount of damage that is estimated is scattered across the County at various places along streams.

Per DOGAMI, areas in the County at significant flooding risk include[139]:

- Commercial areas in the city of Tualatin along Hedges Creek are at risk of flooding.
- Commercial areas in the city of Tigard along Fanno Creek are at risk of flooding.
- Commercial areas in the city of Beaverton along Beaverton Creek are at risk of flooding.

[137] Queensland Government Department of Environment and Resource Management. (2009, May). What Causes Streambed Erosion? https://www.qld.gov.au/__data/assets/pdf_file/0033/67677/what-causes-stream-bed-erosion.pdf
[138] U.S. Geological Survey Water Science School. (2018, June 7). The 100-Year Flood. https://www.usgs.gov/special-topics/water-science-school/science/100-year-flood
[139] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

- Residential and commercial buildings along tributaries to Beaverton Creek throughout the city of Beaverton are at risk of flooding from a 100-year flood.
- Several residences and businesses in the city of North Plains along a tributary to McKay Creek are at risk of flooding.
- Many residential structures are exposed to flooding in the vicinity of Highway 26 and Cedar Mill Creek and Johnston Creek.

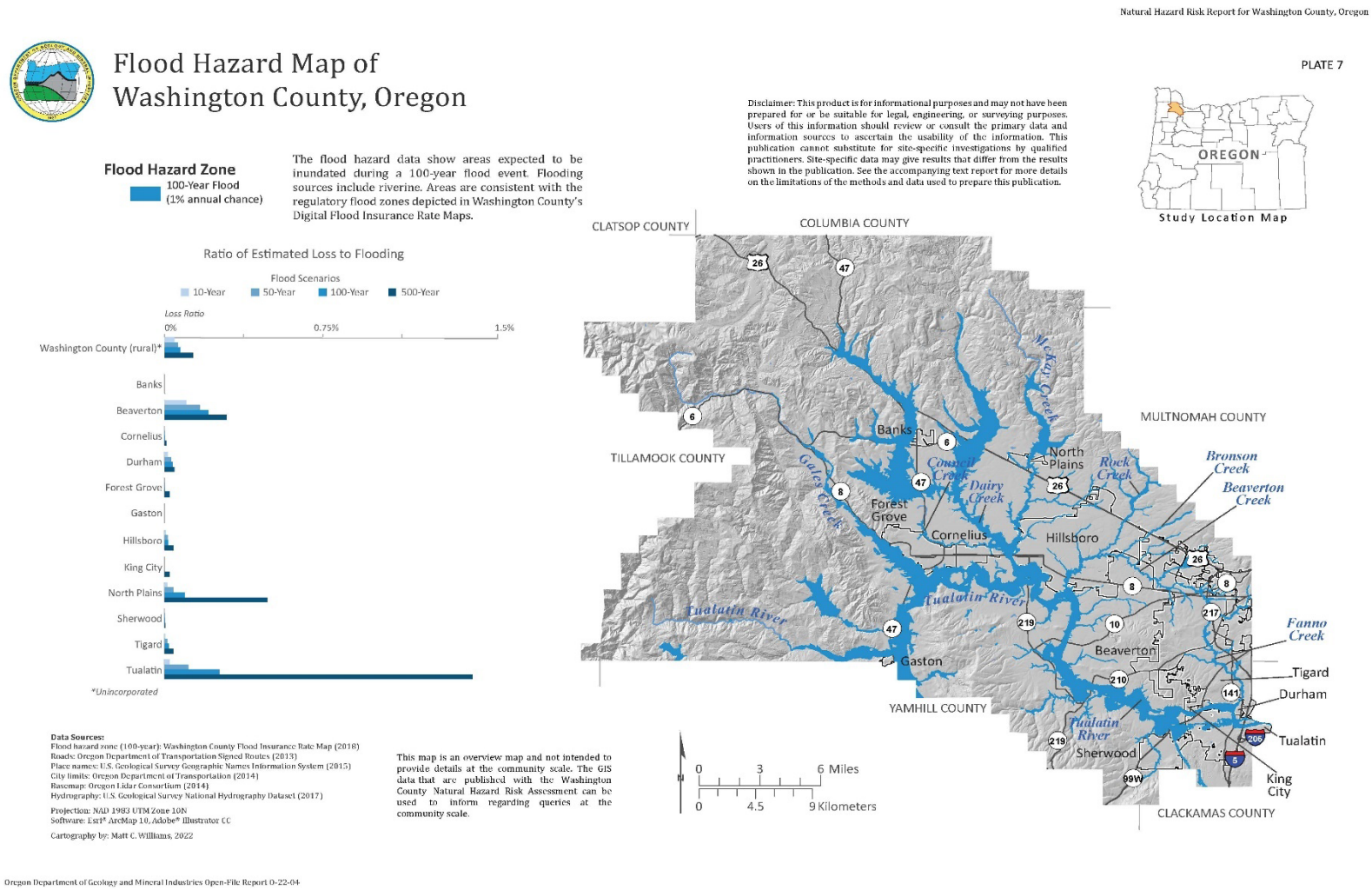


Figure 23: Flood Hazard Map of Washington County, Oregon[140]

[140] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

Increased development accelerates the risk of flooding in urban areas. Impervious surfaces, such as concrete and asphalt, collect water at a faster rate than undeveloped landscape, and the resulting runoff can collect in streets, ditches, and basements and impact county residents. Mitigation efforts must also consider localized areas of high flood risk or repetitive flooding that lie outside mapped floodplains. These areas are identified in participant annexes.

2.7.5.3. History

Flooding is most common from October through April in Washington County. There have been six significant flooding events in the planning area since the adoption of the 2017 NHMP.

The northern Willamette Valley, which includes Washington County, has a lengthy flood history, with significant floods occurring about every 7 to 15 years.[141] The Willamette River has produced numerous floods, and these floods typically occur in the winter. The common pattern includes the accumulation of heavy wet snow in higher elevations followed by a mild, rainy weather system. The resulting snowmelt on saturated or frozen ground sometimes produces devastating flood conditions. These conditions would be worse were it not for many dams on the upper reaches of the Willamette and some of its tributaries.[142]

Table 29: Historic Flooding Events in Washington County[143]

Date	Event
November 2016	A moist Pacific front moving slowly across the area produced heavy rainfall, resulting in flooding of several rivers across northwest Oregon and at least two landslides. Heavy rain resulted in flooding of the Tualatin River at Dilley in unincorporated Washington County. The Tualatin River reached flood stage at 7:30 a.m. on November 25 and crested at 17.7 feet at 12:15 p.m. on November 25. The river dropped below flood stage at 6:40 p.m. on November 25.
February 2017	Heavy rain caused the Tualatin River near Dilley in unincorporated Washington County to flood. The river crested at 17.77 feet, which is 0.27 feet above flood stage. A series of fronts brought moderate to heavy rainfall across northwest Oregon, resulting in flooding on many rivers across the area over the next several days.
February–March 2019	Back-to-back low-pressure systems dropping south along the coast of British Columbia and Washington brought cold air south as well as plenty of moisture into northwest Oregon. A Washington County official reported that 40 county roads were covered with water due to heavy rains and snowmelt. In the city of Tigard, emergency transportation routes were disrupted, and there were multiple outfall and stream bank damage impacts during the event.

[141] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[142] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[143] National Centers for Environmental Information Storm Events Database, Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx, 2023 NHMP Participant Planning Documentation

Date	Event
January 2021	January 12: Road closure at SW 149th Ave. and SW Division St. near South Johnson Creek in Beaverton. A series of slow-moving fronts brought periods of heavy rain along with strong winds. This resulted in river and urban flooding, landslides, and debris flows. The front brought a burst of 35–50 mph winds to the Willamette Valley and southwest Washington interior, resulting in over 100,000 customers without power across southwest Washington and northwest Oregon. The Tualatin River at Dilley in unincorporated Washington County rose above flood stage at 11:30 p.m. on January 12, crested at 18.09 feet, then fell below flood stage at 3:30 a.m. on January 14. Flood stage is 17.5 feet. January 13: Fanno Creek flooding occurred at SW North Dakota Street in the city of Tigard. January 14: The Tualatin River near Farmington in unincorporated Washington County rose above flood stage around 2 p.m., crested at 32.6 feet, then fell below flood stage at 10:15 a.m. on January 16. Flood stage is 32.0 feet.
February 2022	Minor flooding occurred in the County and resulted in road closures. In the city of Tigard, emergency transportation routes were disrupted, and there were multiple outfall and stream bank damage impacts during the event.

2.7.5.4. Probability of Future Events

History, probability, and vulnerability data is used to determine the probability of future flooding events. The probability of occurrence is expressed as a percentage indicating the probability of a specific flood event occurring in any given year. The 100-year flood has traditionally been used as a reference level for flooding and is the standard probability that FEMA uses for regulatory purposes. There is a high probability a flooding event will occur in Washington County within the next five years.

2.7.5.4.1. Climate Change

Flood magnitudes in the planning area are likely to increase due to climate change. Heavy precipitation events are expected to become more intense because a warmer atmosphere can carry more moisture. Also, in a warmer climate, the relatively contribution of rainfall to floods will be greater than that of snowmelt. The consequence is larger flood peaks because, for a given amount of precipitation, the peaks of rainfall-driven floods tend to be larger than those of snowmelt-driven floods. Projected increases in wet-season precipitation also are likely to increase winter flood magnitude. Increases in regulated flows from the main stem of the Columbia River during winter appear likely to increase flood risk throughout the Columbia River reservoir system, which includes Washington County.[144]

Along the Willamette River and its tributaries within the County, the largest increases in extreme river flows are more likely to be upstream toward Cascade Range headwaters, and less likely downstream. Along the Lower Columbia Basin, large increases in extreme flows are least likely. Overall, it is more likely than not (>50%) that increases in extreme river flows will lead to an increase in the incidence and magnitude of damaging floods, although this is a low confidence projection.[145] These potential increases are also dependent on local conditions like site-dependent river channel and floodplain hydraulics, soil

[144] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://blogs.oregonstate.edu/occri/oregon-climate-assessments/.
[145] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

moisture, and water table height. Increases in extreme river flows leading to damaging floods will be less likely in urban areas with strong stormwater management infrastructure and/or river reservoir operations, as these measures have the capacity to offset increases in flood peak.

La Niña events are associated with heavy rain from the western tropical Pacific, where ocean temperatures are well above normal, causing greater evaporation, more extensive clouds, and a greater push of clouds across the Pacific toward Oregon. These events typically occur naturally every three to five years and can last up to two years. Climate change could impact the severity and frequency of La Niña; however, the specific effects are not yet known.

2.7.5.5. Vulnerability Assessment

The vulnerabilities and impacts of flooding can vary widely depending on the size, extent, and magnitude of the event. Additional information about populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County is provided in Volume III, Appendix A and participant annexes in Volume II.

2.7.5.5.1. Populations

Flood waters can create significant public health concerns, such as the spread of infectious diseases, exposure to chemicals, hazardous materials, and debris, and water quality issues. Toxins and pathogens, such as viruses and bacteria, are transported along with contaminated sediments and floating debris. Sediments can be deposited on streets and in residential neighborhoods and parks, causing potential health concerns related to lead, arsenic, and other pollutants stored in the sediments. Water from flooded commercial and industrial facilities, storage tanks, grounded vessels, and common household chemicals are swept up and spread with the flood waters. Flooding can often cause sewage treatment systems to fail, releasing untreated sewage into flood waters. Intestinal bacteria such as E. coli, salmonella, shigella; hepatitis A virus; and agents of typhoid, paratyphoid, and tetanus are often found in flood waters. People exposed to these infectious agents can develop intestinal distress and debilitating disease symptoms. Other flood waterborne pathogens, such as flesh-eating bacteria, can cause severe forms of illness, such as necrotizing fasciitis and sepsis.[146] Water for consumption and daily use may need to be boiled or bottled water purchased for safety reasons, but not all populations have equitable access to these resources.

Injury or death can also occur as people evacuate through flood waters, including individuals who drive through flood waters. DOGAMI's evaluation estimates 4,161 residents might have mobility or access issues due to surrounding water.[147] Additionally, emergency routes may be limited or eliminated, and emergency services may not be able to access portions of the planning area to assist vulnerable populations. Since the adoption of the 2017 NHMP update, Tualatin Valley Fire & Rescue has performed 16 water rescues in Washington County. These rescues included swift-water rescues and searches for a person in water, in addition to watercraft rescue, surf rescue, water- and ice-related rescue, and swimming rescue.[148] Rescues completed by city-specific fire departments are included in their respective annexes.

2.7.5.5.2. Economy

Floods can impact governmental, private, and personal economics. These hazards are also associated with significantly lower local revenues. Floods can lead to a drop in property values, which decreases property taxes, and can disrupt local government spending and sources of intergovernmental revenues,

[146] Greater Houston Flood Mitigation Consortium. (2018, May 15). Fact Sheet 9: How Do Floods Impact Environment? https://www.houstonconsortium.com/graphics/FS9-Environment.pdf
[147] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[148] Tualatin Valley Fire & Rescue. (2022, May 9). Personal communication with Brian Smith, Captain.

causing municipalities to incur more debt. A consequence of flooding is that local governments increase their outstanding debt to fund recovery and maintain public services in their communities.[149]

Recovery efforts can provide temporary increases in revenue for the private sector, including cleaning, hauling, and construction services. However, overall, flooding has a negative economic impact due to suspended economic activity, loss of wages and revenues, and repair or replacement costs that may not be covered by insurance. Flooding can also have an enormous impact on agriculture through damage to crops, land, livestock, and equipment.

2.7.5.5.3. Structures, Improved Property, Critical Facilities, and Infrastructure

Properties within flooded areas may experience major impacts or be destroyed. The level of damage is dependent on the structure type, proximity to the flooding source, the velocity of the inundation water, amounts of debris in the flood water, longevity of the flood, and total depth of the flood.

Increased development accelerates the risk of urban flooding. Impervious surfaces, such as concrete and asphalt, collect water at a faster rate than an undeveloped landscape, and the resulting runoff can collect in streets, ditches, and basements, impacting residents on a regular basis. Storm drains often back up because of the volume of water and become blocked by vegetative debris like yard waste, which can cause additional flooding. Development in the floodplain can raise the base flood elevation, decrease vegetation, and cause flood waters to expand past their historic floodplains.

Infrastructure can also be seriously damaged or destroyed. Water and wastewater systems can become contaminated, electrical systems and communication equipment can be damaged, and transportation routes, including road and rail segments and bridges, are at risk for inundation and damage. Repairs or reconstruction efforts are typically delayed until water levels recede.

The 100-year flood has traditionally been used as a reference level for flooding and is the standard probability measure FEMA uses for regulatory purposes. An analysis completed by DOGAMI using Hazus®-MH shows the 100-year flood loss countywide as[150]:

- Number of buildings: 1,323
- Value of exposed buildings: $60,414,000
- Loss ratio: 0.08%
- Damaged critical facilities: 2

In addition to the Hazus®-MH flood analysis, DOGAMI completed an exposure analysis by overlaying building locations on the 100-year flood extent. This estimates the number of buildings elevated above the level of flooding. This was done by comparing the number of non-damaged buildings from Hazus®-MH with the number of exposed buildings in the flood zone. Of the 1,625 buildings that are exposed to flooding, it is estimated that 302 are above the height of the 100-year flood.

Table 30 through Table 34 provide flood loss estimates and flood exposures for 10-year, 50-year, 100-year, and 500-year flood events in unincorporated Washington County and participating cities.[151]

[149] Sarmiento, C. & Miller, T.R. (2006, October). Costs and Consequences of flooding and the Impact of the National Flood Insurance Program. American Institutes for Research. https://www.fema.gov/sites/default/files/2020-07/fema_nfip_eval-costs-and-consequences.pdf
[150] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[151] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

Table 30: Flood Loss Estimates for 10-Year Flood Scenario

Plan Participant	Total Number of Buildings	Total Estimated Building Value	Number of Buildings	Loss Estimate	Loss Ratio
Unincorporated Washington County	100,745	$28,760,104,000	398	$13,022,000	0%
City of Beaverton	26,405	$11,283,939,000	203	$11,197,000	0.1%
City of Cornelius	3,807	$954,752,000	1	$2,000	0%
City of Forest Grove	8,199	$2,525,502,000	1	$0	0%
City of Hillsboro	37,513	$15,487,612,000	39	$922,000	0%
City of North Plains	1,333	$414,606,000	1	$51,000	0%
City of Sherwood	6,109	$2,194,018,000	1	$10,000	0%
City of Tigard	18,731	$7,526,469,000	15	$213,000	0%

Table 31: Flood Loss Estimates for 50-Year Flood Scenario

Plan Participant	Total Number of Buildings	Total Estimated Building Value	Number of Buildings	Loss Estimate	Loss Ratio
Unincorporated Washington County	100,745	$28,760,104,000	558	$17,547,000	0.1%
City of Beaverton	26,405	$11,283,939,000	310	$18,191,000	0.2%
City of Cornelius	3,807	$954,752,000	1	$7,000	0%
City of Forest Grove	8,199	$2,525,502,000	2	$2,000	0%
City of Hillsboro	37,513	$15,487,612,000	66	$1,995,000	0%
City of North Plains	1,333	$414,606,000	4	$162,000	0%
City of Sherwood	6,109	$2,194,018,000	1	$20,000	0%
City of Tigard	18,731	$7,526,469,000	37	$889,000	0%

Table 32: Flood Loss Estimates for 100-Year Flood Scenario

Plan Participant	Total Number of Buildings	Total Estimated Building Value	Number of Buildings Exposed	Loss Estimate	Loss Ratio
Unincorporated Washington County	100,745	$28,760,104,000	651	$20,649,000	0.1%
City of Beaverton	26,405	$11,283,939,000	355	$22,809,000	0.2%
City of Cornelius	3,807	$954,752,000	1	$8,000	0%

Plan Participant	Total Number of Buildings	Total Estimated Building Value	Number of Buildings Exposed	Loss Estimate	Loss Ratio
City of Forest Grove	8,199	$2,525,502,000	2	$3,000	0%
City of Hillsboro	37,513	$15,487,612,000	74	$2,547,000	0%
City of North Plains	1,333	$414,606,000	9	$383,000	0.1%
City of Sherwood	6,109	$2,194,018,000	1	$30,000	0%
City of Tigard	18,731	$7,526,469,000	45	$1,392,000	0%

Table 33: Flood Loss Estimates for 500-Year Flood Scenario

Plan Participant	Total Number of Buildings	Total Estimated Building Value (in thousands)	Number of Buildings	Loss Estimate (in thousands)	Loss Ratio
Unincorporated Washington County	100,745	$28,760,104,000	1,080	$37,428,000	0.1%
City of Beaverton	26,405	$11,283,939,000	429	$32,268,000	0.3%
City of Cornelius	3,807	$954,752,000	5	$64,000	0%
City of Forest Grove	8,199	$2,525,502,000	20	$579,000	0%
City of Hillsboro	37,513	$15,487,612,000	141	$6,173,000	0%
City of North Plains	1,333	$414,606,000	58	$1,963,000	0.5%
City of Sherwood	6,109	$2,194,018,000	1	$50,000	0%
City of Tigard	18,731	$7,526,469,000	78	$2,959,000	0%

Table 34: Flood Exposure Estimates for 100-Year Flood Scenario

Plan Participant	Total Number of Buildings	Total Population	Potentially Displaced Residents from Flood Exposure	% Potentially Displaced Residents from Flood Exposure	Number of Flood Exposed Buildings	% of Flood Exposed Buildings	Number of Flood Exposed Buildings Without Damage
Unincorporated Washington County	100,745	252,626	1,969	0.8%	865	0.9%	214
City of Beaverton	26,405	98,738	1,376	1.4%	384	1.5%	29
City of Cornelius	3,807	12,674	6	0%	3	0.1%	2
City of Forest Grove	8,199	25,132	0	0%	2	0%	0
City of Hillsboro	37,513	104,041	203	0.2%	99	0.3%	25
City of North Plains	1,333	3,341	22	0.7%	15	1.1%	6
City of Sherwood	6,109	21,315	0	0%	1	0%	0
City of Tigard	18,731	54,729	173	0.3%	59	0.3%	14

2.7.5.5.4. Natural Environments

The impacts of flooding on the environment can be wide-ranging, from the dispersion of low-level household wastes into water systems to contamination of community water supplies and wildlife habitats with extremely toxic substances. Industrial or agricultural chemicals and wastes, solid wastes, raw sewage, and common household chemicals comprise most hazardous materials spread by flood waters that pollute the environment.

Flooding can help spread organic material, nutrients, and sediments, which enrich floodplain soils. Flooding can also replenish water resources and trigger life processes, such as bird breeding events, migration, and seed dispersal in flora and fauna adapted to these cycles. Additionally, good soil moisture can allow crops and pastures to be established. However, a massive flood event can result in widespread injury or death to plants and animals and drastically change nesting and feeding habitats for bird, reptile, and mammal species.[152]

Flooding can have secondary effects of causing stream bank erosion and channel migration, or precipitating landslides that can cause further damage, impacts to the natural environment, and change ecosystems.

2.7.5.6. National Flood Insurance Program

The Flood Insurance and Mitigation Administration, a component of FEMA, manages the NFIP. The three components of the NFIP are:

1. Flood insurance;
2. Floodplain management; and
3. Flood hazard mapping.

Jurisdictions in Washington County participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities.

Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Residents and business owners who own property in high-risk areas, sometimes referred to as Special Flood Hazard Areas, are required to purchase flood insurance if they have a mortgage from a federally regulated or insured lender. They also must carry the insurance for the life of the mortgage. Residents and business owners with a mortgage on a building outside high-risk areas can also purchase flood insurance and may be eligible for lower cost preferred risk policies.

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps floodplains. Mapping flood hazards creates broad-based awareness and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance.

Flood insurance rate maps (FIRMs) provide the most readily available source of information for 100-year floods, and these maps are used to support the NFIP. FIRMs delineate 100- and 500-year floodplain boundaries for identified flood hazards. These FIRMs provide the basis for flood insurance and floodplain management requirements. The most recent FIRM map of Washington County was created November 4, 2016.

[152] Ocean Watch Australia. (n.d.). What are the negative and positive impacts of flooding on the environment? https://www.oceanwatch.org.au/latest-news/coastal-marine/what-are-the-negative-and-positive-impacts-of-flooding-on-the-environment/

In April 2021, FEMA launched Risk Mapping, Assessment, and Planning (Risk MAP) 2.0, an update to the NFIP insurance rate pricing methodology. Risk Rating 2.0 enables FEMA to set rates that are fairer and ensures that both rate increases and decreases are equitable. The new methodology builds on years of investment in flood hazard information by incorporating private sector data sets, catastrophe models, and evolving actuarial science.

With Risk MAP 2.0, FEMA has the capability and tools to address rating disparities by incorporating more flood risk variables. These include flood frequency, multiple flood types—river overflow, storm surge, coastal erosion, and heavy rainfall—and distance to a water source, along with such property characteristics as elevation and the cost to rebuild. Previously, pricing was predominantly based on relatively static measurements, emphasizing a property's elevation within a zone on a FIRM.

Currently, policyholders with lower-valued homes are paying more than their share of the risk while policyholders with higher-valued homes are paying less than their share of the risk. Because Risk Rating 2.0 considers rebuilding costs, it equitably distributes premiums across all policyholders based on home value and a property's unique flood risk.[153]

Floodplain management regulations are the cornerstone of NFIP participation. Communities that participate in the NFIP are expected to adopt and enforce floodplain management regulations that apply to all types of floodplain development and ensure that development activities will not cause an increase in future flood damages. Buildings in floodplains are required to be elevated at or above the base flood elevation as established by the local regulations. Additional details about each participant's involvement in the NFIP are in participant annexes, as applicable.

2.7.5.6.1. Repetitive Loss Properties and Severe Repetitive Loss Properties

A repetitive loss (RL) property is a property insured under the NFIP that the program has paid at least two claims of more than $1,000 in any 10-year period since 1978, regardless of any change(s) of ownership during that period. Nationwide, RL properties constitute 2% of all NFIP-insured properties but are responsible for 40% of all NFIP claims. Mitigation for RL properties is a high priority for FEMA, and the areas in which these properties are located typically represent the most flood-prone areas of a community.

Severe repetitive loss (SRL) properties are properties that have sustained the highest levels of damages and claims. SRL properties are defined as any building that is covered under a Standard Flood Insurance Policy (SFIP) and has sustained flood damage for which:

- Four or more separate claim payments have been made under an SFIP, with the amount of each claim exceeding $5,000 and the cumulative amount of such claims exceeding $20,000; or
- At least two separate claims payments have been made under an SFIP, with the cumulative amount of those payments exceeding the fair market value of the insured structure as of the day before the loss.

The identification of RL properties is an important element to conducting a local flood risk assessment, as the inherent characteristics of properties with multiple flood losses strongly suggest that they will be threatened by continual losses. RL properties are also important to the NFIP, since structures that flood frequently put a strain on the National Flood Insurance Fund.

A primary goal of FEMA is to reduce the number of structures that meet these criteria, whether through elevation, acquisition, relocation, or a flood-control project that lessens the potential for continual losses.

There are 51 RL properties in Washington County as of September 30, 2021. Unincorporated Washington County has seven SRL properties and is the only plan participant with SRL properties. The

[153] Federal Emergency Management Agency. (n.d.). Risk Rating 2.0: Equity in Action. https://www.fema.gov/flood-insurance/risk-rating

specific addresses of the properties are maintained by FEMA, Washington County, and local jurisdictions, but are deliberately not included in this plan as required by law.

Table 35: Number of Repetitive Loss Properties in Washington County as of September 30, 2021[154]

Jurisdiction	Number of RL Properties
City of Beaverton	6*
City of Forest Grove	1
City of Hillsboro	1
City of Tigard	2
City of Tualatin**	4
Unincorporated Washington County	36, including 7 SRL properties
Total	**51**

*FEMA sources show 7 properties, but one is outside city limits.
**Not a 2023 NHMP participant.

Neither the County nor the participating cities are members of the Community Rating System (CRS).

2.7.5.7. Hazard Risk Score Summary

Based on the hazard analysis methodology described in Section 2.2, plan participants assigned the scores below to their overall risk of flooding. Additional information is in the participant annexes.

Table 36: Participant Overall Risk of Flooding[155]

Participant	Overall Risk of Flooding
City of Beaverton	188
City of Cornelius	48
City of Forest Grove	48
City of Hillsboro	159
City of North Plains	181
City of Sherwood	79
City of Tigard	162
Clean Water Services	189
Tualatin Hills Park & Recreation District	143
Tualatin Valley Water District	67
Washington County	173

[154] Personal communication with Washington County Land Use and Transportation Department personnel
[155] 2023 NHMP Participant Planning Documentation

2.7.6. Landslide

Significant Changes
- Additional information on hazard history, vulnerabilities, and how climate change may impact the frequency of landslide added.

2.7.6.1. Characteristics

Landslides are downhill or lateral movements of rock, debris, or soil mass. The term is used for varying phenomena, including mudflows, mudslides, debris flows, rock falls, rockslides, debris avalanches, debris slides, and slump-earth flows. The size of a landslide usually will depend on the geology and the triggering mechanism. Landslides initiated by rainfall tend to be smaller, while those initiated by earthquakes may be large.

Landslides can be rapid or slow moving. The velocity of landslides varies from imperceptible to over 35 miles per hour. Some volcanic induced landslides have been known to travel between 50 to 150 miles per hour. On less steep slopes, landslides tend to move slowly and cause damage gradually.

Rapidly moving landslides, including debris flows and earth flows, present the greatest risk to human life, and persons living in or traveling through areas prone to rapidly moving landslides are at increased risk of serious injury. Rapidly moving landslides have also caused most of the recent landslide-related injuries and deaths in Oregon. Slow-moving landslides can cause significant property damage but are less likely to result in serious human injuries.

Debris flows typically start on steep hillsides as shallow landslides, enter a channel, then liquefy and accelerate. Canyon bottoms, stream channels, and outlets of canyons can be particularly hazardous. Landslides can move long distances, sometimes as much as several miles.

The susceptibility of hillside and mountainous areas to landslides depends on variations in geology, topography, vegetation, and weather. Certain geologic formations are more susceptible to landslides than others. In general, locations with steep slopes are most susceptible to landslides, and the landslides occurring on steep slopes tend to move more rapidly and therefore may pose life safety risks.

Four primary types of landslides can impact Washington County:

- **Slides** move in contact with the underlying surface. These movements include rotational slides, where sliding material moves along a curved surface, and translational slides, where movement occurs along a flat surface. These slides are generally slow moving and can be deep. Slumps are small rotational slides that are generally shallow. Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage but are far less likely to result in serious injuries than rapidly moving landslides.
    - Slides associated with volcanic eruptions are typically large and can include as much as one cubic mile of material.
    - Slides caused by erosion occur when ditches or culverts beneath hillside roads become blocked with debris.
    - Slides caused by erosion are the most common type of landslide in Washington County. Many recent landslides in the County primarily have been slow moving and have caused the greatest impact to roads and culverts.
- **Rock falls** occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways where the road has been cut through bedrock, can cause rock falls. These landslides are fast moving, with the materials free falling or bouncing

down the slope. The total volume of material involved is generally small, but individually the boulders or blocks of rock can be large and can cause significant damage.

- **Flows** are landslides in which soil and rock breaks up and flows like a plastic or liquid. Debris flows normally occur when a landslide moves downslope as a semifluid mass, scouring or partially scouring soils from the slope along its path. Flows often occur during heavy rainfall, can occur on gentle slopes, and can move rapidly for large distances, traveling at speeds of more than 35 miles per hour for several miles. Earthquakes often trigger flows as well. Other types of flows include debris avalanches, mudflows, creeps, earthflows, debris flows, and lahars.
- **Complex landslides** are any combination of landslide types. Most slope failures are complex combinations of the above distinct types, but the generalized groupings provide a useful means for framing discussion of the type of hazard associated with landslides, landslide characteristics, identification methods, and potential mitigation alternatives.

In Washington County, the most common landslides are debris flows and shallow and deep landslides.[156]

Due to their general nature, landslides on steep slopes are typically more dangerous because they can occur with little warning and their movements can be very rapid. Locations at risk from landslides or debris flows include areas with one or more of the following conditions:

- On or close to steep hills.
- Steep roadcuts or excavations into steep slopes.
- Existing landslides or places of known historic landslides; such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular ground surfaces.
- Steep areas where surface runoff is channeled, such as below ground in culverts, V-shaped valleys, canyon bottoms, and steep stream channels.
- Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons, and large boulders (2 to 20 feet in diameter) perched on soil near fans or adjacent to creeks.
- Occurrences of logjams in streams.

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

- Shaking due to earthquakes or seismic tremors can trigger events ranging from rockfalls and topples to massive slides.
- Volcanic activity, especially eruptions, can cause large slides that include as much as one cubic mile of material.
- Intense or prolonged precipitation or large amounts of melting snow can cause flooding and can also saturate slopes and cause failures leading to landslides.
- Extreme precipitation events can occur at all phases of the ENSO cycle, but the largest fraction of these events occur during La Niña episodes and during ENSO-neutral winters. During La Niña episodes, much of the Pacific Northwest experiences increased storminess, increased precipitation, and more overall days with measurable precipitation. The risk of flooding and rain-induced landslides and debris flows can be related to La Niña episodes.
- Erosion can cause slides when ditches or culverts beneath hillside roads become blocked with debris and precipitation runoff is constrained. Runoff water can collect in soil and in some cases cause a slide. Usually the slides are small (100–1,000 cubic yards), but some have been known to be quite large.

[156] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

- Landslides into a reservoir can indirectly compromise dam safety, and a landslide can even affect the dam itself.
- Wildfires can remove vegetation from hillsides, significantly increasing runoff and landslide potential.

2.7.6.2. Location and Extent

Portions of the cities of Beaverton, Tigard, Hillsboro, Forest Grove, and the unincorporated area of Washington County are exposed to landslide hazards. Areas in terrain with moderate to steep slopes or at the base of steep hillsides may be exposed to landslides. While these areas are highly prone to landslides, most of the populated areas are outside these zones because most of the buildings are on the relatively flat ground towards the center of the Tualatin Valley. However, in these areas, even moderate slopes can become unstable and trigger a landslide if rain or runoff oversaturates the soil.

Per DOGAMI, areas of significant landslide risk include the following:

- Residential structures along the west side of the Portland Hills are generally at a higher risk from landslides.
- The southern, western, and northern rural areas of Washington County with steep slopes have an increased risk of landslides.
- Many areas in the southwestern portions of the cities of Beaverton and Tigard are highly susceptible to landslides.
- Buildings built along Rock Creek in the city of Hillsboro are at higher risk of landslides than other adjacent areas.

Approximately 40% of the County has high or very high susceptibility to landslides, while the cities generally have less susceptibility. About 40% of the land in the City of Tigard lies within the category of being moderately susceptible to the landslide hazard. Cities in Washington County have very low percentages of high and very high landslide exposure susceptibility.

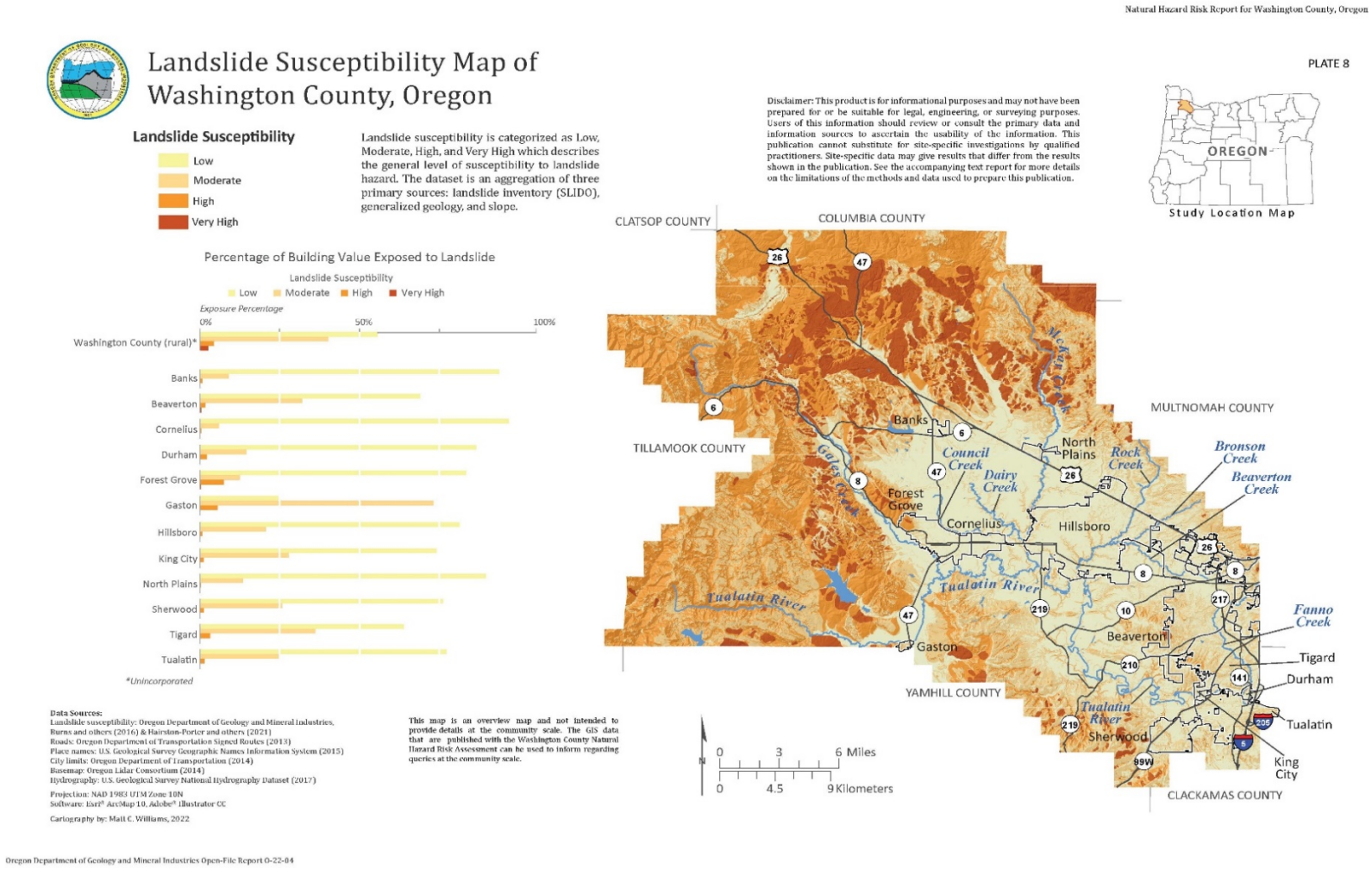


Figure 24: Landslide Susceptibility Map of Washington County, Oregon[157]

[157] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

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

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

As population growth continues to expand and development into landslide susceptible terrain occurs, greater losses are likely to result. Landslide hazards are pervasive in a large percentage of undeveloped land and may present challenges for planning and mitigation efforts. Awareness of nearby areas that are susceptible to landslides is beneficial to reducing risk for every community and rural area of Washington County.

2.7.6.3. History

The likelihood of a landslide in any given slide-prone location is largely dependent on the water content of the soil or rock fill. Landslides may happen at any time of the year, especially during rainy months when soils become saturated with water.

A landslide on December 7, 2021, resulted in an emergency, long-term closure of Dixie Mountain Road from the quarry to the end of the road. The root cause is still under investigation. The road remains closed, and an alternate access to the quarry was opened up. The response cost to the County as of June 2022 is approximately $3,000. No other significant landslide events have occurred in the planning area since the adoption of the 2017 NHMP.[158]

2.7.6.4. Probability of Future Events

The landslide recurrence interval is highly variable. Some large landslides move continuously at slow rates. Others move periodically during wet periods. Very steeply sloped areas can have relatively high landslide recurrence intervals ranging from 10 to 500 years.

Because debris flows can be initiated at many sites over a watershed, in some cases recurrence intervals can be less than 10 years. Slope alterations can greatly affect recurrence intervals for all types of landslides and also cause landslides in areas otherwise not susceptible. Most slopes in Western Oregon steeper than 30 degrees (about 60%) have a risk of rapidly moving landslide activity regardless of geologic conditions. Areas directly below these slopes in the paths of potential landslides are at risk as well.[159]

Areas that have failed in the past often remain in a weakened state, and many of these areas tend to fail repeatedly over time. This commonly leads to distinctive geomorphology that can be used to identify landslide areas, although over time the geomorphic expression may become subtle, making the landslide difficult to identify. Other types of landslides tend to occur in the same locations and produce distinctive geomorphology, such as channelized debris flows, which form a fan at the mouth of the channel after repeated events.

Geologic, terrain, and climatic conditions that led to landslides in the past are good predictors of future landslides. Therefore, data and maps can provide critical information to guide site-specific investigations for future developments and to assist in planning and mitigation in existing landslide-prone areas in the County. However, the location of existing landslides alone is not enough to predict the future. The

[158] 2023 NHMP Planning Documentation
[159] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

geology, slope, and triggering factors, such as water, earthquakes, volcanic eruptions, and human activity, also must be considered. All of these factors combined result in landslide susceptibility, that is, whether a location is more or less likely to experience landslides.

The probability of rapidly moving landslides occurring depends on a number of factors, including steepness of slope, slope materials, local geology, vegetative cover, human activity, and water. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving debris flows. Many slower moving slides present in developed areas have been identified and mapped; however, the probability and timing of their movement is difficult to quantify. The installation of slope indicators or the use of more advanced measuring techniques could provide information on these slower moving slides.

Development and other human activities can also provoke landslides. Increased runoff, excavation in hillsides, shocks and vibrations from construction, placement of non-engineered fill, and changes in vegetation from fire, timber harvesting, and land clearing have all led to landslide events. Weathering and decomposition of geologic material, and alterations in flow of surface or groundwater, can further increase the potential for landslides. As population growth continues and development expands into landslide-susceptible terrain, greater losses are likely to result.

2.7.6.4.1. Climate Change

Changing climate, precipitation patterns, and more frequent wildfire events may increase the planning area's susceptibility to landslides.[160]

Landslides are often triggered by heavy rainfall events when the soil becomes saturated. It is likely that the County will experience an increase in the frequency of extreme precipitation events. Because landslide risk depends on a variety of site-specific factors, it is more likely than not that climate change, through increasing frequency of extreme precipitation events, will result in increased frequency of landslides.[161]

Because landslides often occur together with other natural hazards, the ways in which climate change alters the frequency and intensity of earthquakes, seismic tremors, volcanic activity, precipitation amounts, wildfires, and erosion will impact the probability and strength of future landslides.

2.7.6.5. Vulnerability Assessment

2.7.6.5.1. Populations

Although rapidly moving landslides, including debris flows and earth flows, can present a large risk to human life, the population of the planning area has not experienced impacts from previous events. Injury and loss of life from landslides is more likely to occur to people who live, travel, and pursue recreation opportunities in areas prone to landslides.

2.7.6.5.2. Economy

Disruption of infrastructure, roads, and critical facilities by landslides may also have a long-term effect on the local economy. Roads and bridges are subject to closure during landslide events. Because many Washington County residents are dependent on roads and bridges for travel to work, delays and detours are likely to have an economic impact on county residents and businesses. Affected communities may also be subject to the economic impacts of road closures, which may disrupt ingress to and egress from communities.

[160] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[161] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

2.7.6.5.3. Structures, Improved Property, Critical Facilities, and Infrastructure

Landslides can affect utility services, transportation systems, and critical lifelines. Communities may suffer immediate damages and loss of service. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power, are essential to service community needs. Loss of electricity has the most widespread impact on other utilities and on the whole community. Natural gas pipes may also be at risk of breakage from landslide movements.

In Washington County, many areas with high susceptibility to landslides are in hilly, forested areas. Landslides in these areas may damage or destroy some access roads through rural, hilly areas. Many of the major highways in the County are at risk for landslides at one or more locations, with a high potential for road closures and damage to utility lines. The western portions of the County have limited road network redundancy, and road closures may isolate some communities.

Approximately 3% DOGAMI combined high and very high susceptibility zones as the primary scenarios to provide a general sense of community risk for planning purposes. It was useful to combine exposure for both susceptibility zones to best communicate the level of landslide risk to communities. These susceptibility zones represent areas most susceptible to landslides with the highest impact to the community.

Comparing building locations to geographic extents of identified landslide susceptibility zones provides the following high and very high exposure susceptibility information[162]:

- Number of buildings: 8,997
- Value of exposed buildings: $2,689,627,000
- Percentage of total county building value exposed: 3.6%
- Critical facilities exposed: 1
- Potentially displaced population: 20,383

Proper site evaluation and construction techniques and thorough building codes for buildings in steep and landslide-prone zones are imperative to decrease the potential for loss of life and property damage. Flowing water is the most common trigger of landslides, so managing water is key.[163] Sources of water on a site can include rainfall, broken or leaking sewer or water lines, water retention facilities that direct water onto slopes, lawn irrigation, and streams or creeks. It is important to recognize that water flow can affect the natural geology and/or exacerbate the altered conditions of the site that resulted from grading and construction. Water flow may need to be directed off the site or controlled through construction, drainage and erosion control, and/or grading requirements. As with all other codes and regulations, monitoring and enforcement are essential.

It is vital to consider how uphill buildings and properties can impact downhill developments and communities. Wet, dense soils on the uphill side of a building's foundation can exert a lot of force on the uphill foundation walls of the structure and becomes like a dam holding back a lake of mud. Retention walls are an important structural mitigation measure in these areas.[164]

[162] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[163] Oregon Department of Land Conservation and Development and Oregon Department of Geology and Mineral Industries. (2019, October). Preparing for Landslide Hazards: A Land Use Guide for Oregon Communities. https://www.oregongeology.org/Landslide/Landslide_Hazards_Land_Use_Guide_2019.pdf
[164] MacEvilly, C. (2016, December 13). Should I Buy a Home on a Steep Hillside? https://www.myseattlehomesearch.com/blog/should-i-buy-a-home-on-a-steep-hill-side/

2.7.6.5.4. Natural Environments

Crops, vegetation, parks, and other natural systems can be damaged by landslides if they are located in susceptible areas.

2.7.6.6. Hazard Risk Score Summary

Based on the hazard analysis methodology described in Section 2.2, plan participants assigned the scores below to their overall risk of landslide. Additional information is in the participant annexes.

Table 37: Participant Overall Risk of Landslide[165]

Participant	Overall Risk of Landslide
City of Beaverton	86
City of Cornelius	118
City of Forest Grove	118
City of Hillsboro	34
City of North Plains	24
City of Sherwood	61
City of Tigard	73
Clean Water Services	96
Tualatin Hills Park & Recreation District	72
Tualatin Valley Water District	88
Washington County	102

[165] 2023 NHMP Participant Planning Documentation

2.7.7. Volcanic Ash

Significant Changes

- Previous volcano hazard profile streamlined to focus on volcanic ash.
- Added information on vulnerabilities and how climate change may impact the frequency and severity of volcanic ash.

2.7.7.1. Characteristics

A volcano is a vent or opening in the earth's crust from which molten lava (magma), pyroclastic materials, and volcanic gases are expelled onto the surface. Volcanoes and other volcanic phenomena can unleash cataclysmic destructive power and can pose serious hazards if they occur in populated and/or cultivated regions. These hazards may occur during eruptive episodes or in the periods between eruptions.[166]

The distal eruptive hazards of tephra and ashfall are of the greatest concern in Washington County. Tephra is any type and size of rock fragment that is forcibly ejected from the volcano and travels an airborne path during an eruption.[167] Large fragments generally fall back close to the erupting vent; however, billions of smaller and lighter particles of ash can be carried hundreds to thousands of miles away from the source by wind.[168] Westerly winds dominate in the Pacific Northwest, sending volcanic ash east and north-eastward about 80% of the time, though ash can blow in any direction.[169] Falling ash, even in low concentrations, can cause negative impacts hundreds of miles downwind by causing breathing problems, shorting out utility systems, and making transportation difficult.[170]

2.7.7.2. Location and Extent

Volcanic activity is possible from Mount Hood, Mount St. Helens, Three Sisters, Mount Bachelor, Mount Adams, Mount Rainier, and the Newberry Crater areas. All these volcanoes are known or suspected to be active, and most have geological records that indicate past histories of explosive eruptions with large ash releases. Washington County is not located near these volcanoes, but ashfall has the potential to impact the entire planning area equally, although the scale and types of impacts may differ. The extent of ashfall and the specific consequences from an event can vary depending on the height attained by the eruption column and the atmospheric conditions at the time of the eruption.

Scientists use wind direction to predict areas that might be affected by volcanic ash; during an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction. The predominant wind pattern over the Cascade Range originates from the west, and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes, away from Washington County. The annual probability of 1 centimeter or more of ash accumulation from eruptions throughout the

[166] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[167] U.S. Geological Survey Cascades Volcano Observatory. (n.d.). Tephra Fall Is a Widespread Volcanic Hazard. https://www.usgs.gov/observatories/cascades-volcano-observatory/tephra-fall-widespread-volcanic-hazard
[168] U.S. Geological Survey Cascades Volcano Observatory. (n.d.). Tephra Fall Is a Widespread Volcanic Hazard. https://www.usgs.gov/observatories/cascades-volcano-observatory/tephra-fall-widespread-volcanic-hazard
[169] U.S. Geological Survey Cascades Volcano Observatory. (n.d.). Tephra Fall Is a Widespread Volcanic Hazard. https://www.usgs.gov/observatories/cascades-volcano-observatory/tephra-fall-widespread-volcanic-hazard
[170] U.S. Geological Survey. (n.d.). Ash3d: Volcanic Ash Dispersion Model. https://vsc-ash.wr.usgs.gov/ashgui/#!/#%2F

Cascade Range is 1 in 5,000 to 1 in 10,000 for Washington County.[171] The county is not at risk from other volcanic hazards, such as lahars, lava flows, debris flows or avalanches, and pyroclastic flows.[172]

The Volcanic Explosivity Index (VEI) is a relative measure of the explosiveness of volcanic eruption. The scale is open-ended, with the largest volcanic eruptions in history (supereruptions) given a magnitude 8.0. A value of 0 is given for non-explosive eruptions, defined as less than 10,000 m^3 (350,000 cubic feet) of tephra ejected, and 8 representing a mega-colossal explosive eruption that can eject 1.0 x 1012 m^3 (240 cubic miles) of tephra and have a cloud column height of over 12 miles.[173]

The eruption of Mount St. Helens on May 18, 1980 was a magnitude 5.0, with an erupted tephra volume of 1 km^3. Other eruptions of the mountain, on June 12, 1980, December 7, 1989, and October 1, 2004, ranged from magnitude 3.0 to 0, with erupted tephra volumes ranging from 0.01 km^3 to .0001 km^3.[174]

2.7.7.3. History

There have been no volcanic ash events since the adoption of the 2017 NHMP.

2.7.7.4. Probability of Future Events

The U.S. Geological Survey's Cascades Volcano Observatory (CVO) volcanic-hazard zonation reports include a description of potential hazards that may occur to immediate communities if any of the major Cascade volcanoes were to erupt. The CVO volcanic tephra fall map (see Figure 25) shows the one-year probability of accumulation of 1 cm (0.4 inch) or more of tephra from volcanic eruptions in the Cascade Range and can be used by participants as a guide for forecasting potential tephra hazard problems. Probability zones extend farther east of the range because winds blow from westerly directions most of the time. The patterns on the map show the dominating influence of Mount Saint Helens as a tephra producer. Because small eruptions are more numerous than large eruptions, the probability of a thick tephra fall at a given locality is lower than that of a thin tephra fall. The annual probability of a fall of one centimeter or more of tephra is up to 1 in 10,000 for Washington County.

[171] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[172] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[173] U.S. Geological Survey Volcano Hazards Program. (n.d.). Volcanic Explosivity Index (VEI) is a numeric scale that measures t. https://www.usgs.gov/media/images/volcanic-explosivity-index-vei-a-numeric-scale-measures-t
[174] U.S. Geological Survey Volcano Hazards Program. (n.d.). Volcanic Explosivity Index (VEI) is a numeric scale that measures t. https://www.usgs.gov/media/images/volcanic-explosivity-index-vei-a-numeric-scale-measures-t

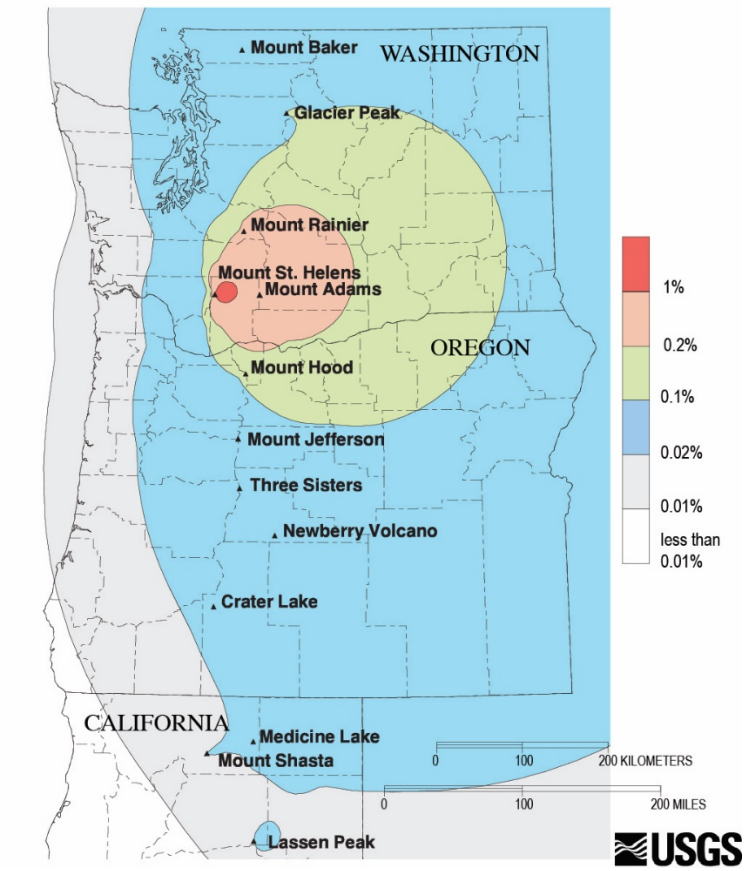


Figure 25: One-Year Probability of Accumulation of 0.4 Inches or More of Tephra from Eruptions of Volcanoes in the Cascade Range[175]

Per the 2020 Oregon NHMP, one method of evaluating the probability of volcanic-hazard events in Oregon is to consider the proximity of a county to the Cascade Range volcanoes along with the probability of tephra accumulation over a 30-year period and apply professional expertise and judgment. Based on the County's western proximity to the Cascade Range volcanoes, the 30-year probability of tephra accumulation of at least 1 cm and at least 10 cm is nonexistent (not applicable). DOGAMI calculated the probability of proximal, distal, and overall volcanic-hazard risks for each county in the state, assigning a number from 1 to 5 indicating very low to very high probability. Washington County has an overall probability of volcanic hazards of 1.5 or lower.[176]

Gases from major explosive eruptions can impact the climate, and several eruptions during the past century have caused a decline in the average temperature at the Earth's surface of up to half a degree (Fahrenheit scale) for periods of one to three years.[177] Sulfur dioxide can cause global cooling, and volcanic carbon dioxide, a greenhouse gas, has the potential to promote global warming; however, volcanoes release less than a percent of the carbon dioxide released currently by human activities.[178] There is limited research on how climate change may impact the frequency and severity of volcanic

[175] U.S. Geological Survey. (2013). Map Showing One-Year Probability of Accumulation of 1 Centimeter. https://www.usgs.gov/media/images/map-showing-one-year-probability-accumulation-1-centimeter
[176] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[177] U.S. Geological Survey Volcano Hazards Program. (n.d.). Volcanoes Can Affect Climate. https://www.usgs.gov/programs/VHP/volcanoes-can-affect-climate
[178] U.S. Geological Survey Volcano Hazards Program. (n.d.). Volcanoes Can Affect Climate. https://www.usgs.gov/programs/VHP/volcanoes-can-affect-climate

eruptions, but a recent study suggests that a warming planet could contribute to an increase in volcanic activity.[179, 180]

2.7.7.5. Vulnerability Assessment

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County have the potential to be exposed to and impacted by volcanic ash. Additional information about populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County is provided in Appendix A and participant annexes.

People with chronic lung problems and preexisting health conditions, children, pregnant women, older adults, and people without access to effective dust masks, eye protection, and drinking water and food uncontaminated by ash are at especially elevated risk of negative impacts.[181]

Though unlikely, the impact of a significant ashfall could be substantial. Any future eruption of a nearby volcano (e.g., Mount Hood, Mount Saint Helens, or Mount Adams) occurring during a period of easterly winds would likely have adverse consequences for the County.

Exposure to volcanic ashfall rarely endangers human life directly, except where very thick ashfalls cause structural damage to buildings (e.g., roof collapse) or indirect casualties, such as those sustained during ash cleanup operations or in traffic accidents.[182]

Short-term effects commonly include irritation of the eyes and upper airways and exacerbation of preexisting respiratory disease, such as asthma; serious health problems are rare. In addition, affected communities may experience increased levels of psychological distress. This is particularly the case when eruptions cause social and economic disruption.[183]

Additional impacts from ashfall include disruption of transportation, including air travel; effects on water supplies, hydroelectric power generation and transmission in northwestern Oregon and southwestern Washington, sanitation, and animal and crop health; and economic disruptions due to short-term business closures.[184]

There are many businesses in the County that could be impacted by volcanic ash, including several electronic manufacturing companies. These companies specialize in hardware, including computer chips, electronic displays, and printers, and volcanic ash can impact their machinery and products, in addition to their staff's health.

Volcanic ash is very abrasive, and vulnerability data from post-eruption impact assessments and laboratory experiments confirm that heating, ventilation, and air-conditioning (HVAC) systems and small electronics components are impacted by tephra fall, especially if the ash is moist. Common impacts are abrasion of fans and motors; blockage of filters and ventilation holes; decreased usability of computers;

[179] Cooper C.L., Swindles G.T., Savov, I.P., Schmidt, A., & Bacon, K.L. (2018). Evaluating the Relationship Between Climate Change and Volcanism. https://eprints.whiterose.ac.uk/124024/1/FinalManuscript.pdf
[180] NPR. (2017, December 22). Climate Change Likely to Increase Volcanic Eruptions, Scientists Say. https://www.npr.org/sections/thetwo-way/2017/12/22/572795936/climate-change-likely-to-increase-volcanic-eruptions-scientists-say
[181] International Volcanic Health Hazard Network . (n.d.). Health Impacts of Volcanic Ash. https://www.ivhhn.org/information/health-impacts-volcanic-ash
[182] U.S. Geological Survey Volcanic Ashfall Impacts Working Group. (2018, May 16). Volcanic Ash Impacts & Mitigation. Health. https://volcanoes.usgs.gov/volcanic_ash/health.html
[183] U.S. Geological Survey Volcanic Ashfall Impacts Working Group. (2018, May 16). Volcanic Ash Impacts & Mitigation. Health. https://volcanoes.usgs.gov/volcanic_ash/health.html
[184] International Volcanic Health Hazard Network. (n.d.). Health Impacts of Volcanic Ash. https://www.ivhhn.org/information/health-impacts-volcanic-ash

and temporary shutdown of systems. The primary damaging mechanism is ingestion of tephra into the component, which is primarily driven by component design.[185]

Free-hanging and portable ambient air cleaners utilize high-efficiency particulate air (HEPA) filters, which significantly improve air quality. HEPA filters trap 99.97% of particles 0.3 microns or larger. In comparison, dangerous volcanic ash particles are less than 4 microns. HEPA filters employ negative air pressure to cleanse the air and recycle it back into the room. These systems are easy to install because they recycle the air instead of requiring ductwork that directs the air outside. Activated carbon filters can also provide additional protection by trapping the gas pollutant molecules and absorbing them.[186]

Emergency power generation equipment is also vulnerable to volcanic ash and should be protected.[187]

2.7.7.6. Hazard Risk Score Summary

Based on the hazard analysis methodology described in Section 2.2, plan participants assigned the scores below to their overall risk of volcanic ash. Additional information is in the participant annexes.

Table 38: Participant Overall Risk of Exposure to Volcanic Ash[188]

Participant	Overall Risk of Exposure to Volcanic Ash
City of Beaverton	178
City of Cornelius	99
City of Forest Grove	99
City of Hillsboro	126
City of North Plains	124
City of Sherwood	119
City of Tigard	137
Clean Water Services	86
Tualatin Hills Park & Recreation District	152
Tualatin Valley Water District	119
Washington County	124

[185] Wilson, G., Wilson, T.M., Deligne, N.I., Blake, D. M., & Cole, J.W. (2017). Framework for Developing Volcanic Fragility and Vulnerability Functions for Critical Infrastructure. *Journal of Applied Volcanology, 6*(14). https://doi.org/10.1186/s13617-017-0065-6
[186] Sentry Air Systems, Inc. (2018, May 18). Dangers & Side Effects of Breathing Volcanic Ash. https://www.sentryair.com/blog/indoor-air-quality/dangers-and-side-effects-of-breathing-volcanic-ash/
[187] Volcanic Ashfall Impacts Working Group. (2015, November 25). HVAC and Generators. https://www.volcano.gov/volcanic_ash/equipment_HVAC.html#:~:text=Air%20intakes%20on%20heating%2C%20ventilation%20and%20air-conditioning%20%28HVAC%29,air%20flow%20and%20and%20HVAC%20condenser%20system%20performance
[188] 2023 NHMP Participant Planning Documentation

2.7.8. Wildland Fire

Significant Changes

- Additional information on hazard history, vulnerabilities, and how climate change may impact the frequency and severity of wildland fires added.
- Added information about wildfire smoke impacts.

2.7.8.1. Characteristics

A wildland fire is a type of wildfire that spreads through consumption of vegetation. Wildfires occur in areas with large amounts of flammable vegetation, and a suppression response may be required to limit impacts of uncontrolled burning. They often begin unnoticed, spread quickly, and are usually signaled by dense smoke that may be visible and cause health impacts for miles around. Wildland fires can be caused by human activities, such as arson or campfires, or by natural events like lightning.

Fire is an essential part of Oregon's ecosystem but can also pose a serious threat to life and property, particularly in areas experiencing population growth and expansion of the built environment in areas with the greatest amount of risk from wildfire.

Due to the large amount of forested land in Washington County and the County's growing population and built environment, wildfire is a significant hazard. Additionally, the County occasionally experiences influxes of smoke from wildfires in nearby areas, which can negatively impact the population and economy.

Wildfires are more likely to pose a risk to communities when conditions are favorable for fire ignition and spread, such as hot, dry and windy weather and large vegetation fuel loads are present, or when suppression is challenging, due to ground conditions or the occurrence of multiple fires that overwhelm committed resources. Once a fire has started, its behavior is influenced by numerous conditions, including fuel, topography, weather, drought, and development.

Wildfire severity is a quantitative measure of the effects of a fire on the environment, typically considering both the damage to vegetation and the impacts on the soil. This measure has three categories[189]:

- **Unburned/low severity:** Less than 25% tree mortality, with limited effects on soils.
- **Moderate severity:** 25%–75% tree mortality, with moderate effects on soils.
- **High severity:** Greater than 75% tree mortality, with extensive mineral soil exposure.

Fire severity is driven by multiple factors that affect how a fire behaves. These factors, also known as the fire behavior triangle, include the following [190]:

- The amount, arrangement, and type(s) of **fuels** present during the fire. These are important factors that determine how a given fire will respond to the landscape and to the degree of fire severity. For example, high-severity burned areas are generally associated with two types of forests: dense, multi-layered forests with "ladders" of flammable materials that allow a ground fire to ignite the canopy, and uniform, young, even-aged forests.
- The **topography** of the landscape, including slope and aspect. Fires tend to be more severe on mid- and upper-slope positions than on lower slopes because wind speeds and convection winds

[189] Oregon State University. (2020, August). Fire FAQs – Are Structures Fuel? The Wildland Urban Interface and the "Built" Environment. https://catalog.extension.oregonstate.edu/em9291/html
[190] Oregon State University. (2020, August). Fire FAQs – Are Structures Fuel? The Wildland Urban Interface and the "Built" Environment. https://catalog.extension.oregonstate.edu/em9291/html

are often greater on the upper slopes due to drainages, canyons, and saddles that channel upslope winds. In most cases, south- and west-facing slopes burn more severely than north-facing slopes because these aspects get more sun for longer periods. Natural barriers such as rock outcroppings and waterways can help to slow the spread of a fire and decrease the severity.

- The **weather** conditions during the fire, including wind, temperature, and humidity. When fires burn during extreme weather conditions, weather almost always overrides the other local factors when fuels are present. Weather that can lead to rapid fire growth and extreme conditions occur when wind speeds are greater than 20 mph at slightly above ground level, temperatures are at 80 ºF or greater, and relative humidity is less than 20 percent. Weather conditions during a fire can change daily or even within the day.
- Decreased soil moisture and increased temperatures associated with **drought** stress vegetation and increase plant mortality, providing fuel for fires. Reduced pond, stream, and reservoir levels can also limit withdrawal sources for fighting wildfires. The extreme conditions can also increase the likelihood of shrub and tree mortality by wildfire in previously fire-adapted ecosystems.
- Areas where **homes and other structures** meet or intermingle with wildland or vegetation fuels can be a part of the WUI. Oregon Senate Bill 762 (SB 762) determines WUI zones by looking at proximity to vegetation and density of development in the area. The WUI is where wildfire impacts are most pronounced and costly. Structures, wood piles, propane tanks, and automobiles in the WUI can act as wildfire fuel, rapidly increasing the size and intensity of the fire and contributing hazard materials to the flames and smoke.

Post-wildfire geologic hazards can also present risk. These secondary hazards typically include:

- **Flood:** Flash floods are particularly common after wildfires. Even areas that are not traditionally flood-prone are at risk, due to changes to the landscape caused by fire. Flood risk remains significantly higher until vegetation is restored—up to five years after a wildfire. Flooding and flood damage after fire is often more severe, as debris and ash left from the fire can form mudflows. As rainwater moves across charred and barren ground, it can also pick up soil and sediment and carry it in a stream of floodwaters. This can cause more significant damage.[191]
- **Landslide and erosion:** Post-fire landslide hazards include fast-moving, highly destructive debris flows that can occur in the aftermath of wildfires in response to high intensity rainfall events. These debris flows are particularly hazardous because they can occur with little warning and move quickly, destroying objects in their paths. The force of the flows can strip vegetation, block drainage, damage structures, and endanger human life. Wildfires could result in the destabilization of preexisting deep-seated landslides over long time periods.[192]
- **Air quality issues:** Exposure to air pollutants in wildfire smoke can irritate the lungs, cause inflammation, alter immune function, and increase susceptibility to respiratory infections. People with asthma, chronic obstructive pulmonary disease (COPD), or heart disease, and children, pregnant women, and responders, are especially at risk.[193]
- **Water quality issues:** During a fire, interruption of electrical power and limited to no access to water treatment plants, ambient water-quality monitoring equipment, and stream diversion and monitoring locations are common. Because existing water quality cannot be adequately determined, source-water suppliers are often forced to shift to stored water or other secondary water supplies. These sources tend to be of lower quality, which can necessitate increased

[191] Federal Emergency Management Agency. (2020, November). FEMA Fact Sheet Flood after Fire: Flood Risks Increase after Fires. https://www.fema.gov/sites/default/files/documents/fema_flood-after-fire_factsheet_nov20.pdf
[192] U.S. Geological Survey. (n.d.). What should I know about wildfires and debris flows? https://www.usgs.gov/faqs/what-should-i-know-about-wildfires-and-debris-flows#:~:text=Post%2Dfire%20landslide%20hazards%20include,and%20loss%20of%20soil%20strength
[193] Centers for Disease Control and Prevention. (2022, July 11). Protect Yourself from Wildfire Smoke. https://www.cdc.gov/air/wildfire-smoke/default.htm#:~:text=Exposure%20to%20air%20pollutants%20in,during%2C%20and%20after%20a%20wildfire

pretreatment actions and processes at considerable additional cost. Runoff from burned areas contains ash, which may have significant effects on the chemistry of receiving waters, such as lakes, wetlands, reservoirs, rivers, and streams. Runoff from burned areas also produces higher nitrate, organic carbon, and sediment levels; warmer temperatures; and flashier streamflows.[194]

2.7.8.2. Location and Extent

In Washington County and throughout the state of Oregon, areas of high hazard are mapped separate from the WUI. The two areas are then overlaid to identify areas where the most population and/or property is at risk. Forest land in the County has the highest wildland fire risk, but these lands do not overlap with the County's WUI, as updated by SB 762. Under this bill, which updated statewide fire risk mapping, the County's WUI became smaller; however, future rural development and expansion in urban growth boundaries in the County may increase the amount of interface between wildlands and developed areas. Figure 26 illustrates landcover in the County that transitioned to urban uses. The dark gray on the map signifies areas that underwent landcover transition but did not change to urban. For example, forested land that became agricultural areas or bare ground.

Much of the forested portions of the rural unincorporated county have elevated levels of wildfire risk compared to densely developed urban locations. Recreation and scenic areas, wildlife habitats, and community watersheds may also be at risk. The City of Beaverton does not experience threat from wildfire due to its high-density urban landscape and will not have a wildfire hazard analysis or action items in their participant annex. An example of a rural-urban fringe not at risk in Beaverton is the Cooper Mountain expansion area. It is mapped as being in the WUI; however, it is not mapped as high risk. Wildfire risk experienced by Tualatin Hills Park & Recreation District, which includes urban forested parks located within Beaverton, is analyzed in the district's participant annex.

[194] U.S. Geological Survey. (2019, March 1). Water Quality After Wildfire. https://www.usgs.gov/mission-areas/water-resources/science/water-quality-after-wildfire

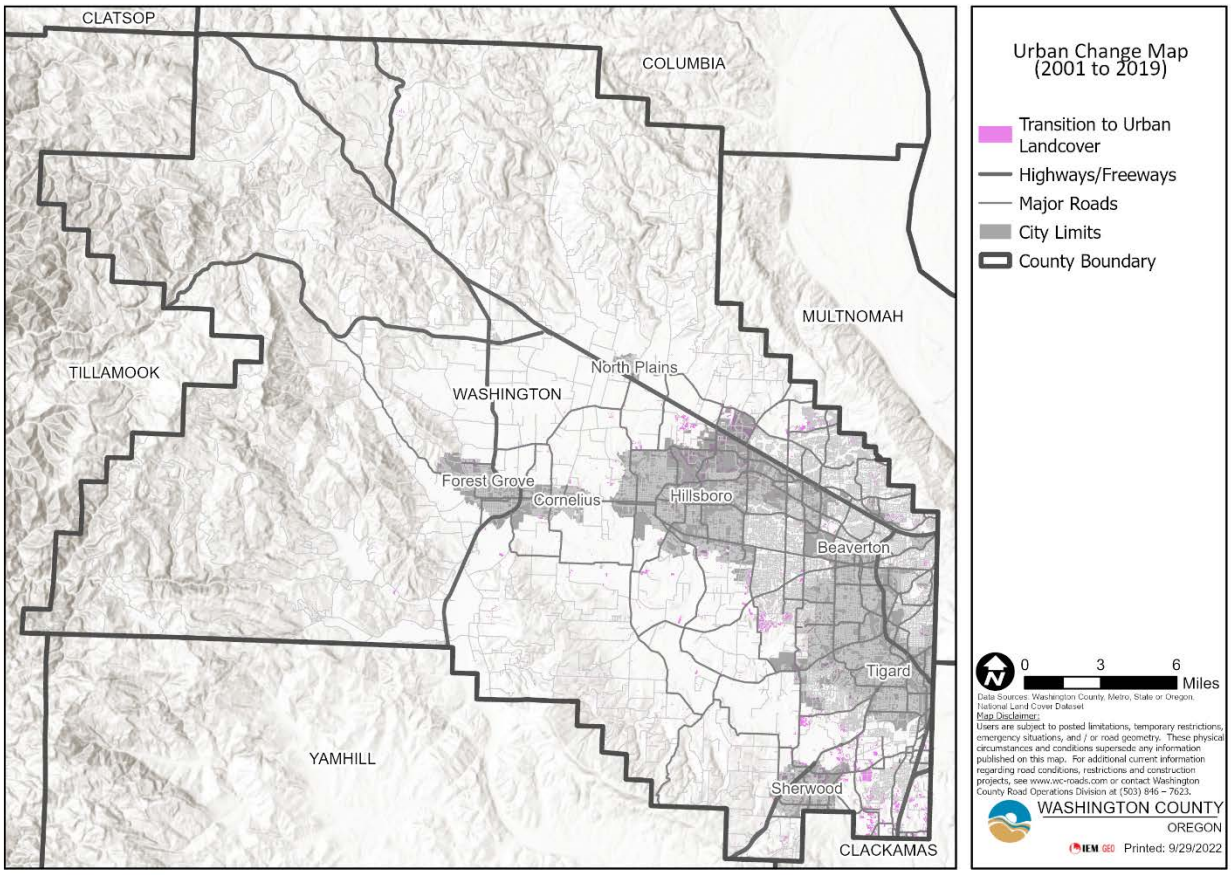


Figure 26: Land Transitioned into Urban Land Cover in Washington County, 2001–2019

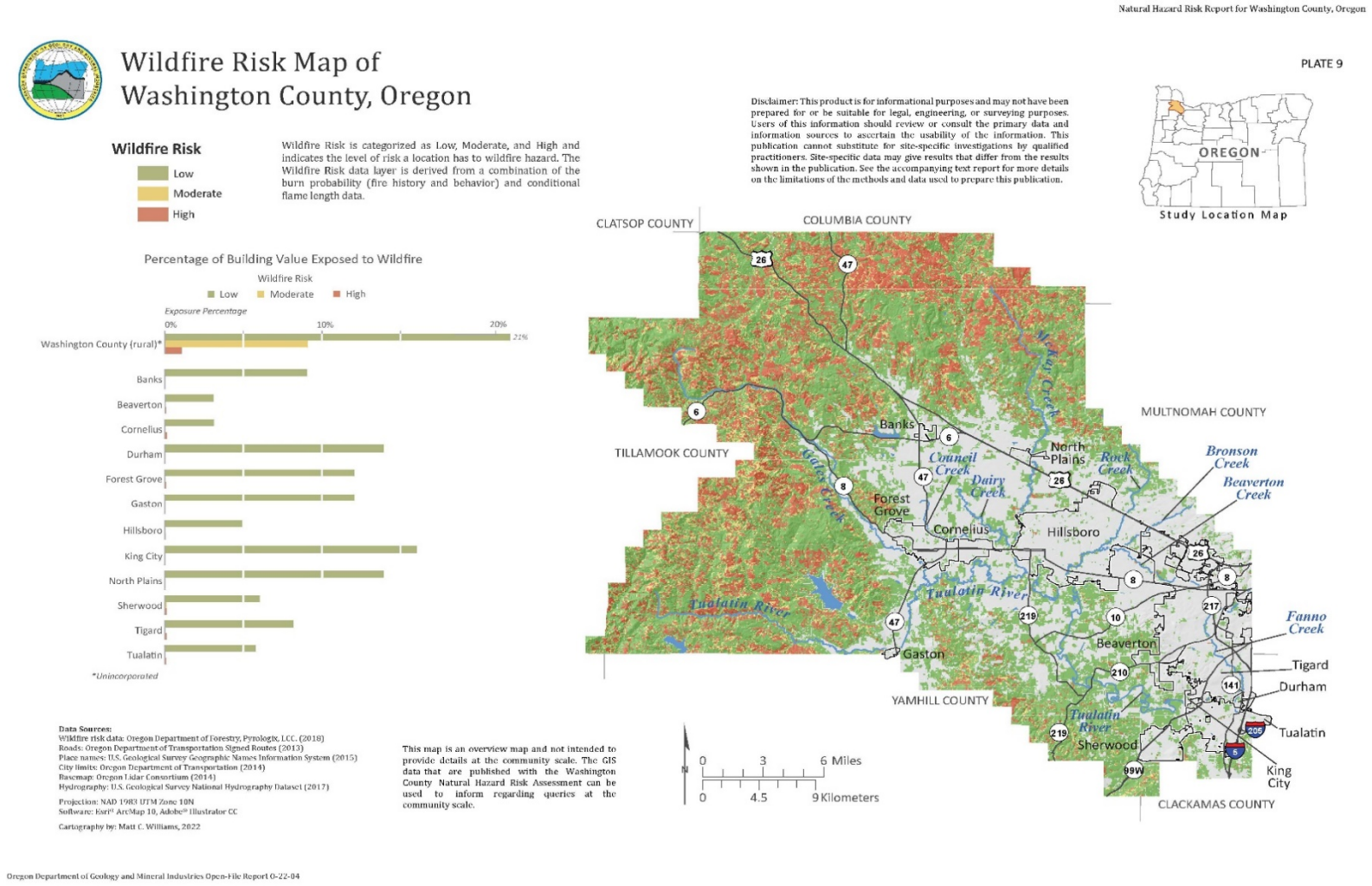


Figure 27: Wildfire Risk Map of Washington County, Oregon[195]

[195] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

2.7.8.3. History

Per ODF records, there have been 210 wildfire events in Washington County since the adoption of the 2017 NHMP.[196] Most of these fires have burned less than one acre. Of the 59 fires that were investigated to determine ignition source, 17 were the result of debris burning, 17 were caused by equipment use, 9 were recreation related, 6 were ignited by lightning, 3 were caused by smoking, and 7 were from miscellaneous sources, including a burning building and spontaneous combustion.[197]

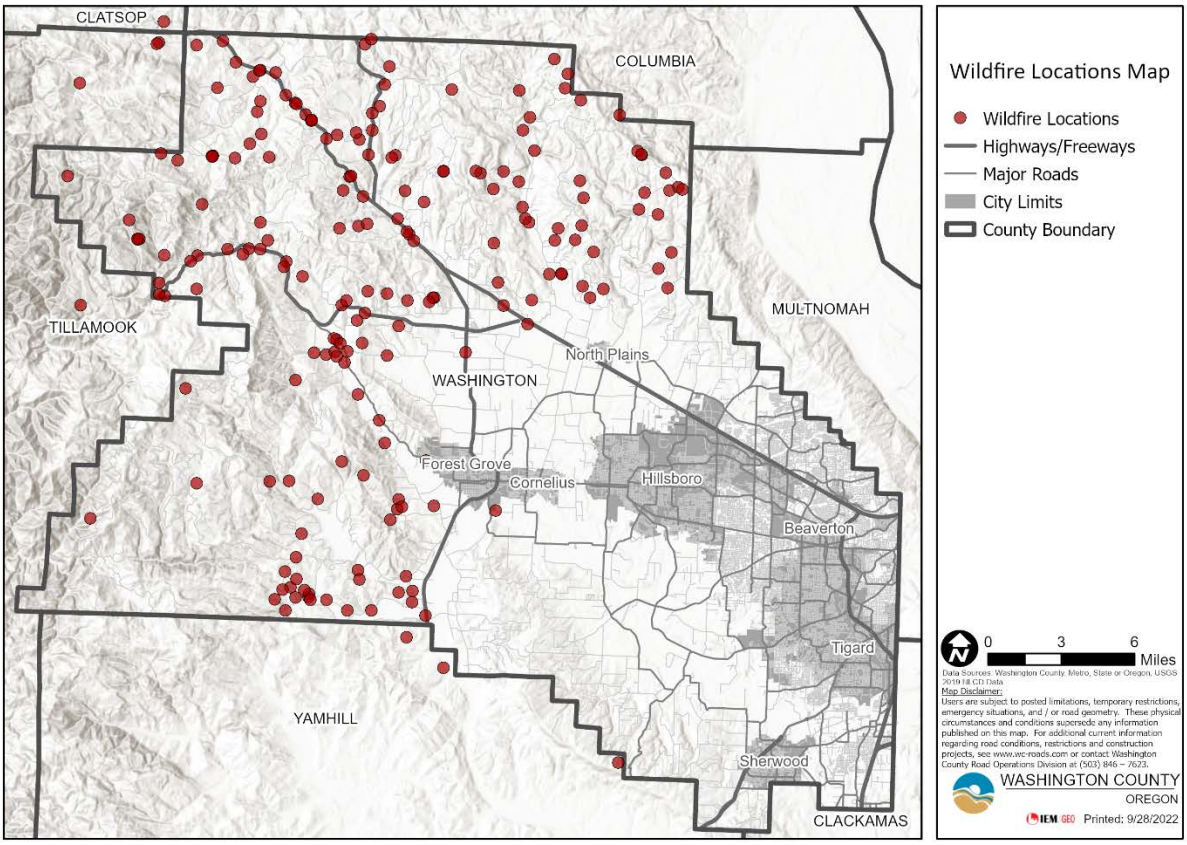


Figure 28: Locations of Wildland Fires in Washington County

Since the adoption of the 2017 NHMP update, Tualatin Valley Fire & Rescue (TVF&R) has responded to 5 fires caused by lightning and 232 wildland fires that required a task force or alarm to be dispatched in the County.[198] There is variation between the data from ODF and TVF&R due to the availability of information at the local level compared to the state level, the diversity of methods for collecting and verifying data between the organizations, and the different service areas of the agencies

There have been two significant wildfire events in Washington County since the adoption of the 2017 NHMP and two instances of smoke from nearby wildfires impacting the County. In September of 2020, two wildfires burned concurrently in the County: the Powerline–Henry Hagg Lake–Cherry Grove wildfire (Powerline wildfire) and the Chehalem Mountain–Bald Peak wildfire.

[196] Oregon Department of Forestry. (2022, July 1). Personal communication with Matt Mackey, Northwest Oregon Area Protection Policy Coordinator
[197] Oregon Department of Forestry. (2022, July 1). Personal communication with Matt Mackey, Northwest Oregon Area Protection Policy Coordinator
[198] Tualatin Valley Fire & Rescue. (2022, May 9). Personal communication with Brian Smith, Captain

The Powerline wildfire began on September 8 and was considered contained on September 13. The fire was started by sparks from powerlines and burned 126 to 175 acres.[199] Day- and night-shift wildland resources assigned to the fire included 3 hand crews, 11 engines, 1 dozer, 1 excavator, 3 water tenders, and overhead personnel. A total of 109 personnel worked on the event.[200] A Level 3 evacuation, the highest evacuation level, and an indication of current or imminent danger, was issued to approximately 150 homes, including those throughout the entire unincorporated community of Cherry Grove and on Dundee Road, SW Patton Valley Road, SW Lee Road, and SW Cascara Road.[201] It also forced the closure of Henry Hagg Lake and Scoggins Valley Park for several days and caused unhealthy air quality.

The five-alarm Chehalem Mountain-Bald Peak wildfire also began on September 8 and was declared 100% contained on September 14. The fire was started by an improperly extinguished campfire on private property in unincorporated Washington County and burned approximately 875 acres in Washington and Yamhill counties. TVF&R conducted fire protection, suppression, and patrols throughout 1,555 acres.[202] The fire spread quickly because of dry fuels, low humidity, high winds, and steep and rugged terrain. In some cases, fire jumped over areas, leaving unburned timber and dry fuels.203 A Level 3 evacuation was issued for approximately 150 people. Level 2 evacuations were issued in several areas. A Level 2 evacuation means there is significant danger to the area and residents should voluntarily relocate to either a shelter or a family or friend's home outside of the affected area. If residents choose to remain in the area, they should be ready to evacuate at a moment's notice. Three barns were destroyed in the fire and power was disrupted. No injuries or deaths were reported.

In response to the fire and evacuations, the following support services were established[204]:

- A staging site and shelter for evacuees was set up at Mountainside High School in the City of Beaverton.
- Three comfort centers were set up at a church in the City of Newberg in Yamhill County. These centers provided air-conditioning, food, water, and showers.
- Animal shelters were set up at the Washington and Yamhill County Fairgrounds. These shelters accepted pets and livestock.
- Campsites and spots for recreational vehicles were created at the Washington County Fairground.

Seven federal, state, and local disaster declarations and emergency executive orders were issued as a result of the fires.

[199] Forest Grove Fire & Rescue. (2022, May 11). Personal communication with David Nemeyer, Division Chief, Fire & Life Safety
[200] Forest Grove. (2020, September 13). Powerline Fire Final Update. https://www.forestgrove-or.gov/fire/page/powerline-fire-final-update
[201] KATU. (2020, September 8). Evacuation Orders Upgraded for Powerline Fire Near Hagg Lake. Evacuation orders upgraded for Powerline Fire near Hagg Lake | KATU
[202] Tualatin Valley Fire & Rescue. (2013, January 30). Civic Alerts. https://www.tvfr.com/CivicAlerts.aspx?AID=608
[203] KGW8. (2020, September 15). Chehalem Mountain–Bald Peak Fire in Washington County Caused by Campfire on Private Property. https://www.kgw.com/article/news/local/wildfire/chehalem-mountain-bald-peak-fire-was-caused-by-a-campfire-on-private-property/283-2a8f44aa-0041-441c-9d92-935b8faca3af
[204] Tualatin Valley Fire & Rescue. (2020, September 9). Civic Alerts. https://www.tvfr.com/CivicAlerts.aspx?AID=608

Table 39: Major Federal Disaster Declarations Related to September 2020 Wildfires[205]

Declaration Number	Declaration Date	Incident Period		Incident	Individual Assistance	Public Assistance Categories
		From	To			
DR-4562	9/15/2020	9/7/2020	11/3/2020	Wildfire and straight-line winds	No	B
Federal Fire Management Assistance Declarations (FM) Including Washington County Since November 1, 2016						
FM-5371	9/10/2020	9/8/2020	9/15/2020	Wildfire	None	B
FM-5358	9/8/2020	9/8/2020	9/14/2020	Wildfire	None	B
Federal Emergency Declarations (EM) Including Washington County Since November 1, 2016						
EM-3542	9/10/2020	9/8/2020	9/15/2020	Wildfire	None	B

Table 40: State of Oregon Emergency Executive Orders Related to September 2020 Wildfires[206]

Emergency Executive Order (EO) Number	Declaration Date	Incident Period		Executive Order Title
		From	To	
EO-20-43	9/14/2020	9/8/2020	9/14/2020	Invocation of Emergency Conflagration Act for the Powerline Fire
EO-20-41	9/9/2020	9/8/2020	11/1/2020	Invocation of Emergency Conflagration Act

Table 41: Washington County Emergency Declaration Related to September 2020 Wildfires[207]

Declaration Date	Incident Period		Incident
	From	To	
9/11/2020	9/8/2020	9/29/2020	Two concurrent wildfires: Powerline–Henry Hagg Lake–Cherry Grove wildfire (Powerline wildfire) and Chehalem Mountain–Bald Peak wildfire

2.7.8.3.1. Wildfire Smoke

The Eagle Creek fire in the Columbia River gorge, located approximately 45 miles east of Washington County, started on September 2, 2017, and was declared 100% contained on November 30, 2017. The fire was started by the illegal use of fireworks during a burn ban and burned 50,000 acres. The Air Quality Index (AQI) daily average in the County reached as high as 99 particulate matter 2.5 ($PM_{2.5}$) during the fire.[208]

[205] FEMA. (2022). Declared Disasters. https://www.fema.gov/disaster/declarations
[206] Office of the Governor. (n.d.) Executive Orders. https://www.oregon.gov/gov/Pages/executive-orders.aspx
[207] 2023 NHMP Participant Planning Documentation
[208] Air Quality Historical Data Platform. (n.d.). City of Beaverton data. https://aqicn.org/data-platform/register/

In September 2020, multiple wildfires throughout Oregon and Washington caused some evacuees to come into the County. The AQI daily average in the County reached as high as 328 $PM_{2.5}$ during the month.[209]

During these events, Washington County residents and evacuees were required to take protective actions, such as staying indoors with the doors and windows closed, using air-cleaning filters indoors, and wearing goggles and face masks when outside.

2.7.8.4. Probability of Future Events

Washington County has a low burn probability, meaning there is a less than approximately 1 in 5,000 chance of a wildfire burning more than 250 acres in a single year.[210] There are eight low-risk communities, one medium-risk community, and one high-risk community.[211] A community at risk is defined as a geographic area within and surrounding permanent dwellings with basic infrastructure and services, under a common fire protection jurisdiction, government, or tribal trust or allotment, for which there is a significant threat due to wildfire. Overall, the County has a very low wildfire exposure rating.[212]

Wildfire season normally begins in late June, peaks in August, and ends in October. However, a combination of above-normal temperatures and drought can increase the length of the traditional fire season, and wildfires can occur during any month of the year. Wildfire hazards throughout the County are highest during prolonged periods of drought, especially after periods of below-normal rainfall, which can result in a combination of high fuel loads and unusually dry conditions. Fire susceptibility throughout the County dramatically increases in late summer and early autumn as summer thunderstorms with lightning strikes increase and vegetation dries out, decreasing plant moisture content and increasing the ratio of dead fuel to living fuel.

The severity of a fire season can usually be determined in the spring by how much precipitation is received, which in turn determines how much fine fuel growth there is. These factors, combined with the annual easterly wind events typically in September and October, drastically increase the chance that a fire start will grow rapidly and resist suppression activities. Furthermore, grain harvest is also occurring at this time. Occasionally, harvesting equipment causes an ignition that can spread into populated areas and timberlands.[213]

Factors influencing the occurrence and severity of wildfires include poor forest health; invasive plant and tree species; great amounts of vegetation from long-term fire exclusion; changes in weather patterns, including warmer and drier summers; and the presence of humans and human development. Human activities such as debris burning, equipment use and malfunction, along with improper use and disposal of cigarettes and fireworks also increase fire risk in the WUI and in heavily vegetated rural areas with greater fire hazards. Not all property owners in high hazard areas or in the WUI are aware of the threats they face due to wildfire and some owners have done very little to manage fire hazards or offset risks on their own property.

2.7.8.4.1. Climate Change

Declining mountain snowpack, earlier spring snowmelt, and increasing frequency and intensity of drought and extreme heat due to climate change has resulted in a lengthening of the fire season over the last several decades. Dry spells during the winter months, especially when combined with winds and dead

[209] Air Quality Historical Data Platform. (n.d.). City of Beaverton data. https://aqicn.org/data-platform/register/
[210] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[211] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[212] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[213] Washington County, Oregon Community Wildfire Protection Plan. (2007, August 6). https://www.co.washington.or.us/EmergencyManagement/upload/WashCo_CWPP_Final.pdf

fuels, may result in fires that burn with a high intensity and rate. Historically, some of the state's largest wildfires have occurred in the climate region that contains the planning area. Though the average rainfall is high within this climate region, past heavy fuel loads created a low-frequency, high-intensity fire environment during the dry periods.[214]

2.7.8.5. Vulnerability Assessment

2.7.8.5.1. Populations

Stress caused by disruptions due to evacuations, staying in shelters, and the uncertainty of wildfire behavior, in addition to experiencing damaged or destroyed property and belongings, can severely negatively impact the mental and physical health of Washington County residents. Additionally, health impacts can occur due to the presence of smoke, even if the wildfire is not directly impacting the County, as seen in 2017 and 2020.

Wildfire smoke is a mixture of gases and fine particles from burning trees and other plant material. The gases and fine particles can be dangerous if inhaled. The particulate matter in wildfire smoke poses the biggest risk to the public's health. The potential health effects vary based on the type of plants burning, atmospheric conditions, and most importantly, the size of the particles. Particles larger than 10 micrometers (PM_{10}) usually irritate only the eyes, nose, and throat. Fine particles 2.5 micrometers or smaller ($PM_{2.5}$) can be inhaled into the deepest part of the lungs and may cause greater health concerns. Smoke can irritate the eyes and the respiratory system and worsen chronic heart and lung diseases. The amount and duration of smoke exposure, as well as a person's age and degree of susceptibility, play a role in determining if someone will experience smoke-related health problems. People with chronic heart disease or lung disease, such as asthma and COPD may be more likely to have serious health effects.[215]

2.7.8.5.2. Health Effects of Wildfire Smoke[216]

Smoke may worsen symptoms for people who have preexisting health conditions and those who are particularly sensitive to air pollution. Sensitive groups include:

- Persons with asthma or other chronic respiratory disease.
- Persons with cardiovascular disease.
- Persons older than 65 years of age.
- Infants and children.
- Pregnant women.
- Smokers, especially those who have smoked for several years.

Wildfire smoke can cause the following effects:

- Watery or dry eyes.
- Persistent cough, phlegm, wheeze, scratchy throat, or irritated sinuses.
- Headaches.
- Shortness of breath, asthma attack, or lung irritation.

[214] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[215] Oregon Health Authority. (2017, October). Frequently Asked Questions About Wildfire Smoke and Public Health. https://sharedsystems.dhsoha.state.or.us/DHSForms/Served//le8626.pdf
[216] Oregon Health Authority. (n.d.). Wildfires and Smoke. https://www.oregon.gov/oha/ph/preparedness/prepare/pages/prepareforwildfire.aspx#health

- Irregular heartbeat, chest pain or fatigue.
- Non-fatal and fatal heart attacks.

For example, first responders and other personnel working directly on fire protection, suppression, and patrols or near a wildfire can experience burns; smoke exposure; heat-related impacts like heat stroke, heat exhaustion, and dehydration; physical fatigue; mental health challenges; injuries; and death.

Additionally, drinking water sources and water treatment infrastructure, food supplies and availability, and access to medical resources or care may be impacted by wildfire and can cause health impacts on a large scale.

2.7.8.5.3. Economy

Wildfires can have both positive and negative effects on local economies. Positive effects come from economic activity generated in the community during fire suppression and post-fire rebuilding. These may include forestry support work, such as building fire lines and performing other defenses, or providing firefighting teams with food, ice, and amenities, such as temporary shelters and washing machines. However, local economies only experience positive effects if fire suppression spending and contracting are done locally. In addition, future benefits are only possible if the fire stimulates, rather than stops, economic development efforts associated with recovery and forest restoration.[217]

Local governments have the obligation to ensure public safety and fire protection. The short-term budget impact of wildfire to governments includes costs for fire suppression, staff, equipment, supplies, and transportation and mobilization of those fighting the fire.[218] Governments may also be responsible for the costs of evacuations and sheltering operations. Long-term budget impacts include post-fire recovery and rebuilding costs associated with government-owned buildings, property, and infrastructure, and loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity. Although some event-related costs may be recouped via state and federal assistance, it is not guaranteed.

In addition to physical impacts to facilities, businesses can experience shipping delays, low stock, interruptions in employee productivity or staffing shortages, and loss of revenue.[219] Wildfires can affect personal and household economics through loss of income, increased medical costs, and property damage that may not be covered by insurance. If a fire threatens an agriculture area, it may require emergency watering, feeding, evacuation, and shelter of livestock.

Post-fire management of the natural environment is a complex issue. Management requires extensive funding for watershed restoration and hazard mitigation efforts. Portions of these funds are used to restore habitat and control the potential impact of erosion and floods in the following seasons. While not easily measured, loss of ecosystem services can be included in the total economic loss.[220]

2.7.8.5.4. Structures, Improved Property, Critical Facilities, and Infrastructure

The 2022 multi-hazard report for Washington County created by the Oregon DOGAMI includes a wildfire risk analysis. This analysis was based on historical data collected prior to adoption and implementation of Senate Bill 762 in 2021, and as such the resulting risk categories are not consistent with current state wildfire program policy and implementation. Additionally, the data used for the report is not the same data as ODF and other state agencies that implement wildfire policy are currently using.

[217] Diaz, J.M. (n.d.). SFE Fact Sheet 2012-7: Economic Impacts of Wildfire. Southern Fire Exchange. https://fireadaptednetwork.org/wp-content/uploads/2014/03/economic_costs_of_wildfires.pdf
[218] Diaz, J.M. (n.d.). SFE Fact Sheet 2012-7: Economic Impacts of Wildfire. Southern Fire Exchange. https://fireadaptednetwork.org/wp-content/uploads/2014/03/economic_costs_of_wildfires.pdf
[219] Diaz, J.M. (n.d.). SFE Fact Sheet 2012-7: Economic Impacts of Wildfire. Southern Fire Exchange. https://fireadaptednetwork.org/wp-content/uploads/2014/03/economic_costs_of_wildfires.pdf
[220] Diaz, J.M. (n.d.). SFE Fact Sheet 2012-7: Economic Impacts of Wildfire. Southern Fire Exchange. https://fireadaptednetwork.org/wp-content/uploads/2014/03/economic_costs_of_wildfires.pdf

The Oregon DOGAMI uses 2021 Oregon State University – Extension Service Fire Program and Wildland Fire Associates' Integrated Hazard database to categorize the extent of wildfire exposure. The dataset combined conditional flame length and burn probability data from the 2018 Pacific Northwest Quantitative Wildfire Risk Assessment. Conditional flame length is a measurement of fire intensity or the predicted level of severity of a simulated wildfire. Burn probability is derived from simulations using many elements, such as, weather, ignition frequency, ignition density, and fire modeling landscape. Under this analysis, the following three hazard categories were used based on mean annual burn probabilities[221]:

- **Low wildfire hazard:** 1 in 10,000 to 1 in 5,000 mean annual burn probability (0.0001–0.0002)
- **Moderate wildfire hazard:** 1 in 5,000 to 1 in 500 mean annual burn probability (0.0002–0.002)
- **High wildfire hazard:** 1 in 500 to 1 in 25 mean annual burn probability (0.002–0.04)

The DOGAMI wildfire analysis identified Washington County's countywide wildfire exposure as high or moderate risk, with the following projections:

- Number of buildings exposed to wildfire risk: 2,297
- Value of exposed buildings: $589,719,000
- Percentage of total county value exposed: 0.8%
- Critical facilities exposed to wildfire risk: 0
- Potentially displaced population due to wildfire: 3,309

The high and moderate hazard categories were the primary risk scenarios for the DOGAMI wildfire risk report. Moderate wildfire risk was included because under certain conditions moderate risk zones can be very susceptible to burn. By looking at these two risk categories together within Washington County, analysts can emphasize areas where lives and property are most at risk.

Per the DOGAMI analysis, there are no critical facilities exposed to direct wildfire risk; however, damage, destruction, and operational impacts may still occur to critical facilities and infrastructure due to secondary wildfire impacts. After a wildfire is extinguished, hazards and risks arise from potential flooding, erosion, debris flows, and infrastructure damage. Water supplies and infrastructure, if not damaged during the active fire period, can be at risk during subsequent post-fire flood events.

For this DOGAMI risk assessment, the building locations were compared to the geographic extent of the wildfire hazard categories. A total of 2,111 buildings in rural unincorporated Washington County are exposed to high or moderate wildfire hazard, but the incorporated communities have little exposure to high or moderate wildfire risk. The primary areas of exposure to this hazard are in the forested unincorporated areas in the northern and western portions of the County. The incorporated cities of Forest Grove, North Plains, and Sherwood have the highest percentage of exposure to moderate wildfire hazard within the County.[222]

Wildfires frequently damage community infrastructure, including water delivery systems. In Washington County, both public and private water systems, including wells, are especially vulnerable to the impacts of wildfire. Because of the heat of the fire, some plastic components in the water systems can melt and decompose before cooling, and contaminated water can compromise the broader water system.[223] Direct impacts to public water systems and private water systems may occur through contamination of ash and

[221] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[222] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[223] National Academies of Sciences, Engineering, and Medicine. (2020). Implications of the California Wildfires for Health, Communities, and Preparedness: Proceedings of a Workshop. Washington, DC: The National Academies Press. https://doi.org/10.17226/25622

debris during the fire; destruction of water delivery lines; equipment malfunction or failure; and soil erosion or debris deposits into waterways after the fire.

People moving from urban areas to more rural ones may be unaware of where structural fire protection services are provided or what level of service to expect. New residents do not always realize when they are living outside of a structural fire protection district. Even when located within a rural fire district service area, equipment and personnel can be substantially limited. Protection of lives and property from fire may rely more on the landowner's personal initiative to take fire prevention and suppression measures than initiatives undertaken by the rural fire district. Therefore, public education and awareness plays a greater role in rural areas.

2.7.8.5.5. Natural Environments

If not promptly controlled, wildland fires may grow exponentially and cause serious damage to the natural environment and ecosystems. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thereby enhancing flood potential, harming aquatic life, and degrading water quality. Lands stripped of vegetation are also subject to increased debris flow hazards.

2.7.8.6. Alignment and Integration with Existing Plans and Regulations

Washington County Community Wildfire Protection Plan

The County's Community Wildfire Protection Plan (CWPP) was completed in 2007, consistent with the 1997 Forestland-Urban Interface Fire Protection Act (SB 360). The CWPP builds on and supplements the wildfire information presented in this NHMP. The goals of the CWPP planning process include integration with the federal-level initiatives of the National Fire Plan, the Healthy Forests Restoration Act of 2003, the DMA 2000, and FEMA Region 10 guidelines for local hazard mitigation plans.

The 2007 CWPP considered the following local planning documents:

- Washington County Comprehensive Plan: Framework Plan for the Urban Area, Rural/Natural Resource Plan, and Community Development Code
- Oregon Fire Code: Metro Code Committee
- Oregon Ballot Measure 37: Washington County Ordinance No. 636

The following Oregon Statewide Planning Goals and Guidelines are integrated into the current CWPP:

- Goal 4: Forest Lands (OAR 660-015-0000(4))
- Goal 5: Natural Resources, Scenic and Historic Areas, and Open Spaces (OAR 660-015-0000(5))
- Goal 6: Air, Water, and Land Resources Quality (OAR 660-015-0000(6))
- Goal 7: Areas Subject to Natural Disasters and Hazards (OAR 660-015-0000(7))

State of Oregon Wildfire Legislation

Comprehensive wildfire legislation Senate Bill 762 was passed in 2021. To improve wildfire preparedness, the bill focuses on three key strategies: creating fire-adapted communities, developing safe and effective response, and increasing the resiliency of Oregon's landscapes. This omnibus bill provides more than $220 million to addresses a broad set of wildfire-related topics including utility

infrastructure, clean-air shelters, availability of property insurance, as well as mapping wildfire risk statewide.

Unincorporated Washington County Development Review

Land use siting standards guide the location of new dwellings in the County's forested areas designated Exclusive Forest and Conservation (EFC). Some of the wildland fire mitigation standards in County building code and land use regulations include:

- Use of fire-rated construction materials
- Egress requirements
- Limitations to building wall openings and roof coverage
- Structural fire protection
- Identification of water supply for fire suppression
- Provision of adequate road access in urban and rural areas
- Use of fire breaks to buffer habitable structures from vegetative fuels and guide development away from steep slopes that increase rate of wildfire spread
- Using fire retardant roofs and spark arresters on chimneys

2.7.8.7. Hazard Risk Score Summary

Based on the hazard analysis methodology described in Section 2.2, plan participants assigned the scores below to their overall risk of wildland fire. Additional information is in the participant annexes.

Table 42: Participant Overall Risk of Wildland Fire

Participant	Overall Risk of Wildland Fire
City of Beaverton	–
City of Cornelius	240
City of Forest Grove	240
City of Hillsboro	177
City of North Plains	201
City of Sherwood	142
City of Tigard	168
Clean Water Services	127
Tualatin Hills Park & Recreation District	143
Tualatin Valley Water District	161
Washington County	191

2.7.9. Windstorm, Including Tornado

Significant Changes

- Additional information on hazard history, vulnerabilities, and how climate change may impact the frequency of windstorm, including tornado added.
- Enhanced Fujita scale added to illustrate extent of tornadoes.

2.7.9.1. Characteristics

A windstorm is generally a short duration event involving straight-line winds or gusts in excess of 50 mph. The most persistent high winds take place along the Oregon Coast and in the Columbia River gorge. The most impactful winds experienced in Washington County are the result of low-pressure weather systems that form over the Pacific Ocean and make landfall on the Oregon Coast. Most of the winds that come from the west are subdued by the time they reach the planning area because of the influence of the Coast Range. The most destructive winds are those that blow from the south, parallel to the major mountain ranges.

A tornado is a violently rotating column of air touching the ground, usually attached to the base of a thunderstorm. Though tornadoes are not common in Washington County, they do occasionally occur and sometimes produce significant property damage and even injury. Most of the tornadoes that occur in the County are caused by intense local thunderstorms common between April and October.

Windstorms can intensify the magnitude, extent, and impacts of extreme heat, landslides, volcanic ash spread, wildland fire, and winter storm events. Each of these natural hazards is individually discussed in detail in their respective hazard profiles.

2.7.9.2. Location and Extent

The entire county is susceptible to damaging windstorm events. In general, higher elevations experience stronger winds than areas in low-lying valley floors. Therefore, the following areas tend to experience the strongest winds: western portions of the County in the Coast Range, northern and eastern areas within the Tualatin Mountains, southern areas in the Chehalem Mountains, and Bull Mountain the southeastern portion of the County.

Several low-pressure centers make landfall in the Pacific Northwest each winter. The low-pressure centers bring sustained winds (40–60 mph) strong enough to topple power lines and trees. These prolonged windstorms are likely to last an average of three to six hours before moving on, and the damaging effects of windstorms may extend for distances of 100 to 300 miles from the center of storm activity.[224]

The Enhanced Fujita Scale (EF Scale) is used to rate how strong a tornado was, using a scale of EF0 to EF5. It is calculated by surveying the damage and comparing it with damage to similar objects at certain wind speeds. The EF Scale is not meant to be used as a measure of how strong a tornado currently on the ground is. It uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage based on 28 indicators.[225] These estimates vary with height and exposure.

[224] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[225] National Weather Service. (n.d.). The Enhanced Fujita Scale (EF Scale). https://www.weather.gov/oun/efscale

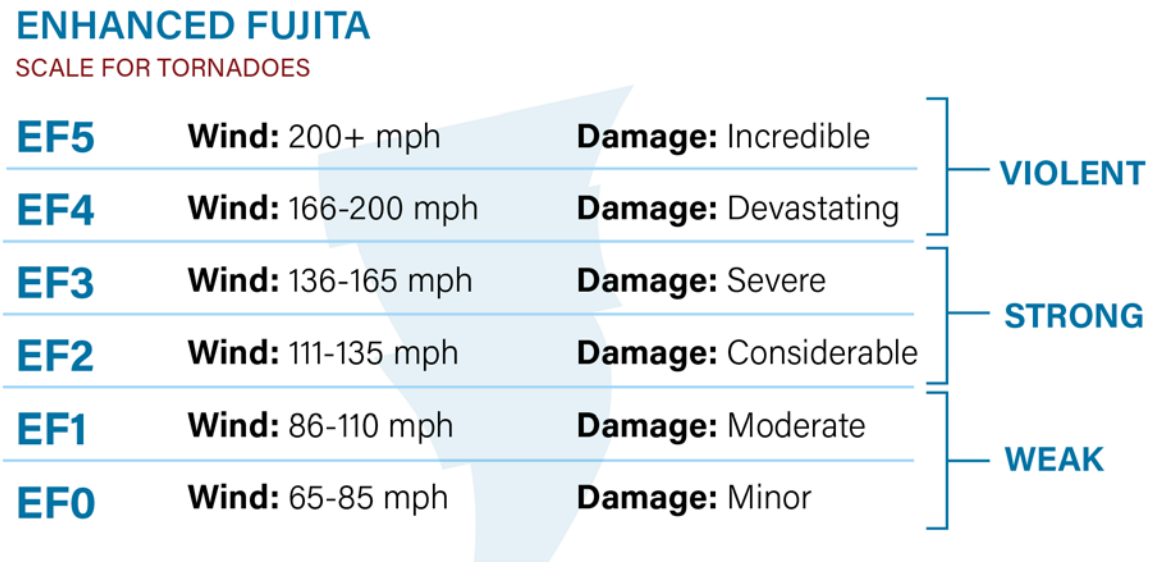


Figure 29: Enhanced Fujita Scale for Tornadoes

2.7.9.3. History

There have been 11 windstorm events of varying degrees and 1 tornado event in the planning area since the adoption of the 2017 NHMP.

Table 43: Historic Windstorm Events in Washington County[226]

Date	Event
December 8, 2016	A strong frontal system brought strong east winds to the north Willamette Valley, with wind gusts up to 47 mph. A mix of snow, sleet, and freezing rain were also part of the event. Approximately $13,000 in damages were reported.
February 1, 2017	A high-pressure system sliding down into the Columbia Basin and a low-pressure system offshore generated strong easterly winds through the Columbia River gorge and into the northern Willamette Valley, with wind gusts around 30–40 mph. There were $5,000 in damages reported.
April 7, 2017	Many weather stations across the planning area recorded wind gusts up to 60 to 75 mph. The Hillsboro Airport Automated Surface Observing System stations recorded wind gusts up to 61 mph. Several trees came down across the area. One fatality occurred due to a fallen tree branch, and another fatality was due to rough conditions on the Columbia River. Damages totaling $70,000 were reported.
April 7, 2018	A strong low-pressure system tracking northeast towards Vancouver Island generated strong winds along the coast and in the Willamette Valley. Approximately $3,000 in damages were reported.

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Date	Event
October 29, 2018	Multiple greenhouse structures were damaged at a farm on Thatcher Road in the city of Forest Grove. Witness accounts also confirmed a tornado. The tornado was likely on the ground for about 30 seconds to 1 minute. A cold front that moved through on October 27 brought a much cooler air mass in aloft, which destabilized the atmosphere enough for thunderstorm development across the area on October 28 and 29. There were $100,000 in damages reported.
December 14, 2018	A strong low-pressure system tracked northeast into British Columbia. The associated cold front brought with it strong southerly winds on the north and central Oregon coast. This system also brought windy conditions to the Willamette Valley, bringing down tree limbs and a few trees, which caused scattered power outages and $10,000 in damages.
December 18, 2018	Several power outages were reported by PG&E. Peak wind gusts of 35 to 43 mph were recorded across the north Willamette Valley. A strong low-pressure system over the Gulf of Alaska brought a strong cold front and generated strong winds across northwest Oregon.
January 5, 2019	A strong low-pressure system moving up the coast from the south brought strong southerly winds across all of northwest Oregon. Wind gusts of up to 54 mph were recorded in the Willamette Valley. At one point there were over 100,000 people without power. PGE reported that 150 power lines were brought down by strong wind. Damages totaling $750,000 were reported.
September 7, 2020	After a period of upper-level ridging brought a return to above-normal temperatures in early September, strong easterly downslope and offshore winds off the Cascades and Pacific Coast Ranges occurred. Winds increased rapidly during the afternoon and evening of September 7, with the passage of an unseasonably strong backdoor cold front and persisted through much of the following day. Widespread wind gusts from 50 to 70 mph were common on ridge tops and in numerous other exposed areas, including portions of the Willamette Valley. Strong winds caused widespread damage to trees and downed numerous power lines across the region, which started at least 13 wildfires. Seven federal, state, and local disaster declarations and emergency executive orders were issued as a result of the fires; evacuations were ordered; and approximately 1,730 acres were burned in the County.
January 13, 2021	A front brought a burst of 35–50 mph winds to the Willamette Valley and southwest Washington interior, resulting in over 100,000 customers without power across southwest Washington and northwest Oregon. Approximately $2,000 in damages were reported.
April 30, 2022	Significant infrastructure, tree, and personal property damage was sustained throughout the city of Tigard. A short-lived gustnado (a brief, shallow surface-based vortex that forms within the downburst emanating from a thunderstorm) at the lowest level elevation in the city tore off roofs of dugouts at a youth baseball field during the game.

2.7.9.4. Probability of Future Events

Windstorms in the County usually occur in the winter from October to March, and their extent is determined by their track, intensity (the air pressure gradient they generate), and local terrain. Summer thunderstorms may also bring high winds along with heavy rain and hail. The NWS uses weather forecast models to predict oncoming windstorms while monitoring storms with weather stations in protected valley locations throughout Oregon.

The 2020 Oregon NHMP shows the probability of severe wind events in Washington County, one-minute average, 30 feet above the ground. The table below shows the wind speed probability intervals that structures 30 feet above the ground would expect to be exposed to within a 25-, 50-, and 100-year period.

Table 44: Probability of Severe Wind Events in Washington County

Probability of Severe Wind Events in Washington County (One-Minute Average, 30 Feet above the Ground)	25-Year Event (4% annual probability)	50-Year Event (2% annual probability)	100-Year Event (1% annual probability)
	65 mph	72 mph	80 mph

Climate and weather conditions in Washington County make the occurrence of major tornadoes unlikely; however, minor tornadoes rated EF0–EF1 may occasionally occur.

2.7.9.4.1. Climate Change

There is insufficient research on changes in the likelihood of windstorms in the Pacific Northwest as a result of climate change. While climate change has the potential to alter surface winds through changes in the large-scale free atmospheric circulation and storm systems, there is as yet no consensus on whether or not extratropical storms and associated extreme winds will intensify or become more frequent along the Pacific Northwest coast under a warmer climate.[227]

2.7.9.5. Vulnerability Assessment

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the planning area have the potential to be exposed to and impacted by windstorm and tornado events; however, higher elevations are likely to experience more exposure and impacts compared to lower elevations. Additional information about populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County is provided in Volume III, Appendix A and participant annexes in Volume II.

2.7.9.5.1. Populations

Downed trees, power lines, and damaged property caused by windstorm events can be major hindrances to emergency response and disaster recovery, which can impact populations throughout the planning area. Debris carried by high winds or tornadoes can directly contribute to injuries or loss of life. Power outages and transportation disruptions can also negatively impact populations. Widespread and powerful windstorms can result in the need for public shelters and care for adversely impacted individuals.

2.7.9.5.2. Economy

The planning area is susceptible to indirect impacts and costs stemming from business closures and lost work time resulting from windstorm and tornado events. Industry and commerce can suffer losses from power interruptions and extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from windstorms and tornadoes related to both physical damages and interrupted services. Additionally, high winds can impact renewable energy facilities and agricultural operations.

Windstorms and tornadoes have the potential to create tons of storm-related debris that planning participants may be responsible for clearing and disposing of in accordance with federal, state, and local

[227] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

laws and regulations. This process can be very costly and time-consuming and may impact the economic well-being of planning participants.

2.7.9.5.3. Structures, Improved Property, Critical Facilities, and Infrastructure

Most vulnerabilities to windstorms and tornadoes occur in the built environment. Many buildings, utilities, and transportation systems in the planning areas are vulnerable to wind damage.

Old or poorly constructed structures and insufficiently anchored manufactured homes are vulnerable to strong winds and can be heavily damaged. Well-built and newly constructed structures are more resilient to strong wind events, although the entire built environment is vulnerable to high winds and may experience varying degrees of damage.

Wind pressure can create a direct frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multistory structures. The forces applied by the wind to the building's protective envelope (doors, windows, and walls) can cause the failure of some of the building's components, resulting in considerable structural damage.

Major infrastructure and above-ground utility lines can also be damaged by wind events, especially trees downed during these events. Fallen trees can block roads and rails for long periods. Uprooted or shattered trees can down power and other utility lines, disrupting essential services and hindering the operation of essential facilities and infrastructure. Trees in forested areas, along tree-lined roads and electrical transmission lines, and on residential parcels where trees have been planted for aesthetic purposes may be especially prone to damage. During wet winters, saturated soils cause trees to become less stable and more vulnerable to uprooting from high winds.

2.7.9.5.4. Natural Environments

Windstorms and tornadoes can damage natural environments, mostly through the uprooting of trees, which can affect habitats and disturb ecosystems. Natural grasslands, farmlands, and forested areas are at highest risk.

2.7.9.6. Hazard Risk Score Summary

Based on the hazard analysis methodology described in Section 2.2, plan participants assigned the scores below to their overall risk of windstorm, including tornado. Additional information is in the participant annexes.

Table 45: Participant Overall Risk of Windstorm, Including Tornado[228]

Participant	Overall Risk of Windstorm, Including Tornado
City of Beaverton	208
City of Cornelius	240
City of Forest Grove	240
City of Hillsboro	205
City of North Plains	132
City of Sherwood	178

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Participant	Overall Risk of Windstorm, Including Tornado
City of Tigard	205
Clean Water Services	147
Tualatin Hills Park & Recreation District	208
Tualatin Valley Water District	169
Washington County	132

2.7.10. Winter Storm

Significant Changes
- Additional information on hazard history, vulnerabilities, and how climate change may impact the frequency of winter storms added.

2.7.10.1. Characteristics

Winter storm events occur annually in Washington County, sometimes becoming severe. Severe winter weather in the County is characterized by extreme cold, snow, ice, and sleet.

A severe winter storm is generally a prolonged event involving snow or ice. The characteristics of severe winter storms are determined by a number of meteorological factors, including the amount and extent of snow or ice, air temperature, wind speed, and event duration.

Winter storms occurring in the County can result in other natural hazards, including floods, landslides/debris flows, and windstorms. Each of these natural hazards is individually discussed in detail in their respective hazard profiles.

The principal types of winter storms that can occur in the County include the following:

- **Snowstorms** require three ingredients: cold air, moisture, and air disturbance. The result is snow—small ice particles that fall from the sky. In Oregon, the further inland and north one moves, the more snowfall can be expected.
- Meteorologists define **heavy snow** as 6 inches or more falling in less than 12 hours, or snowfall of 8 inches or more in 24 hours.
- A **blizzard** is a severe winter weather condition characterized by low temperatures and strong winds blowing a great deal of snow. The NWS defines a blizzard as having wind speeds of 35 mph or more, with a visibility of less than a quarter mile. Sometimes a condition known as a **whiteout** can occur during a blizzard. This is when the visibility drops to zero because of the amount of blowing snow.
- **Ice storms** occur when a layer of warm air is sandwiched by two layers of cold air. Frozen precipitation melts when it hits the warm layer and refreezes when hitting the cold layer below the inversion. These storms can include sleet (when the rain refreezes as ice pellets before hitting the ground) or freezing rain (when the rain freezes once hitting the ground). Rain freezes to surfaces, such as on trees and utilities, and roads become glazed with ice. Even small accumulations of ice can cause a significant hazard to property, pedestrians, and motorists. Sleet can accumulate like snow and cause roads and walkways to become hazardous.
- The planning area can also experience **silver thaws**, which result from the formation of ice on cold surfaces during a period of rapid thaw after a severe frost. This clear ice can coat all solid surfaces and impact transportation, utilities, and communication infrastructure.[229]
- **Extreme cold** includes dangerously low temperatures accompany many winter storms. The wind chill factor is a measure of how cold the combination of temperature and wind actually feels. Wind chill of 50 °F or lower can be dangerous. Hypothermia can occur quickly, exposed skin can develop frostbite in less than a minute, and a person or animal could freeze to death after just 30 minutes of exposure.

[229] Decker, F. (2010, July 8). Oregon's Silver Thaw https://www.tandfonline.com/doi/abs/10.1080/00431672.1979.9931868?journalCode=vwws20

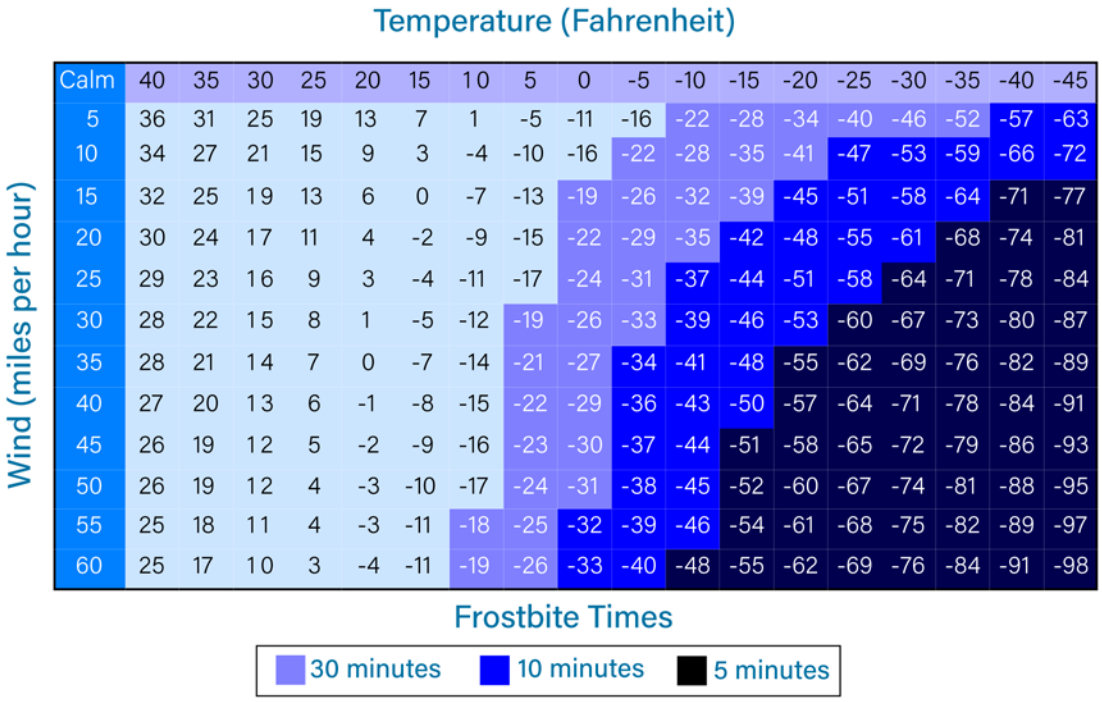


Figure 30: Wind Chill Chart

2.7.10.2. Location and Extent

The entire county is susceptible to damaging winter storms. Elevations over 500 feet will experience more risk of snow and ice; however, the entire county can face damage from winter storms and, for example, the hail or dangerously cold temperatures that winter storms bring. Additionally, although the entire planning area can experience winter storms, the vulnerability faced by participants varies due to differences in populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments.

2.7.10.3. History

Severe winter storms affecting the planning area are typically most common from October through March. Severe freezes, where high temperatures remain below freezing for five or more days, occur every three to five years in Washington County. Severe or prolonged snow events occur less frequently.

Table 46: Historic Winter Storm Events in Washington County[230, 231]

Date	Event
December 8, 2016	A strong frontal system brought strong east winds to the north Willamette Valley and a mix of snow, sleet, and freezing rain down to the valley floor. Four to six inches of snow fell along Interstate 84 before turning to sleet and freezing rain. One to 1.5 inches of ice accumulation was also reported. The Portland Metro area generally had 1–2 inches of snow, with 0.2 to 0.3 inches of ice accumulation. Ice accumulations were higher in the West Hills and near the Columbia River gorge, with 0.8 inches of ice accumulation reported at Council Crest in southeast Portland. The NWS office in Parkrose had 0.4 inches of ice accumulation.
January 7–8, 2017	A broad shortwave trough brought multiple rounds of precipitation, including a wintry mix of snow and ice for many locations across northwest Oregon. Strong easterly pressure gradients generated high winds through the Columbia River gorge as well on January 8. General snowfall totals of 2–4 inches were reported, with the greatest total being 4.5 inches. Major ice accumulations occurred after the snow, with several locations reporting 0.50–1.00 inches. The combination of snow and ice resulted in significant power outages and closures across the area. DR-4328 was declared for Columbia, Hood River, Deschutes, and Josephine counties. Columbia County is directly north of Washington County.
February 2017	The area received light freezing rain, ice pellets, and light snow. No major impacts occurred.
February 2018	Less than a half inch of light snow fell in the area. No impacts occurred.
February 2019	The lowest temperature of the year, 23 °F, was recorded on the mornings of February 6 and 7. Light snow also occurred. No impacts were documented.
January 2020	Many areas in the County received an inch of snow, and areas of the region lost power for up to five days. In the city of Tigard, road and water infrastructure had significant impacts, and trees and powerlines were damaged.
December 2021	The area experienced 1–3 inches of snowfall during a minor event. Tualatin Hills Park & Recreation District buildings experienced delayed openings, partial openings, or were completely closed due to weather and road conditions December 27–30.
February 2021	Between February 11 and February 14, freezing rain and heavy snow came down, and gusty winds up to 50 mph occurred, resulting in a five-day ice storm. Primary impacts in the County were in the West Hills and southeast areas of the Cities of Beaverton, Tigard, and Tualatin. An initial damage assessment was completed by the County and noted that multiple trees were downed at Metzger Park in unincorporated Washington County near Washington Square. In Tigard, Emergency Transportation Routes were impacted, overhead powerlines connecting residents and commercial structures were damaged, and structure damage impacts were reported. The city of Hillsboro experienced snowy and icy roads, downed tree limbs, localized power outages, and travel impacts. Tualatin Valley Water District received 30 calls for service that required response, and over 18 staff worked throughout the event. Additionally, two water mains broke.

[230] National Centers for Environmental Information Storm Events Database, Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[231] Weather Spark. (n.d.). Winter Weather History. https://weatherspark.com/

2.7.10.4. Probability of Future Events

Winter storms occur annually in Washington County. Based on historical data, severe winter storms could occur about every four years in the area. It is expected that the planning area will have continued annual storm events.[232]

2.7.10.4.1. Climate Change

Climate models project future warmer winter temperatures in the planning area. It is anticipated that this will result in an increase in the proportion of precipitation falling as rain rather than snow and a decrease in mountain snowpack; however, exact impacts are not known. These changes could have multiple, concurrent impacts in the County.

- **Drought:** Watersheds in the northwest that receive both rain and snow, and in which snowmelt contributes substantially to streamflow during spring and summer, are the most sensitive to projected winter warming.[233] The frequency of hydrological drought is projected to increase in such watersheds. Snow drought is also projected to occur more frequently under a warmer climate as the proportion of precipitation falling as snow decreases. These conditions are projected to increase winter runoff and decrease runoff during spring and summer.[234]
- **Flooding:** The frequency and intensity of heavy precipitation events in winter is projected to grow. As temperatures warm, the proportion of precipitation falling as rain rather than snow is projected to increase, especially at lower to intermediate elevations. Projected increases in wet-season precipitation are likely to increase winter flood magnitude.[235]
- **Wildfire:** Decreased soil moisture and increased temperatures stress vegetation and increase plant mortality, providing fuel for fires. Reduced ponds, streams, and reservoir levels can also limit withdrawal sources for fighting wildfires.[236]

2.7.10.5. Vulnerability Assessment

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County have the potential to be exposed to and impacted by winter storm events; however, elevations over 500 feet are likely to experience more exposure and impacts compared to lower elevations. Additional information about populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County is provided in Volume III, Appendix A and participant annexes in Volume II.

2.7.10.5.1. Populations

People can experience frostbite and hypothermia during winter storms due to the extreme cold and wind chill. These health concerns are especially elevated for populations that are unhoused or do not have access to sufficient heating, insulated clothing, or dry living conditions. Older adults and infants, and people who take certain medications, have certain medical conditions, or have been drinking alcohol, also are at increased risk for hypothermia. Additionally, carbon monoxide poisoning can occur if proper

[232] Oregon Natural Hazards Mitigation Plan. (2020, September 24). Oregon Department of Land Conservation and Development. https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx
[233] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://oregonstate.app.box.com/s/7mynjzhda9vunbzqib6mn1dcpd6q5jka
[234] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://oregonstate.app.box.com/s/7mynjzhda9vunbzqib6mn1dcpd6q5jka
[235] Dalton, M. & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://oregonstate.app.box.com/s/7mynjzhda9vunbzqib6mn1dcpd6q5jka
[236] American Planning Association. (2019). Falling Dominoes: A Planner's Guide to Drought and Cascading Impacts. A Planner's Guide to Drought and Cascading Impacts (planning-org-uploaded-media.s3.amazonaws.com

ventilation is not used or available when heating sources are utilized. The potential for power outages during winter storm events can increase the likelihood that frostbite, hypothermia, and carbon monoxide poisoning may occur.

Overall, most winter storm deaths result from vehicle or other transportation accidents caused by ice and snow. Black ice is likely to form under bridges and overpasses, in shady areas, and at intersections. This thin layer of ice is difficult to see, and tires and brakes do not work properly on it, which can lead to immediate loss of vehicular control.

Exhaustion and heart attacks brought on by overexertion are two other common causes of deaths related to winter storms. Such tasks as shoveling snow, pushing a vehicle, or even walking in heavy snow can cause a heart attack, particularly in people who are older or who are not used to high levels of physical activity. The number of injuries and deaths due to falls may also increase due to slick or icy conditions.

2.7.10.5.2. Economy

The planning area is susceptible to indirect impacts and costs stemming from business closures and lost work time resulting from winter storms. Industry and commerce can suffer losses from power interruptions and extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from winter storms related to both physical damages and interrupted services.

2.7.10.5.3. Structures, Improved Property, Critical Facilities, and Infrastructure

Direct impacts to infrastructure and property can occur during winter storm events. Snow and ice can disrupt essential infrastructure systems such as public utilities, telecommunications, and transportation routes. Historically, falling trees due to snow and ice accumulation and wind have been the major cause of power outages. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted.

Additionally, buildings and roofs can collapse or be damaged, roads and bridges can be damaged or blocked, and pipes can freeze and burst. Home fires also occur more frequently in the winter because people do not take the proper safety precautions when using alternative heat sources. Fires during winter storms present a great danger because water supplies may freeze, and it may be difficult for firefighting equipment to get to the fire.

2.7.10.5.4. Natural Environments

Crops, vegetation, parks, and other natural systems can be damaged by winter storm events. Livestock can also be negatively impacted by extreme cold, snow, and ice.

2.7.10.6. Hazard Risk Score Summary

Based on the hazard analysis methodology described in Section 2.2, plan participants assigned the scores below to their overall risk of winter storm. Additional information is in the participant annexes.

Table 47: Participant Overall Risk of Winter Storm[237]

Participant	Overall Risk of Winter Storm
City of Beaverton	203
City of Cornelius	240
City of Forest Grove	240
City of Hillsboro	205
City of North Plains	187
City of Sherwood	208
City of Tigard	205
Clean Water Services	142
Tualatin Hills Park & Recreation District	208
Tualatin Valley Water District	206
Washington County	211

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3. Mitigation Strategy

CFR 44 §201.6 Requirements

- **§201.6(c)(3):** [The hazard mitigation plan shall include a] mitigation strategy that provides the jurisdiction'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.
  - **§201.6(c)(3)(i):** [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.
  - **§201.6(c)(3)(iii):** [The hazard mitigation strategy shall include an] action plan describing how the actions identified in paragraph (c)(3)(ii)…will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost-benefit review of the proposed projects and their associated costs.

3.1. Overview

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Stafford Act directs hazard mitigation plans to describe hazard mitigation actions and establish a strategy to implement those actions. Therefore, all other requirements for a hazard mitigation plan lead to and support the mitigation strategy.

This section provides a summary of the mitigation strategy for the NHMP. Additional details about each participant's mitigation strategy are in the participant annexes. Each annex provides an analysis of current mitigation capabilities, including an assessment of NFIP participation and compliance, as applicable.

3.2. Mitigation Plan Mission

The purpose of the Washington County NHMP is to foster coordinated partnerships and the development of multi-objective strategies for mitigation. The NHMP mission is intended to provide overall direction for the hazard mitigation programs of participants.

The mission of the Washington County NHMP is to promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events.

The 2023 NHMP Steering Committee reviewed the previous plan's mission statement and agreed that it still applies as written.

3.3. Funding Priorities

As necessary, plan participants will seek outside funding sources to implement mitigation projects in both pre-disaster and post-disaster environments. When applicable, potential funding sources have been identified for each participant's proposed action items listed in participant annexes. Funding priority will go toward action items with a high positive impact on community mitigation and resilience as measured by the action's scope and cost-benefit analysis.

3.4. Mitigation Goals

Mitigation plan goals provide statements of directions to form a bridge between the broad mission statement and the mitigation strategy, including action items. These goals serve as checkpoints as plan participants begin implementing mitigation action items.

The Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 city of Beaverton NHMP, 2011 cities of Cornelius and Forest Grove NHMPs, and 2020 Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals below. These goals are the basis of this plan and summarize what the Steering Committee will accomplish by implementing this plan.

1. Develop and implement strategies to minimize loss of life, public and private property damage, and damage and disruption of essential infrastructure from the impact of natural hazards while protecting and restoring the environment.
2. Ensure effective implementation of mitigation strategies and increased success in funding opportunities. This includes:
    a. Develop and maintain partnerships and promote mitigation leadership within local and regional public agencies; the public; non-profit organizations; and businesses.
    b. Ensure consistency between city, county, regional, and state mitigation strategies.
    c. Consistently seek diverse funding and resource partnerships for future mitigation efforts.
3. Develop and implement natural hazard education and outreach programs to increase awareness, engagement, and partnership among the public; local, city, and regional agencies; nonprofit organizations; and businesses. Includes:
    a. Engage and motivate the public to invest in natural hazard risk reduction policies and projects.
    b. Motivate the “whole community” to build resilience and mitigate against the effects of natural hazards through engagement, listening, learning, information-sharing, and funding opportunities.
4. Support the adoption and application of development policies and standards that address the potential impacts of natural disasters and prevent development within mapped hazardous areas where risks to people and property cannot be practicably mitigated.
5. Enhance communication, collaboration, and coordination among agencies at all levels of government and the private sector to mitigate natural hazard risks.
6. Integrate and align hazard mitigation strategies with local comprehensive plans, climate adaptation efforts, and emergency operations plans and procedures, when possible.
7. Enhance the ability of the economies of Washington County and its jurisdiction to rebound quickly from natural hazard events, by strengthening emergency operations including increasing communication, collaboration, and coordination among public agencies, non-profit organizations, and businesses. Includes mitigating the inequitable impacts of natural hazards by prioritizing and directing resources and investments to build resilience in the most vulnerable populations and the communities least able to respond and recover.

3.5. Action Items

A mitigation action is a specific action, project, activity, or process taken to reduce or eliminate long-term risk to people and property from hazards and their impacts. Implementing mitigation actions helps achieve the plan’s mission and goals. The actions to reduce vulnerability to threats and hazards form the core of the plan and are a key outcome of the planning process.

A list of action items was identified by each plan participant and is located in their respective annexes. Previous action items are also recorded in these annexes, as applicable.

FEMA identifies four primary types of mitigation actions to reduce long-term vulnerabilities: (1) local plans and regulations, (2) structure and infrastructure projects, (3) natural systems protection, and (4) public education and awareness programs. Additional details about these types of actions are shown in Table 48. These actions are also traditionally eligible for hazard mitigation and other types of funding.

Table 48: Primary Types of Action Items

Local Plans and Regulations	
Definition	**Examples**
These actions include government authorities, policies, or codes that encourage risk reduction.	• Comprehensive plans • Land use ordinances • Subdivision regulations • Development review • Building codes and enforcement • Capital improvement programs • Open space preservation • Stormwater management regulations and master plans • Fuels management, and fire breaks
Structure and Infrastructure Projects	
Definition	**Examples**
These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. These actions also include constructing new structures to reduce the impact of hazards. This could apply to public or private structures as well as critical facilities and infrastructure.	• Acquisitions and elevations of structures in flood-prone areas • Utility undergrounding • Seismic structural retrofits • Floodwalls and retaining walls • Detention and retention structures • Culverts
Natural Systems Protection	
Definition	**Examples**
These are actions that minimize damage and losses while preserving or restoring the function of natural systems.	• Sediment and erosion control • Stream corridor restoration • Forest management • Conservation easements • Wetland restoration and preservation

Public Education and Awareness Programs	
Definition	**Examples**
These are long-term, sustained programs to inform and educate the public and stakeholders about hazards and mitigation options. This can also include training.	• Radio or television spots • Websites with maps and information • Social media • Real estate disclosure • Presentations to school groups or neighborhood organizations • Mailings to populations in hazard-prone areas • StormReady® certification through the NWS StormReady program • Participation in the National Fire Protection Association's FireWise USA® program

3.5.1. Previous Mitigation Actions

A thorough review of mitigation actions identified in previous NHMPs was conducted to determine the effectiveness of each action and the progress made to date. Each participant with previous actions was asked to review and update the status of each to determine whether: the action was completed, the project is in progress, the strategy is no longer applicable, or the action should be moved forward and included in the 2023 plan. The updated status of previous mitigation actions is provided in the individual participant annexes of Washington County and the Cities of Beaverton, Cornelius, Forest Grove, Hillsboro, and Tigard.

3.5.2. New Mitigation Actions

Each participant updated its list of mitigation actions based on the review of its risk assessment, its existing capabilities, and the status of its previous action items, as applicable. The lists of actions include participant-specific details from a comprehensive range of action item categories and are included in each participant annex. To facilitate implementation, each action item includes information on timeline, coordinating and partner organizations, ideas for implementation, and plan goals addressed. Additional information about implementation resources and funding opportunities is in Volume III, Appendix C.

3.5.2.1. Action Item Development Process

Members of the Steering Committee worked with their Technical Committees to review and analyze the results of their risk assessment and current planning, regulatory, administrative, technical, education, outreach, and NFIP capabilities to identify a comprehensive range of action items to reduce the impact of natural hazards. Committee members consulted subject matter experts, collected ideas from stakeholders and the public, researched existing guides and resources, and reviewed and considered activities eligible for FEMA Hazard Mitigation Assistance funding, as applicable.

3.5.2.2. Evaluating and Prioritizing Mitigation Actions

Through discussion and analysis, each participant used the STAPLEE evaluation method to evaluate and prioritize mitigation actions. The STAPLEE evaluation method uses seven criteria to assess a mitigation action: social, technical, administrative, political, legal, economic, and environmental. Actions that met the STAPLEE evaluation criteria to the satisfaction of the participant and had the potential to reduce vulnerability to hazards are included in the plan.

Within each of these criteria are additional considerations that may call upon the hazard risk assessment and other sources of information for evaluation. Table 49 describes each category and its considerations.

Table 49: STAPLEE Evaluation Criteria for Mitigation Actions

Social (S)	
Definition	**Considerations**
The public must support the overall mitigation implementation strategy and specific mitigation actions. Mitigation actions are evaluated in terms of community acceptance and impact on the population.	• **Community acceptance:** Will the action disrupt housing or cause the relocation of people? Is the action compatible with present and future community values? • **Impact on population:** Will the proposed action adversely affect one segment of the population?
Technical (T)	
Definition	**Considerations**
It is important to determine if the proposed action is technically feasible, will help to reduce losses in the long term, and has minimal secondary impacts. This category evaluates whether the action is a whole or partial solution, or not a solution at all.	• **Technical feasibility:** How effective is the action in avoiding or reducing future losses? • **Long-term solution:** Does the action solve the problem or only a symptom of the problem? • **Secondary impacts:** Will the action create more problems than it solves?
Administrative (A)	
Definition	**Considerations**
This category examines the anticipated staffing, funding, time, and maintenance requirements for the mitigation action to determine if the participant has the personnel and administrative capabilities to implement the action or whether outside help will be necessary.	• **Staffing:** Does the organization have the capability (staff, technical experts, and training) to implement the action? • **Funding allocated:** Does the organization have the funding to implement the action or can it readily be obtained? • **Time:** Can the action be accomplished in a timely manner? • **Maintenance/Operations:** Can the community provide the necessary maintenance? It is important to remember that most federal grants will not provide funding for maintenance.

Political (P)	
Definition	**Considerations**
This category considers the level of political support for the mitigation action.	• **Political support:** Is there political support to implement and maintain this action? Have political leaders participated in the planning process so far? • **Local champion or proponent:** Is there a respected community member willing to help see the action to completion? • **Public and stakeholder support:** Is there enough public support to ensure the success of the action? Have all stakeholders been offered an opportunity to participate in the planning process?
Legal (L)	
Definition	**Considerations**
Whether the participant has the legal authority to implement the action or whether the participant must pass new laws or regulations is important in determining how the mitigation action can be best carried out.	• **State authority:** Does the State of Oregon have authority to implement the action? • **Existing local authority:** Are proper laws, ordinances, and resolutions in place to implement the action? • **Potential legal challenge:** Is there a technical, scientific, or legal basis for the mitigation action (i.e., does the mitigation action "fit" the hazard setting)? Are there any potential legal consequences? Is the action likely to be challenged by stakeholders who may be negatively affected?
Economic (E)	
Definition	**Considerations**
Economic considerations must include evaluation of the present economic base and projected growth. Cost-effective mitigation actions that can be funded in current or upcoming budget cycles are more likely to be implemented than actions requiring general obligation bonds or other instruments that would incur long-term debt to a community.	• **Benefits of action:** What financial benefits will the action provide? • **Cost of action:** Does the cost seem reasonable for the size of the problem and the likely benefits? What burden will be placed on the tax base or local economy to implement this action? • **Contribution to economic goals:** Does the action contribute to community or organizational economic goals, such as capital improvements or economic development? • **Outside funding required:** Are there current sources of funding that can be used to implement the action? Should the action be considered "tabled" for implementation until outside sources of funding are available?

Environmental (E)	
Definition	**Considerations**
The impact on the environment is an important consideration due to public desire for sustainable and environmentally healthy communities. Statutory considerations, such as the National Environmental Policy Act (NEPA), also need to be kept in mind when using federal funds.	• **Impact on land/water bodies:** How will this action impact land/water? • **Impact on endangered species:** How will this action impact endangered species? • **Impact on hazardous materials and waste sites:** How will this action impact hazardous materials and waste sites? • **Consistency with community environmental goals:** Is this action consistent with community and organizational environmental goals? • **Consistency with federal laws:** Is the action consistent with federal laws, such as NEPA?

After considering the STAPLEE criteria, each participant assigned a prioritization category of low, medium, or high to each action item being created or retained. The categories were defined as:

- **Low:** The action has the potential to reduce vulnerability to hazards, is based on one to two STAPLEE criteria and is feasible and important for the jurisdiction. The action should be implemented as funding becomes available. The projected timeline for completion is five or more years.
- **Medium:** The action has the potential to reduce vulnerability to hazards, is based on three to four STAPLEE criteria and is feasible and important for the jurisdiction. Its implementation is not as urgent as a high-priority action item, and it can be implemented in the long term. The projected timeline for completion is three to five years.
- **High:** The action has the potential to reduce vulnerability to hazards, is based on five or more STAPLEE criteria, and is feasible and important for the jurisdiction. It is especially important for the jurisdiction to implement it in the short term and as quickly as possible. The projected timeline for completion is one to two years.

The evaluation and prioritization process helps the planning team weigh the pros and cons of different action alternatives. However, the decision-making process is not necessarily straightforward; it is highly specific to each jurisdiction. Prioritization may change over time in response to changes in community characteristics and risks and to take advantage of available resources.

It is not intended that this plan and its participants will attempt to act on all identified action items, but the list of actions will be maintained to provide documentation for future planning efforts.

4. Plan Execution, Maintenance, and Adoption

CFR 44 §201.6 Requirements

- **§201.6(c)(4)(i):** [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
- **§201.6(c)(4)(iii):** [The plan maintenance process shall include a discussion] on how the community will continue public participation in the plan maintenance process.

4.1. Overview

This mitigation plan is a living document that will guide mitigation actions over time. As conditions and circumstances change, new information may become available, and actions may progress over the life of the plan. The actions and plan contents may be adjusted as necessary to maintain the relevance and effectiveness of the plan.

Each jurisdiction or special district has identified an individual by position or title and department or division who is responsible for ensuring the participant's plan is achieving its purpose and goals during the planning cycle. The participant annexes provide the primary and alternate contacts for mitigation planning for each plan participant.

Additionally, clearly defined roles, responsibilities, procedures, and schedules for plan implementation, monitoring, evaluating, and updating outlined in this section will increase the possibility that the plan will remain current, useful, applicable, and that mitigation strategies are being utilized, implemented, and integrated into existing plans, policies, and procedures.

Plan maintenance activities take place at two levels. This section describes how the Steering Committee will carry out the plan maintenance functions related to Volume I of the plan and its supporting appendices in Volume III. Concurrently, each participant has the authority and responsibility to maintain its annex to the plan and may choose to establish an internal schedule to be consistent with the planning area's schedule.

Any necessary revisions to plan elements shall follow the plan amendment process outlined in state and FEMA guidance. Mitigation actions may be changed, updated, removed, or added by a participant at any time if the change or addition is considered, evaluated, and approved by the participant's Technical Committee and the public has had the opportunity to review and comment on the modification.

If a participant no longer wishes to actively partake in the development and maintenance of the plan, it must notify the Washington County NHMP Project Manager and OEM in writing.

4.2. Plan Implementation

Each participant in this plan is responsible for implementing specific mitigation actions as described in the mitigation strategies located in the annexes. In each mitigation strategy, every proposed action is assigned to a specific department or division in order to assign responsibility and accountability and increase the likelihood of subsequent implementation. This approach enables individual participants to update their unique mitigation strategy as needed, without altering the broader focus of the countywide plan. The separate adoption of participant-specific actions also ensures that each plan member is not held responsible for monitoring and implementing the actions of other jurisdictions or special districts involved in the planning process.

The Washington County NHMP Project Manager is the lead position for plan implementation and will work with the Steering Committee to ensure mitigation actions are implemented according to jurisdictional or special district capabilities and planning procedures. Each participant will implement the plan and their individual mitigation actions, as resources permit, through existing plans, programs, and policies and in the timeframe appropriate for their planning processes. As necessary, participants may consider seeking outside funding sources to implement mitigation projects in both the pre-disaster and post-disaster environments. When applicable, potential funding sources have been identified for proposed actions listed in the mitigation strategies.

4.3. Monitoring Plan Implementation

Following review of the plan maintenance process and meeting schedule outlined in the NHMP, the Steering Committee, which includes the Project Manager, have agreed to meet on at least a semiannual basis. Additional meetings will be called on an as-needed basis, such as following a natural hazard event or federal, state, or local disaster declaration. The committee will meet once in the fall prior to the governmental budget season and once in the spring following the winter storm season. These biannual meetings fulfill Emergency Management Performance Grant reporting requirements and exceed FEMA NHMP guidance.

Each Steering Committee member is responsible for monitoring and tracking the progress of action items identified by their jurisdiction or special district in this NHMP and submitting a status summary to the County's project manager biannually using the action item planning document. The committee, including the project manager, will also participate in and complete the functions below.

During the fall meeting, the Steering Committee will, at minimum:

- Discuss methods for continued public involvement and education; and
- Document successes and lessons learned during the year.

During the spring meeting, the Steering Committee will, at minimum:

- Update all hazard histories;
- Review new hazard data and update risk assessments as needed; and
- Review potential funding availability, including state and federal grant program Notices of Funding Opportunities.

Additionally, each committee member will work with their Technical Committee and other jurisdictional or special district representatives to:

- Review existing action items to determine appropriateness for local funding;
- Update decision makers on progress of the plan;
- Review existing action items to determine appropriateness for funding; and
- Prioritize potential mitigation projects.

Table 50: NHMP Monitoring Roles and Responsibilities

Responsible Party	Tasks
Washington County NHMP Project Manager	• Coordinate and facilitate the monitoring process. • Initiate and maintain a schedule of monitoring activities. • Collect data and disseminate reports. • Maintain records and documentation of all monitoring activities.
NHMP Steering Committee	• Participate in the monitoring process as requested by the Washington County NHMP Project Manager. • Assist in collecting and analyzing data. • Assist in disseminating reports to stakeholders and the public. • Maintain records and documentation of all jurisdictional and special district monitoring activities. • Promote the mitigation planning process with the public and solicit public input.

The format of the plan allows the County and participating jurisdictions to review and update sections and action items when new data and information becomes available. New data can be easily incorporated, resulting in an NHMP that remains current and relevant to the participating jurisdictions. To make the coordination and review of the Washington County NHMP as broad and as useful as possible, the Steering Committee will engage additional stakeholders and other relevant hazard mitigation organizations and agencies to implement the identified action items. Specific organizations have been identified as either internal or external partners on the individual action item forms participants completed as part of the NHMP planning documentation.

4.4. Evaluating Plan Effectiveness

This plan evaluation step assesses the effectiveness of the plan at achieving its stated purpose and goals. Plan evaluation may not occur as frequently as plan monitoring, but it is an important step to ensure that the plan continues to serve a purpose. This evaluation will include analysis of current mitigation projects, evaluation of success, reevaluation of future mitigation needs, and prioritization based upon changes in needs and/or capabilities. The mitigation plan shall be viewed as an evolving, dynamic document.

Table 51: NHMP Evaluation Roles and Responsibilities

Responsible Party	Tasks
Washington County NHMP Project Manager	• Coordinate and facilitate the evaluation process. • Initiate and maintain a schedule of evaluation activities. • Collect data and disseminate reports. • Maintain records and documentation of all evaluation activities.
NHMP Steering Committee	• Participate in the evaluation as requested by the Washington County NHMP Project Manager. • Assist in collecting and analyzing information. • Assist in disseminating reports to stakeholders and the public. • Maintain records and documentation of all jurisdictional and special district evaluation activities. • Promote the mitigation planning process with the public and solicit public input.

Table 52 describes the steps that the NHMP Project Manager will take annually and/or following a federally declared disaster or significant event to evaluate the effectiveness of the plan.

Table 52: NHMP Evaluation Procedure and Schedule

Action	Responsible Party	Tasks	Deliverable or Outcome
Initiate Annual Review	Washington County NHMP Project Manager	Notify lead agency/individual in each jurisdiction and special district to facilitate the annual review.	Work plan, schedule, and assigned resources to implement the plan review process.
Invite Steering Committee and Key Stakeholders	Washington County NHMP Project Manager	Invite Steering Committee members, key stakeholders, and others to participate in the plan evaluation process.	Invitation to participate, list of invited jurisdictions and special districts, existing and new stakeholders and other key planning partners, and public notice of annual evaluation.
Review Policies, Regulations, and Studies	Washington County NHMP Project Manager	Work with the Steering Committee to facilitate the research of new or updated laws, policies, regulations, initiatives, and studies that contribute to the hazard risk assessment or identified mitigation actions.	Status update for existing and new policies, regulations, initiatives, and/or studies.

Action	Responsible Party	Tasks	Deliverable or Outcome
Review Funding Programs and Planning Mechanisms	Washington County NHMP Project Manager	Coordinate with the Steering Committee to assess changes in local, state, and federal agencies and their funding procedures, new grant programs or areas of focus, and their potential integration into existing planning mechanisms.	Status update on existing and new funding procedures, grant programs, new areas of focus, and progress on integration into planning mechanisms.
Hazard Information	Washington County NHMP Project Manager	Work with the Steering Committee to facilitate the research of new or updated data and information that can contribute to risk assessments, loss estimates, or vulnerabilities in assets for plan participants.	Status update on recent hazard events, impacts, and losses, lessons learned, and status of facilities and infrastructure. Annual update of NHMP to reflect new risk assessment and capability data gathered from review of hazard events and impacts.
Mitigation Actions	Washington County NHMP Project Manager	Coordinate with the Steering Committee to assess progress in previously implemented actions that reduce vulnerability and losses and any new opportunities for mitigation actions.	Status update on completed actions, pending actions, and the implementation status of actions collected through monitoring procedures.
Outcomes	Washington County NHMP Project Manager	Coordinate with the Steering Committee to maintain and complete documentation of the NHMP review process, including any needed plan updates, and prepare a summary report.	Summary report, including the results of the annual monitoring and evaluation processes.

4.5. Five-Year Plan Update

This plan will be updated every five years in accordance with the update schedule outlined in the DMA 2000. The 2023 Washington County NHMP is due to be updated by April 11, 2028. The Washington County NHMP Project Manager will be responsible for organizing the Steering Committee to address plan update needs. The Steering Committee, which includes the project manager, will be responsible for updating any areas for improvement found in the plan and for ultimately meeting the DMA 2000 plan update requirements.

Table 53: NHMP Update Roles and Responsibilities

Responsible Party	Tasks
Washington County NHMP Project Manager	• Coordinate and facilitate the plan review, revision, and update process. • Initiate and maintain a schedule of all plan update activities. • Collect data and disseminate reports. • Maintain records and documentation of all monitoring, evaluation, and update activities. • Identify and implement opportunities for public participation and input in the planning process, including review of the revised draft plan.
NHMP Steering Committee	• Each committee member shall act as a representative of the jurisdiction or special district to which they belong and participate in the planning cycle, including the plan review, revision, and update process. • Collect and report data to the Washington County NHMP Project Manager. • Maintain records and documentation of all plan review and revision activities conducted in the jurisdiction or special district they represent. • Promote the mitigation planning process with stakeholders and the public and solicit public input.

The plan review and revision process is ongoing throughout the five-year life cycle of the plan. The monitoring and evaluation activities that are conducted, at a minimum, annually and following a major disaster will assist in maintaining currency of multiple components of the plan, such as the hazard identification and risk assessment and mitigation actions and priorities.

Table 54: NHMP Plan Five-Year Update Process and Schedule

Schedule	Plan Update Processes and Related Activities
Monitoring and Evaluation Activities Ongoing throughout the five-year planning cycle	• Monitoring and evaluation results, meeting documentation, and other pertinent documents will be collected throughout the five-year life cycle of the plan and used in the next NHMP update. • Multiple meetings with elected officials, the Steering Committee, local jurisdictions, state and federal agencies, and interested parties will be conducted. • Activities, meetings, and interactions will be tracked and documented throughout the planning cycle. • The initial review of the NHMP to kick off the plan update process will be conducted using the most recent version of the NHMP that has incorporated annual and periodic revisions as the basis. •
Updating the Risk Assessment Conducted in the first quarter of the fifth year of the planning cycle	• The NHMP Project Manager will work with the Steering Committee to identify key stakeholders to invite to participate and contribute to the updated risk assessment. • Monitoring and evaluation results will be incorporated. • Changes since the previous plan approval will be identified. • Each hazard will be assessed and updated to include new data since the date of plan approval and adoption and subsequent updates. • New hazard occurrences and potential changes in low-ranked hazards will be identified and assessed. • Any significant changes in jurisdictional risk assessments will be noted during plan review and integrated into the updated NHMP.
Reviewing and Updating the Goals and Objectives Conducted in the second quarter of the fifth year of the planning cycle	• The NHMP Project Manager will coordinate with the Steering Committee and key partners to assess the status of current mitigation goals and objectives for potential revision. • The status of integration of mitigation goals and objectives with existing planning mechanisms will be assessed. • Any significant changes in mitigation goals, especially those that are not consistent with the current plan goals, will be assessed and incorporated as appropriate in the updated NHMP. • Monitoring and evaluation results will be used to modify the goals and objectives and describe achievements.
Reviewing and Updating Mitigation Actions Conducted in the third quarter of the fifth year of the planning cycle	• The NHMP Project Manager and Steering Committee and key partners will obtain an update on the current status of actions. • Monitoring and evaluation results will be used to assess the status and effectiveness of mitigation actions in meeting the goals and reducing risks. Actions may be changed, updated, removed, or added as necessary if approved by the participant's Technical Committee. • Plan maintenance data from the implemented activities will be used to describe progress in the previous five years.

Schedule	Plan Update Processes and Related Activities
Compiling and Reviewing Information Conducted in the third quarter of the fifth year of the planning cycle	• The NHMP Project Coordinator and Steering Committee will compile data and develop the updated NHMP. • A draft will be made available for stakeholder review and input. • A draft will be made available for public review and comment. • All comments and suggestions will be incorporated, and the final draft completed.
FEMA Review Conducted in the fourth quarter of the fifth year of the planning cycle	• FEMA will review the draft NHMP update.
Plan Adoption Conducted in the fourth quarter of the fifth year of the planning cycle	• The updated NHMP will be adopted prior to the plan expiration date.

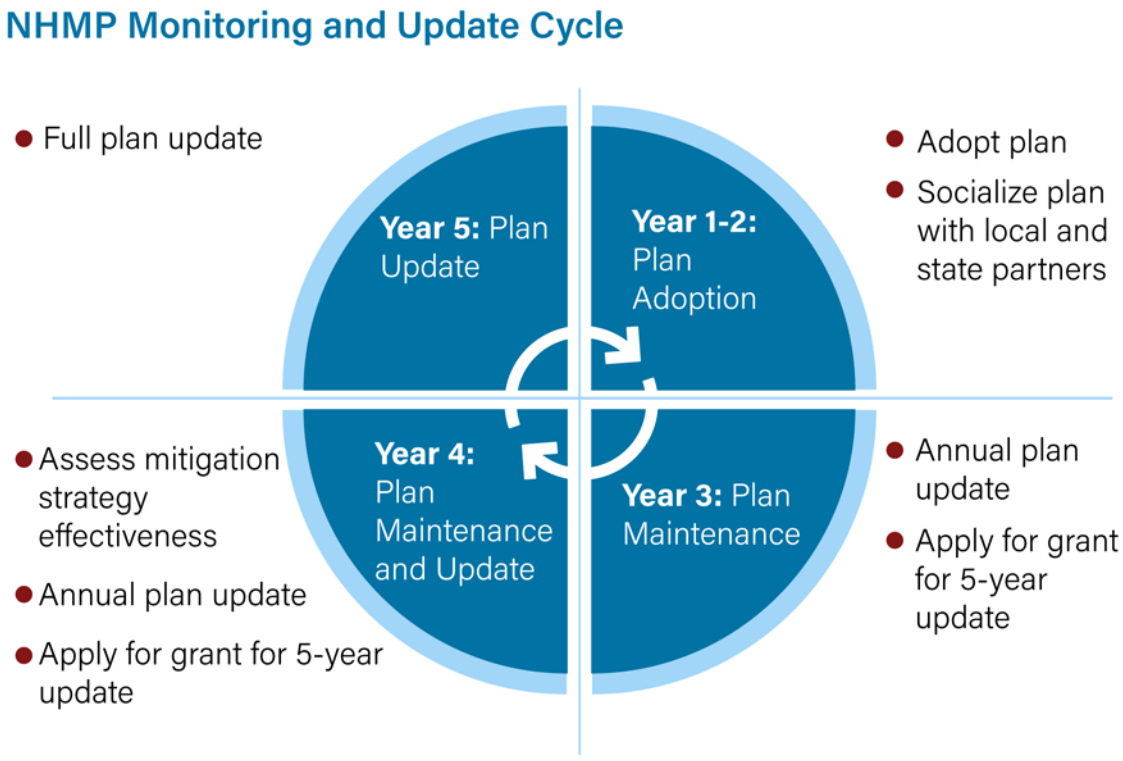


Figure 31: Plan Update and Monitoring Cycle

Adherence to the monitoring, evaluation, and update process schedule will ensure the plan is kept current throughout its five-year cycle. The plan update process and schedule are designed to focus on various components of the plan throughout the five-year cycle. Based on the schedule described, all parts of the plan will have been reviewed at the end of the five-year cycle, potentially reducing the time and resource burden in the final planning year.

4.6. Incorporation into Existing Planning Mechanisms

This NHMP includes a range of actions that, when implemented, will reduce loss from hazard events in the County. An ongoing responsibility of the Steering Committee is to identify additional stakeholders and existing planning mechanisms that can be used to integrate mitigation planning into short- and long-term community development and resiliency planning. This involves establishing hazard mitigation as a planning priority supported through the same capabilities defined in the participant capabilities assessment in each annex:

- Planning and regulatory
- Administrative and technical
- Safe growth
- Fiscal and resources
- Education and outreach

Each step in the planning cycle includes ongoing opportunities to identify existing planning processes that will provide a platform for the integration of hazard mitigation into existing planning mechanisms. The primary means for integrating mitigation strategies will be through the revision, update, and implementation of each participant's individual plans and regulations such as comprehensive plans, capital improvement plans, and land development regulations, as applicable.

The members of the Steering Committee will remain charged with ensuring the goals and strategies of new and updated local planning documents for their jurisdictions and special districts are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability in the County. Specific planning initiatives that provide the opportunity to integrate hazard mitigation are described in the participant annexes.

4.7. Continued Public Involvement

Participants are committed to involving the public directly in the maintenance and update of the NHMP. Although the Steering Committee members are responsible for annual review and update of the NHMP and represent the public to some extent, the public will still have an opportunity to provide direct feedback about the NHMP.

Public participation will be sought throughout the implementation, evaluation, and maintenance of the NHMP. This participation can be sought in a multitude of ways, including but not limited to periodic presentations on the plan's progress to elected officials, schools, or other community groups; questionnaires or surveys; public meetings; and postings on social media and participant websites.

Each participant in this plan is responsible for creating and documenting continued public involvement opportunities throughout the life of the NHMP. The Washington County NHMP Project Manager may facilitate countywide public involvement strategies that include plan participants, such as partnering with the Washington County Emergency Management Cooperative to distribute and disseminate public surveys and information related to mitigation. Copies of the NHMP and annual revisions will be posted on the websites of plan participants, as appropriate.

4.8. Plan Approval and Adoption Process

Once the NHMP has received FEMA Approvable Pending Adoption (APA) status, each participating jurisdiction or special district will take the plan to their governing body for final public comment and adoption. A copy of each adoption resolution will be inserted into Appendix B and held on file at FEMA, OEM, and the Washington County Emergency Management Office.

Annex A: City of Beaverton

1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for the City of Beaverton was the Emergency Management Officer.

1.2. Annex Organization

This annex includes six sections that satisfy mitigation requirements in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

The information provided in this annex is for the City of Beaverton alone. All pertinent information about the City that is not identified in this annex is identified in other sections of this NHMP or within the respective appendices included as part of the overall Washington County NHMP.

1.3. NHMP Adoption Process

Once the Washington County NHMP received the designation “Approvable Pending Local Adoption” from the Federal Emergency Management Agency (FEMA), the City presented the plan to City Council for final public comment and local adoption. A copy of the resolution was inserted into the NHMP and is held on file in the City of Beaverton and Washington County.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

City officials recognize the benefits of having a long-term, all-hazards approach to mitigating natural hazards. The passage of the Disaster Mitigation Act of 2000 (DMA 2000) enabled City officials to recognize the benefits of having a long-term, all-hazards approach to hazard mitigation and mitigating natural hazards. The City's involvement in the Washington County NHMP represents the collective efforts of the NHMP Steering Committee members, all participating local Technical Committee members, the public, and stakeholders.

The City developed this annex in accordance with guidance outlined in 44 CFR §201.6(c)(5) of DMA 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in the geographical area of the City.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP. An open involvement process was established for the public and all stakeholders, which provided an opportunity for everyone to be engaged in the planning process and make their views known.

Two teams worked simultaneously on this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of points of contact from each plan participant. The group met to discuss countywide topics, including hazards and mitigation strategies. The points of contact were the leads of their local Technical Committee.
2. **Local Technical Committee:** Each plan participant had a Technical Committee that consisted of the Steering Committee representative for that jurisdiction or special district, as well as designated representatives from within the organization. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. City of Beaverton's Technical Committee

This annex within the NHMP was developed by the City of Beaverton's local Technical Committee with support from IEM, a consulting firm hired to assist with the planning process. The efforts of the committee were led by the City's Emergency Management Officer throughout 2022.

Table 55: City of Beaverton Technical Committee Members for the 2023 NHMP

Position	Department	Role in Committee and Planning Process
Emergency Management Officer	Emergency Management	General oversight, hazard identification, and plan development
Emergency Manager	Emergency Management	Hazard identification and plan development
Emergency Management Coordinator	Emergency Management	Critical facilities
Sustainability Analyst	City Services and Engagement – Sustainability	Hazard identification and plan development
Project Engineer	Community Development – Site Development Division	Hazard identification and plan development

Position	Department	Role in Committee and Planning Process
City Building Official	Community Development Building Administration	Hazard identification and plan development
Geographic Information System (GIS) Manager	Information Services and Technology – GIS	Hazard identification and plan development
Economic Development Manager	Community Development – Economic Development	Hazard identification and plan development
Planning Division Manager	Community Development Division	Hazard identification and plan development
City Engineer	Public Works – Engineering Management Services	Hazard identification and plan development
Utility Manager	Public Works – Storm, Sewer, and Street Division	Hazard identification and plan development

IEM also supported or led the following activities associated with the development, approval, and adoption of the plan:

1. Facilitated the NHMP update process.
2. Based on committee direction and stakeholder and community input, prepared the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.
3. Submitted the proposed plan to the State of Oregon Department of Emergency Management (OEM) and FEMA for review and approval and completed edits or revisions requested by these organizations.
4. Coordinated the plan adoption processes with the City, OEM, and FEMA.

2.3. Public Participation

Public participation is an important component of this NHMP and also a required element as outlined in 44 CFR §201.6(c)(5), FEMA's mitigation planning guidance. Public participation offered community members the opportunity to voice their ideas, interests, and opinions about hazards that affect them and the best way to mitigate hazard impacts. As the City implements the mitigation actions identified in this annex, there will be additional opportunities for public participation.

Plan participants used a survey to collect information about community perceptions of natural hazards and priorities. The Steering and Technical Committees used the results to inform their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP. See Volume III, Appendix B for additional information about the survey and opportunities for public comment.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist the City of Beaverton in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards.

3.1. Changes in Development Since Adoption of the 2020 NHMP

(In compliance with 44 CFR §201.6(d)(3))

Since the 2020 Beaverton NHMP was adopted, the City's population has increased approximately 1.5%.[238,239] The City has a limited supply of shovel-ready vacant land, and leadership has focused on using this land efficiently and effectively and utilizing and repurposing already developed land as part of its community development strategy. The City has prioritized investment in affordable housing, transit-oriented development, and revitalization of the downtown core to catalyze housing and transportation choices and retail amenities.

The City's 2020–2022 Strategic Plan created by the Community Development Department contains five strategic priorities and actions and success measures for these priorities.[240] Actions include updating plans to create more equitable outcomes for low-income, historically underserved, and limited English proficiency communities, and implementation of the Beaverton Urban Renewal Agency's Five-Year Action Plan, which includes continued investment in the City's downtown area. Additionally, the Strategic Plan focuses on the development of the Cooper Mountain Community Plan to lay the groundwork for successful future neighborhood development, creation of the Cooper Mountain Utility Master Plan, updating the Transportation Systems Plan to address needed street network improvements, creating options the City might pursue to facilitate annexation to the City, and the overhaul of the development code for mixed use and commercial districts to facilitate mixed use and transit-oriented development.

The Beaverton Comprehensive Plan highlights the themes of livability, equity, sustainability, and resiliency, and the work and initiatives the City has undertaken since adoption of the 2020 NHMP have focused on these qualities.[241]

3.2. Community Profile

This section provides information on City-specific characteristics. Additional discussion of the planning area's community characteristics is outlined in Volume III, Appendix A of the NHMP.

Some community characteristics may suggest how natural hazards may impact communities and how communities choose to plan for natural hazard mitigation. Identifying and considering the City-specific assets during the planning process may assist in identifying appropriate measures for natural hazard mitigation.

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[238] United States Census Bureau. (2010, April 1). QuickFacts Beaverton City, Oregon. Accessed September 22, 2022, from https://www.census.gov/quickfacts/fact/table/beavertoncityoregon/PST045221

[239] World Population Review. (2022). Beaverton, Oregon Population 2022. https://worldpopulationreview.com/us-cities/beaverton-or-population

[240] City of Beaverton. (2020). City of Beaverton Community Development 2020 Strategic Plan. https://content.civicplus.com/api/assets/c0692800-0d0c-457e-833c-54754566574f

[241] City of Beaverton. (n.d.). Comprehensive Plan for the City of Beaverton, Volume I: City of Beaverton Comprehensive Plan. https://content.civicplus.com/api/assets/11e63537-b441-49ab-94f5-e3e8149197a9

Table 56 below reflects the community demographics and vulnerable populations in the City. This information was gathered from the U.S. Census, Portland State University, and the City of Beaverton.

Table 56: Community Demographics*

Population	Total	Percent Change
2010 population[242]	89,803	
2021 population[243]	97,782	+9%
2035 forecasted population[244]	112,608	+15%
Race and Ethnicity[245]	**Total**	**Percent of Population**
White alone	71,033	72%
Asian alone	13,049	13%
Hispanic/Latino/a/x of any race	16,066	16%
Two or more races	5,789	6%
Black or African American alone	2,171	2%
American Indian and Alaska Native alone	338	0.3%
Native Hawaiian and Other Pacific Islander alone	488	0.5%
Language Spoken at Home[246]	**Percent of Population**	
English only	74%	
Spanish	12%	
Asian and Pacific Island languages	8%	
Indo-European languages	5%	
Other languages	1%	
Vulnerable Age Groups[247]	**Percent of Population**	
Less than 15 years of age	17%	
65 years and older	14%	

[242] United States Census Bureau. (2010, April 1). QuickFacts Beaverton City, Oregon. Accessed September 12, 2022, from https://www.census.gov/quickfacts/fact/table/beavertoncityoregon/PST045221
[243] Portland State University Population Research Center. (2022). Population Estimate Reports. Accessed September 12, 2022, from https://www.pdx.edu/population-research/population-estimate-reports
[244] Oregon Metro. (2013, January 15). 2035 Forecast of Population by City and County. Accessed September 12, 2022, from https://www.oregonmetro.gov/sites/default/files/2014/05/29/population_housing_forecasts_by_city_county.pdf
[245] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Demographic and Housing Estimates, Table DP05. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20dp05
[246] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Language Spoken at Home, Table S1601. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20S1601
[247] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates Age and Sex Estimates, Table S0101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20s0101

Disability Status of Non-Institutionalized Civilians [248]	Percent of Population
Total	12%
Less than 17 years of age	9%
65 years and older	70%

* Due to how respondents identify and answer questions, there may be overlapping responses, and results may equal greater than 100% of the population. Percentages are rounded.

3.2.1. Geography, Topography, and Climate

The City of Beaverton is seven miles west of downtown Portland in eastern Washington County and is part of the Portland metropolitan area. It is Oregon's sixth-largest city and the second-largest incorporated city in Washington County.

The City's terrain is predominately flat or rolling hills, with an average elevation of 189 feet. There are two prominent features around Beaverton: Portland's West Hills, which are to the northeast of the City, and Cooper Mountain, with an elevation of 730 feet, to the southwest of the City. Mount Williams, with an elevation of 471 feet in west Beaverton, and Sexton Mountain, with an elevation of 413 feet in southwest Beaverton, are two moderate landscape features within the City.

There are no rivers in the City; however, a number of creeks run through it that tend to flood during heavy rains. Beaverton Creek is the most significant creek in the City, and numerous wetlands surround the creek, which help control runoff and prevent flooding.

The climate in Beaverton is mild year-round. The City receives approximately 39.4 inches of rain per year, most of which falls from October through April, with December being the wettest month of the year. The average low temperature is 33 degrees Fahrenheit (°F), and the average high is 81 °F. The coldest temperatures typically occur in January, and the hottest occur in August. Average humidity ranges from 82% in the winter to 62% in the summer.

3.2.2. Transportation, Infrastructure, and Housing

3.2.2.1. Transportation

Transportation in Beaverton includes State and County highways, arterial streets, collector streets, neighborhood routes, local streets, the Tri-County Metropolitan Transit District (TriMet) bus service, the Metropolitan Area Express (MAX) Westside Light Rail, Westside Commuter Rail, and multiple bicycle routes. Beaverton's transportation network serves both residential and commercial commuters.

TriMet provides public transportation in Beaverton. TriMet's service includes bus, light rail, and commuter rail. The MAX Westside Light Rail line is aligned in an east–west direction from downtown Portland following Highways 26 and 217 to the Beaverton Transit Station and continuing west to downtown Hillsboro. TriMet's Westside Express Service (WES) commuter rail line lies in a north–south orientation, paralleling portions of Interstate 5 and Highway 217 from the Beaverton Transit Station to Wilsonville.

U.S. Highway 26, also known as the Sunset Highway, has the greatest traffic volume and serves as a central connecting route between the coast and downtown Portland. Oregon Highway 217 serves to connect Highway 26 to and from Interstate 5 and carries the second highest traffic volume in Washington County. Highway 26 runs east to west, while Highway 217 runs north to south. Both of these highways

[248] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates Disability Characteristics Estimates, Table S1810. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20s1810

are major traffic routes through and around Beaverton. Highway 210, also known as Scholls Ferry Road, also carries a high traffic volume. Highways 8 and 10 are major commuting routes as well but carry slightly lower traffic volumes.

3.2.2.2. Infrastructure

The City of Beaverton's critical and vulnerable facilities listed below in Table 57 may be vulnerable to one or more natural hazards.

Table 57: Critical Facility and Asset Inventory[249]

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Arco Iris Spanish Immersion School	School	8205 SW Creekside Place	The building was constructed between 1984 and 1993 and had a seismic retrofit in 2018, bringing it up to current seismic code. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a Cascadia Subduction Zone (CSZ) wet soil scenario is potentially moderate to very high. The property has a 0.2% chance of flooding.
Arts & Communication High School and Magnet Academy (ACMA)	School	11375 SW Center Street	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Autumn of Life Senior Housing and Advisory Services	Assisted/Senior Living	14845 SW Murray Scholls place, Suite 110, PMB132	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Beaverton Central MAX Station	Transportation	SW Hall Boulevard, north of Canyon Road	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.

[249] City of Beaverton 2023 NHMP planning documentation

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Beaverton City Hall	City Facility	12725 SW Millikan Way	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Beaverton City Library	City Facility	12375 SW 5th Street	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Beaverton City Library at Murray Scholls	City Facility	11200 SW Murray Scholls Place	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Beaverton Community Center	City Facility	12350 SW 5th Street, Suite 100	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Beaverton Creek MAX Station and Park and Ride	Transportation	SW 153rd Drive, south of Jenkins	The property is on the edge of a floodplain. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Beaverton High School	School	13000 SW 2nd Street	The building was constructed before 1984. The property has a 0.2% chance of flooding on the SW side, on Erickson Avenue. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. A considerable portion of the school is URM. There have also been a number of undocumented additions to the original building causing the probable cost estimate.[250]
Beaverton Public Works/Operations Department	City Facility	9600 SW Allen Boulevard	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high.
Beaverton Senior Care Home	Assisted/Senior Living	14890 SW Davis Road	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high. There is an active fault north of the facility.
Beaverton Public Safety Center and Emergency Operations Center	Law Enforcement – Emergency Operations Center – City Facility	6125 SW Hall Boulevard	The building was constructed in 2020 and was built to the latest seismic and Critical Infrastructure and Key Resources (CIKR) standards. Damages from a 6.8 magnitude Portland Hills earthquake and permanent ground deformation from liquefaction from a CSZ wet soil scenario are potentially minor.

[250] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Beaverton Creek Park and Ride	Transportation	SW Millikan Way	The property is in a floodplain. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high.
Beaverton Transit Center	Transportation	4050 SW Lombard Avenue	The property is in a floodplain. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Brookdale Beaverton	Assisted/Senior Living	16655 NW Walker Road	The building was constructed between 1994 and the present. There is a floodplain on the north side of the facility. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high to very high.
Canfield Place	Assisted/Senior Living	14570 SW Hart Road	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Cedar Park Middle School	School	11100 SW Park Way, Portland, OR 97225	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. This building has been partially seismically upgraded; however, it still contains significant deficiencies, particularly around the concrete gymnasium, cafeteria, and wrestling rooms. The classroom wing does not have shear walls.[251]
Chehalem Elementary School	School	15555 SW Davis Road	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. The property is on an active fault line. A Seismic Assessment Report completed by the Beaverton School District noted seismic deficiencies in the building including, but not limited to, exterior concrete foundation walls not being adequately anchored to foundations and re-entrant corners lacking sufficient tensile capacity to develop strength of diaphragm.[252]
Cherry Hill Adult Foster Home	Assisted/Senior Living	13890 SW Cherryhill Court	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. This facility is permanently closed.

[251] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District
[252] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Clean Water Services Field Operations Facility	Utility	2025 SW Merlo Court	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high.
Conestoga Middle School	School	12250 SW Conestoga Drive	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Wall segments in the building exceed allowable aspect ratios and may leave other lateral elements undersized.[253]
Cooper Mountain Elementary School	School	7670 SW 170th Avenue	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to high. Seismic structural deficiencies include, but are not limited to, the connection of the concrete walls around the gymnasium to the diaphragm needs to be strengthened and wood posts in the 1987 addition are not attached to the foundations or wood floor framing.[254]

[253] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District
[254] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Cor Deo Christian Academy	School	5755 SW Erickson Avenue	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
DaVita Kidney Care	Medical	1700 NW 167th Place, Suite 320	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high.
Edgewood Point Senior Living	Assisted/Senior Living	7733 SW Scholls Ferry Road	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Edison High School	School	9020 SW Beaverton Hillsdale Highway, Portland, OR 97225	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Elmonica Elementary School	School	16950 SW Lisa St	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high. Seismic structural deficiencies include, but are not limited to, no positive connections from wood posts to foundations at both 1988 and 1992 additions and roof pop-ups at additions require additional chords and collector members.[255]
Elmonica MAX Station and Park and Ride	Transportation	1200 SW 170th Avenue	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high.
Farmington Square Beaverton	Assisted/Senior Living	14420 SW Farmington Road	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.

[255] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Fir Grove Elementary School	School	6300 SW Wilson Avenue	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, masonry reinforcement spacing is greater than maximum allowed, and 1954 addition only has one line of shear wall in the east–west direction.[256]
Five Oaks Middle School	School	1600 NW 173rd Avenue	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high.
Fresenius Kidney Care Beaverton	Medical	2715 SW 153rd Drive	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, no connection being present between slabs and foundations elements and reinforced brick site walls potentially being a falling hazard.[257]

[256] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

[257] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Fresenius Kidney Care Twin Oaks	Medical	15201 NW Greenbrier Parkway, Suite C2	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to high.
Garden Home Community Library	Tualatin Hills Park and Recreation District facility	7475 SW Oleson Road, Portland, OR 97223	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
German American School of Portland	School	3900 SW Murray Boulevard	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high.
Greenway Elementary School	School	9150 SW Downing Drive	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, ties between foundation elements at play shelter do not exist and no out-of-plane support at gymnasium roof on the north side.[258]

[258] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Beaverton Municipal Court (Griffith Building)	City Facility	4755 SW Griffith Drive	The building was constructed before 1984 and is not up to seismic standards. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Hearthstone of Beaverton	Assisted/Senior Living	12520 SW Hart Road	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Hearthstone at Murrayhill	Assisted/Senior Living	10880 SW Davies Road	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high.
Highland Park Middle School	School	7000 SW Wilson Avenue	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, precast wall panels lacking a positive connection to the foundation and tectum roof in the gymnasium, shop, and wrestling room are not capable of transferring lateral forces.[259]

[259] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Hiteon Elementary School	School	13800 SW Brockman Street	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, vertical reinforcement in the exterior masonry shear walls being spaced too far apart and the standalone 1989 covered play area has lateral support in only one direction.[260]
Jesuit High School	School	9000 SW Beaverton Hillsdale Highway, Portland, OR 97225	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Legacy-GoHealth Urgent Care	Medical	2870 SW Cedar Hills Boulevard	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Legacy Medical Group – Cornell	Medical	1960 NW 167th Place	The building was constructed before 1964. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high. This property also houses Providence Orthopedics.

[260] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Legacy Medical Group – Cardiology	Medical	1960 NW 167th Place, Cornell Medical Plaza, Suite 205	The building was constructed before 1964. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high.
Legacy Medical Group – Raleigh Hills	Medical	8329 SW Beaverton Hillsdale Highway, Portland, OR 97225	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Legacy Medical Group – Westside Internal Medicine	Medical	2725 SW Cedar Hills Boulevard, Suite 250	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Living Wisdom School	School	4855 SW Watson Avenue	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Kaiser Permanente Cedar Hills Dental and Medical Office	Medical	12450 SW Walker Road	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Kaiser Permanente Beaverton Medical Office	Medical	4855 SW Western Avenue	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Maryville Memory Care	Assisted/Senior Living	4520 SW 148th Avenue	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Maryville Nursing Center	Assisted/Senior Living	14645 SW Farmington Road	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
McKay Elementary School	School	7485 SW Schools Ferry Road	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, wood posts from 1950 not having a positive connection to the foundations or the wood framing at the second floor and many interior and exterior shear walls only have gypsum board sheathing rather than plywood sheathing and require strengthening.[261]

[261] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
McKinley Elementary School	School	1500 NW 185th Avenue	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high. Seismic structural deficiencies include, but are not limited to, wood framed walls and foundations missing positive connections in multiple areas and many inadequate shear wall to roof diaphragm connections.[262]
Merlo Station Community High School	School	1841 SW Merlo Drive	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high. Seismic structural deficiencies include, but are not limited to, no foundation ties connecting the strip footings to the precast tilt-up shear walls and the diaphragm is unblocked and spans more than 40 feet.[263]
Merlo/SW 158th Avenue MAX Station and Park and Ride	Transportation	SW Merlo Road & 158th Avenue	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high.
Millikan Way MAX Station and Park and Ride	Transportation	SW Millikan Way & 141st Avenue	Access to the property is compromised by the flood zones A and AE that surround the facility. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.

[262] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

[263] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Montclair Elementary School	School	7250 SW Vermont Street, Portland, OR 97223	The building was constructed before 1984. Flood zones A and AE surround the school. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high. Seismic structural deficiencies include, but are not limited to, wood posts not having positive connections to foundations and some interior wood shear walls using gypsum board as primary sheathing.[264]
MorningStar Assisted Living & Memory Care of Beaverton	Assisted/Senior Living	14475 SW Barrows Road	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high.
Mountainside High	School	12500 SW 175th Avenue	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Murray Highland Memory Care	Assisted/Senior Living	4900 SW Murray Boulevard	The building was constructed between 1994 and the present. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.

[264] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Nancy Ryles Elementary School	School	10250 SW Cormorant Drive	The building was constructed in the 1990s. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high. A landslide deposit less than or equal to 15 feet is on the west side of the school, along with a 25% slope on the west side of the property. Seismic structural deficiencies include, but are not limited to, roof chords being discontinuous at sloped roof pop-ups and gypsum wallboard being used for shear walls in several locations throughout the 1991 structure.[265]
Oregon Health & Science University (OHSU) Diagnostic Imaging	Medical	1500 NW Bethany Boulevard, Suite 195	The building was constructed before 1984. Flood zones A and AE are on the property. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high to very high.
OHSU Medical Clinic	Medical	15700 SW Greystone Court	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Pacific Academy/Cascade Academy/Columbia Academy	School	14255 SW Brigadoon Court, Suite 140	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high.

[265] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Patricia Reser Center for the Arts	Cultural Resource	12625 SW Crescent Street	The building was constructed in 2020. Damages from a 6.8 magnitude Portland Hills earthquake and permanent ground deformation from liquefaction from a CSZ wet soil scenario are potentially moderate; however, the facility was built to the latest seismic standards.
Prestige Senior Living Beaverton Hills	Assisted/Senior Living	4525 SW 99th Avenue	The building was constructed between 1994 and the present. There is a floodway and flood zones A and AE north of the facility. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Pilgrim Lutheran School	School	5650 SW Hall Boulevard	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Prince of Peace Lutheran School	School	14175 NW Cornell Road, Portland, OR 97229	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Providence ExpressCare – Murrayhill	Medical	14600 SW Murray Scholls Drive	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Providence Immediate Care – Scholls is also at this location.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Providence Infusion – West Portland	Medical	10126 SW Park Way, Portland, OR 97225	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. There is no potential permanent ground deformation from liquefaction from a CSZ wet soil scenario.
Providence Medical Group – Progress	Medical	12345 SW Horizon Boulevard, Suite 57 A	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Providence Medical Group – Sunset	Medical	417 SW 117th Avenue, Suite 200, Portland, OR 97225	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high. There is a slope equal to or greater than 25% on the property.
Rachel Carson School of Environmental Science	School	11100 SW Park Way, Portland, OR 97225	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Raleigh Hills Elementary School	School	5225 SW Scholls Ferry Road, Portland, OR 97225	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, nonexistent ties between foundation elements at play shelter and exterior concrete foundation walls not being adequately anchored to diaphragms for out-of-plan forces at original construction and additions.[266]
Ridgewood Elementary School	School	10100 Inglewood Street, Portland, OR 97225	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. There is no potential permanent ground deformation from liquefaction from a CSZ wet soil scenario.
Right Fit Senior Living Solutions	Assisted/Senior Living	12745 SW Beaverdam Road, Suite 315	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Scholls Heights Elementary School	School	16400 SW Loon Drive	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, roof chords being discontinuous at sloped roof pop-ups and a roof diaphragm containing plywood but not being blocked in all locations.[267]

[266] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

[267] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Sexton Mountain Elementary School	School	15645 SW Sexton Mountain Road	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, wall segments exceeding allowable aspect ratios and walls appearing not to have hold-downs.[268]
Southridge High School	School	9625 SW 125th Avenue	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, seven inch diagonal braces possibly not meeting moderate ductility requirements and seismic isolation joint at auditorium being inadequate to handle horizontal displacement in two directions.[269]
Southwest Christian School	School	14605 SW Weir Road	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.

[268] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

[269] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
St. Cecilia School	School	12250 SW 5th Street	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
St. Stephens Academy	School	7275 SW Hall Boulevard	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Sunset High School	School	13840 NW Cornell Road, Portland, OR 97229	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, long window lines at exterior elevations create weak lines of lateral support and a narrow shear wall at the east wall of shop additions.[270]
Sunset Transit Center Park and Ride	Transportation	10470 SW Barnes Road, Portland, OR 97225	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. There is no potential for permanent ground deformation from liquefaction from a CSZ wet soil scenario.

[270] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Sunshine Montessori Preschool and Kindergarten	School	4845 SW Murray Boulevard	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
The Portland Clinic – Medical Clinic	Medical	15950 SW Millikan Way	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high to very high.
The Portland Clinic – Urgent Care Clinic	Medical	9250 SW Hall Boulevard	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Terra Linda Elementary	School	1998 NW 143rd Avenue, Portland, OR 97229	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, wood posts in the 1989 addition not having a positive connection to the foundation and wood ledgers in cross-grain bending at some roof connections.[271]

[271] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Tumwater Middle School	School	650 NW 118th Avenue Portland, OR 97229	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Tunai Adult Care Home	Assisted/Senior Living	13045 SW Combine Street	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Tualatin Valley Fire & Rescue (TVF&R) – Station 53 Progress	Fire – TVF&R	8480 SW Scholls Ferry Road	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
TVF&R – Station 61 Butner Road	Fire – TVF&R	13730 SW Butner Road	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
TVF&R – Station 66 South Beaverton	Fire – TVF&R	13900 SW Brockman Street	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
TVF&R – Station 67 Farmington	Fire – TVF&R	13810 SW Farmington Road	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
TVF&R – Station 70 Raleigh Hills	Fire – TVF&R	8299 SW Beaverton Hillsdale Highway, Portland, OR 97225	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Valley Catholic High School	School	4275 SW 148th Avenue	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Vineyard Home Senior Living	Assisted/Senior Living	15675 SW Hart Road	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Vose Elementary School	School	11350 SW Denney Road	The building was constructed in 2019. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
Washington County Sheriff's Office – East Precinct	Law Enforcement– County Sheriff's Office	3700 SW Murray Boulevard	The building was constructed before 1984. The property is north of a flood zone. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate to very high.
Waterhouse Ridge Memory Care	Assisted/Senior Living	1115 NW 158th Avenue	The building was constructed between 1994 and the present. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate to heavy. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
West Sylvan Middle School	School	8111 SW West Slope Drive, Portland, OR 97225	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high.
Whitford Middle School	School	7935 SW Scholls Ferry Road	The building was constructed before 1984. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate. Seismic structural deficiencies include, but are not limited to, tectum roofs at gymnasium, shop, and wrestling room are not capable of transferring lateral forces and precast wall panels that lack a positive connection to the foundation capable of developing strength of the wall.[272]
William Walker Elementary School	School	11940 SW Lynnfield Lane, Portland, OR 97225	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially moderate.
YMCA Kindergarten	School	15650 NW Blueridge Dr	The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high.

[272] KPFF Consulting Engineers. (2019, April 12). Seismic Assessments for the Beaverton School District. Seismic Reports and Upgrades - Beaverton School District

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Young Learners Preschool	School	1800 NW 169th Place Suite C-100	The building was constructed between 1984 and 1993. The property is not vulnerable to flooding. Damages from a 6.8 magnitude Portland Hills earthquake would potentially be moderate. Permanent ground deformation from liquefaction from a CSZ wet soil scenario is potentially high.

3.2.2.3. Housing

Housing characteristics are an important factor in mitigation planning. The information below shows that most housing units are owner-occupied and consist of one-unit buildings built before 1999. The older the housing, the more at risk it can be to damage from natural hazards such as earthquakes and windstorms, including tornadoes.

Table 58: Housing Characteristics*

Households	Total
Total households[273]	41,026
Units in Housing Structure[274]	**Percent of Housing**
One-unit structures	55%
Two-or-more-unit structures	44%
Manufactured homes and all other types	<1%
Year Housing Structure Built[275]	**Percent of Housing**
Pre-1979	41%
1980–1999	37%
2000 to present	22%
Housing Tenure and Vacancy	**Percent of Housing**
Owner-occupied[276]	50%
Renter-occupied[277]	50%
Vacant[278]	2%

* Due to how respondents answer questions there may be overlapping responses and results may equal greater than 100%. Percentages are rounded.

[273] United States Census Bureau. (2021, July 1). 2021 American Community Survey 1-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20S1101&tid=ACSST1Y2021.S1101
[274] United States Census Bureau. (2021, July 1). 2021 American Community Survey 1-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20S1101&tid=ACSST1Y2021.S1101
[275] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Physical Housing Characteristics for Occupied Housing Units, Table S2504. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20S2504&tid=ACSST1Y2021.S2504
[276] United States Census Bureau. (2021, July 1). 2021 American Community Survey 1-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20S1101&tid=ACSST1Y2021.S1101
[277] United States Census Bureau. (2021, July 1). 2021 American Community Survey 1-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20S1101&tid=ACSST1Y2021.S1101
[278] United States Census Bureau. (2021, July 1). 2020 Decennial Census Occupancy Status, Table H1. Accessed September 28, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20h1

3.2.3. Economy

Beaverton's economy is a mix of high-tech and software companies, professional and business services, and retail trade. It supports both traditional and knowledge-based industries and provides goods and services to export markets and local consumers. Some of the City's large private employers include Nike, Comcast, Leupold and Stevens, Reser's Fine Foods, and Pacific Office Automation. As part of the Silicon Forest, Beaverton is the location of numerous technology organizations and companies, including the Linux Technology Center of IBM, Tektronix, Analog Devices, VeriWave, and the Oregon Technology Business Center, a non-profit tech startup incubator. Phoenix Technologies operates its Northwestern Regional Office in Beaverton. Some of the largest public and institutional employers include City of Beaverton, Beaverton School District, and Providence Health Plans.

Table 59: Income Characteristics[279]*

Households by Income Category	Percent of Households
Less than $5,000	3%
$5,000 to $9,999	2%
$10,000 to $14,999	2%
$15,000 to $19,999	3%
$20,000 to $24,999	4%
$25,000 to $34,999	7%
$35,000 to $49,999	11%
$50,000 to $74,999	18%
$75,000 to $99,999	15%
$100,000 to $149,999	19%
$150,000 or more	18%
Median Household Income	
$76,520	

* Due to how respondents answer questions, there may be overlapping responses, and results may equal greater than 100%. Percentages are rounded.

[279] United States Census Bureau. (2021, July 1). American Community Survey 5-year Estimates, Financial Characteristics, Table S2503. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=beaverton%20oregon%20S2503

3.3. Natural Hazard Profiles

The City of Beaverton's Technical Committee utilized the OEM's hazard analysis methodology to examine hazard vulnerability and probability by collecting information about history, probability, vulnerability, and maximum threat for each hazard that impacts the City. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants.

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Volume I, Section 2.

The scores for each hazard that impact the City are presented below. Due to geographic location, topography, and density of the built environment, the City cannot be impacted by dam failure or wildland fire.

Table 60: Natural Hazard Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	–	–	–	–	–
Drought	Low	High	High	High	198
Earthquake	Low	High	High	Medium	196
Extreme heat	Low	High	High	High	212
Flooding, including channel migration and streambed erosion	High	Medium	Medium	High	188
Landslide	Low	Low	Low	Medium	86
Volcanic ash	Low	Medium	High	High	178
Wildland fire	–	–	–	–	–
Windstorm, including tornado	High	High	High	High	208
Winter storm	High	Medium	High	High	203

Full descriptions of each hazard are provided in Volume I, Section 2. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description, also in Volume I, Section 2.

The timeframe of data collected during the planning process for the City of Beaverton was November 1, 2016, to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the City's Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events since the 2017 NHMP update, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are presented in the same order, as applicable: populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

3.3.1. Dam Failure

Due to geographic location and topography, the City cannot be directly impacted by dam failure.

3.3.2. Drought

Drought typically occurs as a regional event and often affects more than one city and county simultaneously. Drought may occur in the City of Beaverton and may affect the agricultural and recreational economic sectors, which are a small part of the City's overall economy. Potential impacts of and vulnerabilities to drought are identified below.

3.3.2.1. Potential Impacts

The potential impacts from a drought event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event.

- Reduction or loss of water supply, water use restrictions, and lack of potable water supply.
- Health effects, including increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions.
- Reduced economic productivity or business closures, including agriculture, livestock, recreation, energy, tourism, timber, and fisheries.
- Supply chain restrictions, including food shortages.
- Loss of power or reduced availability of electricity due to infrastructure damage and high demand.
- Property and infrastructure damage due to expansive soils, which are clay-based soils that expand and contract based on the amount of moisture in the soil.
- Damage to natural environments, including low water levels in lakes, rivers, and other water bodies, reduced plant growth, local species reduction or extinction, increased water temperature, and deteriorated water quality, which may result in fish kills and increased waterborne pollutants.
- Concurrent hazards, including extreme heat, wildfire, flooding, and landslides.

3.3.2.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to drought. This includes:

- People in the City with preexisting health conditions, those without access to clean water, children, pregnant women, and older adults.
- Those who are employed in water-dependent sectors, such as agriculture and recreation, may experience a reduction in income.
- The water supply in the upper Tualatin River, the City's source of groundwater.
- Critical transportation infrastructure, including State and County highways, arterial streets, collector streets, neighborhood routes, local streets, and eight TriMet stations and bus and rail service equipment.
- Other critical infrastructure and facilities vulnerable to drought include 46 schools, 18 medical facilities, 7 city facilities, 18 assisted living facilities, 5 fire department facilities, 2 police facilities, one Clean Water Services field operations facility, and one arts center.[280]

[280] City of Beaverton 2023 NHMP planning documentation

3.3.3. Earthquake

The City could experience earthquakes that originate from the Cascadia Subduction Zone (CSZ), Portland Hills Fault Zone, and Gales Creek Fault Zone. It could also experience liquefaction and landslides as the result of an earthquake. Beaverton has mostly silt-type soil, which is subject to liquefaction. The soil can lose its ability to support structures, flow down even very gentle slopes, and erupt to the ground surface to form sand boils. Potential impacts of and vulnerabilities to earthquake are identified below.

3.3.3.1. Potential Impacts

The potential impacts from an earthquake event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event.

- Injuries or deaths.
- Mental health impacts, including post-traumatic stress disorder.
- Public health hazards resulting from disruption of drinking water and wastewater systems.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to ground utilities; residential, public, and private buildings; and transportation systems above and below.
- Disruption of essential infrastructure systems, such as power systems, public utilities, and telecommunications.
- Blocked road and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction.
- Downed or damaged power lines that can lead to wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Change in water flows, including paths of rivers and streams.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards initiated by an earthquake, including flood, wildland fire, and landslide.

3.3.3.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to earthquakes. This includes:

- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.
- Underground infrastructure, such as pipelines and utility lines, buildings, and roads, are vulnerable to damage from liquefaction due to the silt-type soil in the City. This includes the Clean Water Services field operations facility located in the City.
- Buildings with very high or high collapse potential include residential and commercial buildings constructed prior to 1990. Of the critical facilities and infrastructure identified by the City, 50 are known to be built prior to 1993. This includes 6 assisted living facilities, 9 medical facilities, including a level II hospital, 5 city facilities, including the public works operations facility and the municipal court, 29 schools, and the Washington County Sheriff's Office East Precinct location.[281]
- There is one assisted living facility and one elementary school that are located on an active fault line. The municipal court building is not built up to seismic standards.[282]
- Potential shaking damage and permanent ground deformation levels due to liquefaction that may impact the City's identified critical facilities and infrastructure are as follows:[283]
  - Perceived shaking and damage potential from a Portland Hills 6.8 magnitude earthquake may cause heavy damage to one elementary school, moderate to heavy damage to 23 critical facilities, and moderate damage to 100 critical facilities.
  - A CSZ wet soil scenario could result in liquefaction that may cause various permanent ground deformation levels, impacting critical facilities and infrastructure throughout the City, including:
    - Very high to high permanent ground deformation at 3 facilities.
    - High permanent ground deformation at 18 facilities.
    - Very high to moderate permanent ground deformation at 13 facilities.
    - High to moderate permanent ground deformation at 2 facilities.
    - Moderate permanent ground deformation at 83 facilities.
- Using 2022 Hazus®-MH information, it is estimated a 6.7 magnitude Gales Creek Fault earthquake event would result in 87 yellow-tagged buildings, 5 red-tagged buildings, and $109,000,000 in total economic losses.[284]
- A 2018 Oregon Department of Geology and Mineral Industries (DOGAMI) report shows the following[285]:
  - A CSZ magnitude 9.0 earthquake in "dry" soil conditions could result in $1,230,000,000 in building repair costs, 548,000 tons of debris, 1,227 long-term displaced residents, and up to 1,068 deaths.

[281] City of Beaverton 2023 NHMP planning documentation
[282] City of Beaverton 2023 NHMP planning documentation
[283] City of Beaverton 2023 NHMP planning documentation
[284] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[285] Oregon Department of Geology and Mineral Industries. (2018). Open File Report O-18-02: Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-18-02/O-18-02_report.pdf

- A CSZ magnitude 9.0 earthquake in “wet” soil conditions could result in $1,943,000 in building repair costs, 751,000 tons of debris, 6,267 long-term displaced residents, and up to 1,946 deaths.
- A Portland Hills Fault magnitude 6.8 earthquake in “dry” soil conditions could results in $3,510,000 in building repair costs, 1,310,000 tons of debris, 5,597 long-term displaced residents, and up to 3,508 deaths.
- A Portland Hills Fault magnitude 6.8 earthquake in “wet” soil conditions could results in $5,201,000 in building repair costs, 1,775,000 tons of debris, 19,130 long-term displaced residents, and up to 5,711 deaths.

3.3.4. Extreme Heat

Because extreme heat events have increased in frequency, severity, and impacts, the NHMP Steering Committee chose to include this hazard for the first time in the Washington County NHMP. Potential impacts of and vulnerabilities to extreme heat and previous significant events are identified below.

3.3.4.1. Significant Events

Extreme heat was not included in previous NHMPs. The City identified three significant extreme heat events it has experienced.

- **June 26–29, 2021:** The maximum temperature reached 115 °F. Throughout Washington County there were numerous fatalities, closures and postponements of businesses and events, and buckled roads, and cooling shelters were opened. There was one heat-related death in the City.
- **July 19–30, 2021:** The highest temperature reached was 96 °F. City events were modified or canceled, economic impacts occurred due to the limited possibility of safe outdoor work, and cooling shelters were opened.
- **August 11–14, 2021:** The high temperature at Hillsboro Airport was 103 °F, with a heat index of 109 °F on August 11 and 12. Peak afternoon temperatures ranged from 100 °F to 105 °F. Throughout Washington County there were fatalities, closures and postponements of businesses and events, and cooling shelters were opened.

3.3.4.2. Potential Impacts

The potential impacts from an extreme heat event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event.

- Injuries or deaths.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, heat stroke, and death.
- Extended operational hours of County staff and additional resources needed for response to the event, including the operation of daytime cooling centers and overnight cooling shelters.
- Strain on or loss of water supply due to increased demand.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic losses from decreased worker efficiency and effectiveness and time lost on the job when workers take more frequent or longer breaks to avoid overheating.
- Economic impacts from closure of outdoor activities and events, such as farmers markets and concerts.
- Property damage, such as roof expansions, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding.
- Disruption of essential infrastructure systems from overheated and damaged utilities, including power, water, transportation, and communication systems.
- Impacts to roadways as heat expands concrete or causes cracking and buckling. Public transit can also be impacted due to melted cables, sagging wires, and warping tracks.
- Damage to crops, livestock, parks, and natural systems.

- Impacts to greenspaces, such as scorch and sunscald of new foliage, branches or tops of trees dying, and significant stress and die-off of native trees, particularly Douglas fir and cedar. These impacts are intensified if drought is also occurring.
- Concurrent hazards include drought and wildland fire.

3.3.4.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to extreme heat.

Populations substantially vulnerable to extreme heat include:

- People who work or spend a significant amount of time outdoors, including those in construction, landscaping, maintenance and repair, roofing, and solid waste collection.
- People who live and/or work in buildings without air conditioning or cooling equipment.
- People living, working, or spending time in heat islands within the City.
- People living outdoors or in the upper floors of multi-family housing units.
- Populations with higher heat sensitivity, including older adults, infants and children, pregnant women, people with preexisting or chronic diseases, and those who take certain medications that affect thermoregulation or block nerve impulses. This includes those living in or spending time in the City's 18 assisted living facilities and 46 schools.
- People with limited mobility and no access to cooling systems who may not be able to travel to cooling centers or shelters.
- People who live in social isolation, including linguistic isolation, or those living alone with few social relationships.
- People with mental health conditions. Extreme heat can be associated with higher levels of aggression, violence, and suicidal behavior.
- Factors including race and ethnicity, income, and educational attainment are negatively correlated with heat-related illness.

Additional vulnerabilities to extreme heat include:

- Plants, animals, ecosystems, and natural environments are vulnerable to high rates of mortality due to excessive heat.
- Bridge infrastructure is vulnerable to thermal expansion of bridge joints and paved surfaces and deterioration of steel, asphalt, protective cladding, coats, and sealants.
- Asphalt pavement is vulnerable to accelerated deterioration through softening, rutting, and migration of liquid asphalt.
- Vehicles, including first responder vehicles, are vulnerable to engine overheating and tire deterioration.
- Aboveground utility and power lines may droop or sag and create a heightened fire risk.

3.3.5. Flooding, Including Channel Migration and Streambed Erosion

Some degree of flooding is common throughout the County, with events typically occurring from October through April. The City is primarily affected by urban and riverine flooding, and any low-lying area has the potential to flood. All stormwater runoff is directed to the nearest creek or stream. Water is not intentionally directed into the sanitary sewer system. Riverine flooding, when rivers and streams flow over their banks, is the largest single form of flooding in the City. Potential impacts of and vulnerabilities to flooding are identified below.

3.3.5.1. Potential Impacts

The potential impacts from a flooding event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event.

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Displaced residents in need of sheltering.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal economic impacts from loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.5.2. Vulnerabilities

Population, economic, built environment, critical facility, infrastructure, and natural environment vulnerabilities to a flooding event include:

- Populations without access to private transportation for the purpose of evacuation.
- There are 15 critical facilities vulnerable to flooding due to proximity to floodplains and flood zones A and AE, including three schools, four TriMet stations, four assisted living facilities, two medical facilities, and the Washington County Sheriff's Office East Precinct location.[286]
- Repetitive loss (RL) properties within the City.

[286] City of Beaverton 2023 NHMP planning documentation

- Properties without flood insurance.
- Special Flood Hazard Areas (SFHAs) within the City.
- The potential for property damage from Beaverton Creek flooding is especially severe due to the inadequate size and moderate grade of the channel; culverts and bridges that constrict creek flow; and previously constricted banks that result in increased upstream flood heights.
    - The potential for property damage is significant due to the extensive commercial and residential development within the Beaverton Creek floodplain.
- The following creeks are located in the City and can be a source of flooding:
    - Beaverton Creek is the most significant creek in the City and flows through the major commercial area.
        - This creek has five tributaries within the City:
            - South Fork of Beaverton Creek
            - Johnson Creek
            - Hall Creek
            - Willow Creek
            - Cedar Mill Creek
    - Erickson Creek
    - South Johnson Creek
    - Fanno Creek
- The floodplains in the City are generally located along Beaverton Creek, Fanno Creek, and Fanno Creek tributaries. There are approximately 750 acres within the 100-year floodplain, and a total of 845.69 acres of tax lots are within the 100-year floodplain. Within these tax lots, there are 320 total structures valued at $339,537,830.
- There are 18 National Flood Insurance Program (NFIP)-designated flood loss properties dispersed throughout the City; however, concentrations of these properties may be found near the following locations:
    - Highway 217 and Denny Road. The flooding source is Fanno Creek.
    - Near Highway 217 between the Beaverton–Hillsdale Highway and Canyon Road. The flooding source is Beaverton Creek.
    - Near the intersection of Murry and Allen Boulevards. The flooding source is Johnson Creek.
- Flood loss estimates determined by Hazus-MH include[287]:
    - 10-year flood scenario
        - Number of buildings lost: 203
        - Loss estimate: $11,197,000
    - 50-year flood scenario
        - Number of buildings lost: 310

[287] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

- Loss estimate: $18,191,000
- 100-year flood scenario
  - Number of buildings lost: 355
  - Loss estimate: $22,809,000
- 500-year flood scenario
  - Number of buildings lost: 429
  - Loss estimate: $32,268,000

Table 61: Land Use Types in Beaverton within the 100-Year Floodplain

Land Use Type	Total Parcels in 100-Year Floodplain	Total Value of Exposed Parcels	Total Area in Jurisdiction (Acres)	Total Area in the 100-Year Floodplain (acres)	Percentage of Area in the 100-Year Floodplain
Agriculture	0	$0	71.54	0	0%
Commercial	204	$1,007,950,200	1978.34	571.73	28.9%
Forest	1	$59,240	86.91	2.73	3.14%
Industrial	2	$12,269,700	50.58	10.81	21.37%
Multi-Family Residential	112	$697,276,560	842.57	192.82	22.88%
Public	166	$371,981,710	2016.17	867.75	43.04%
Rural	0	$0	0	0	0%
Single-Family Residential	322	$175,225,090	3654.5	100.38	2.75%
Vacant	35	$2,925,210	396.96	50.09	12.62%
Other	86	$75,145,630	974.95	288.86	29.63%
Total	**928**	**$2,342,833,340**	**10,072.52**	**2085.17**	**20.70%**

Table 62: Buildings in Beaverton within FEMA-Mapped Floodplains

Building Classification	Buildings within Beaverton	Buildings within 100-Year Floodplain	Buildings within 500-Year Floodplain	Buildings within Combined 500-Year & 100-Year Floodplain
Total Buildings	28,220	480	171	651
Percentage of Buildings within Beaverton	100%	1.7%	0.6%	2.3%

3.3.6. Landslide

There is evidence that steep slopes within the City have experienced four minor and two major ancient slides. Other than these ancient slides, there are no known active locations susceptible to landslides. Potential impacts of and vulnerabilities to landslides are identified below.

3.3.6.1. Potential Impacts

Potential impacts from a landslide event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event.

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Mobility or access issues for residents due to blocked or damaged transportation routes.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income and property damage that may not be covered by insurance.
- Debris flows.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Power outages and natural gas leaks.
- Disruption of traffic due to damaged or destroyed transportation systems.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.6.2. Vulnerabilities

The type, magnitude, and extent of landslide events may vary based on the scale of the event.

- The potential for landslide impacts is relatively minimal except for small areas in the southwestern portion of the City.[288]

[288] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

- Per DOGAMI, 0.3% of building value within the City has a very high susceptibility to landslide exposure, 1.5% of building value within the City has a high susceptibility, and 31% of building value within the City has a moderate susceptibility.[289]
- One elementary school has a landslide deposit less than or equal to 15 feet and a 25% slope on the west side of the property, and one health care facility has a slope equal to or greater than 25% on its property.[290]
- The landslide hazard is pervasive in a large percentage of undeveloped land and may present challenges for future planning and mitigation efforts. Creating awareness of nearby areas susceptible to the landslide hazard is a significant step toward reducing risk for every community in Washington County.

[289] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[290] City of Beaverton 2023 NHMP planning documentation

3.3.7. Volcanic Ash

Volcanic activity is possible in mountains near the County. It is anticipated that ashfall from a volcanic eruption has the potential to impact the City, although the scale and types of impacts and vulnerabilities may differ depending on which volcano erupts, the level of eruption, and the wind direction during and after eruption. Potential impacts of and vulnerabilities to volcanic ash are identified below.

3.3.7.1. Potential Impacts

Though unlikely, the impacts of a significant ashfall can be substantial, including:

- Indirect injuries and deaths, such as those sustained during ash cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation. This includes public water systems that rely on outdoor reservoirs.
- The need to shelter individuals to protect them from poor air quality, including houseless persons and persons displaced from their residences due to poor residential air filtration systems.
- Delayed emergency response times due to decreased visibility and increased traffic hazards.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and cleanup activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.7.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environmental assets in the City are vulnerable to volcanic ash. This includes:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults. This includes those living in or spending time in the City's 18 assisted living facilities, 46 schools, and 18 medical facilities.
- People without access to effective dust masks, eye protection, and drinking water and food uncontaminated by ash.

- Critical transportation infrastructure, including State and County highways, arterial streets, collector streets, neighborhood routes, local streets, and eight TriMet stations and bus and rail service equipment.
- Equipment at the City's seven fire department facilities, three police facilities, and one public works facility.
- Other critical infrastructure, including the Clean Water Services field operations facility, medical centers and the hospital, communication structures, drainage systems, and emergency generators.
- Artwork and other items of cultural importance at the Patricia Reser Center for the Arts.

3.3.8. Wildland Fire

Due to the density of the built environment, the City cannot be impacted by wildland fire. The most recent Washington County Wildfire Protection Plan shows the City as a High Density Urban area that is not a Forest Service Community at Risk and is not in one of the plan's strategic planning areas for wildland fire protection. Historically, the City has been more likely to be affected by smoke and poor air quality due to wildland fires outside its boundaries.

3.3.8.1. Significant Events Since Adoption of the 2020 NHMP

The City has not been directly impacted by a wildland fire event since the 2020 NHMP was adopted. However, in September 2020, multiple wildfires occurred concurrently in the County, outside the County, and outside the state, and significant smoke from the fires drifted into the City. At this time, the Air Quality Index in the City was between 108 and 328, with particulate matter 2.5 micrometers or smaller ($PM_{2.5}$).[291]

Residents were advised to limit outdoor activities, susceptible populations (the very young, the elderly, and those who are frail) experienced increased breathing difficulties and outdoor events were cancelled, leading to economic impacts due to loss of revenue.

[291] The World Air Quality Index Project. (2022). Air Quality Historical Data Platform. City of Beaverton. https://aqicn.org/data-platform/register/

3.3.9. Windstorm, Including Tornado

The City sits at an elevation of 194 feet and historically has not experienced the same frequency of windstorms as that seen in parts of the county with higher elevations.

3.3.9.1. Potential Impacts

The potential impacts from a windstorm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event.

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked road and rail transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.9.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to windstorms, including tornadoes. This includes:

- Critical facilities and infrastructure identified by the City, including 46 schools, 18 medical facilities, 7 city facilities, 18 assisted living facilities, 5 fire department facilities, 2 police facilities, one Clean Water Services field operations facility, and one arts center.[292]

[292] City of Beaverton 2023 NHMP planning documentation

- Older buildings and infrastructure not built to withstand high winds, including manufactured homes and buildings. This may include the 50 critical facilities known to be built prior to 1993, which are 6 assisted living facilities, 9 medical facilities, including a level II hospital, 5 city facilities, including the public works operations facility and the municipal court, 29 schools, and the Washington County Sheriff's Office East Precinct location.[293]
- Equipment at the City's five fire department facilities, two police facilities, and one Clean Water Services field operations facility.
- Aboveground utility and power lines, and infrastructure including roads, bridges, and TriMet light rail.
- Other critical infrastructure, including communication structures and emergency generators.
- Trees and outdoor signs.
- If the windstorm is accompanied by rain, blowing leaves and debris may clog catch basins, which can contribute to localized inundation flooding.

[293] City of Beaverton 2023 NHMP planning documentation

3.3.10. Winter Storm

The City has an elevation of 189 feet and historically has not experienced the same frequency and intensity of winter storms as that seen in parts of the county with higher elevations. Heavy snowfall rarely occurs in Beaverton. When it does occur, many of the subsequent problems are related to the public's lack of familiarity in dealing with such conditions.

3.3.10.1. Potential Impacts

The potential impacts from a winter storm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event.

- Injuries or deaths, including from carbon monoxide poisoning, falls from slick or icy conditions, frostbite, and hypothermia.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components.
- Stranded travelers due to ice, snow, and transportation impacts.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- An increased number of house fires due to unsafe alternate heating methods.
- Significant property damage and loss of water due to frozen or damaged pipes or the thawing of frozen pipes.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property, causing blocked road and rail transportation routes.
- Downed or damaged power lines can lead to wildfires, and tree debris can create fuel load for wildfire.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including flooding.

3.3.10.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to winter storms. This includes:

- People who do not have access to sufficient heating, insulated clothing, or dry living conditions, including unhoused populations.
- Older adults and infants, people who take specific medications, people who have certain medical conditions, and people who have been drinking alcohol are at increased risk for hypothermia. This may include those living in or spending time in the City's 18 assisted living facilities, 46 schools, and 18 medical facilities.
- People improperly using generators and heating devices.
- Critical infrastructure and facilities vulnerable to winter storms include 46 schools, 18 medical facilities, 7 city facilities, 18 assisted living facilities, 5 fire department facilities, 2 police facilities, one Clean Water Services field operations facility, and one arts center.[294]
- Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of snow and ice landing on the roof. This may include the 50 critical facilities known to be built prior to 1993, which are 6 assisted living facilities, 9 medical facilities, including a level II hospital, 5 city facilities, including the public works operations facility and the municipal court, 29 schools, and the Washington County Sheriff's Office East Precinct location.[295]
- Critical transportation infrastructure, including State and County highways, arterial streets, collector streets, neighborhood routes, local streets, and eight TriMet stations and bus and rail service equipment.
- Equipment at the City's seven fire department facilities, three police facilities, and one public works facility.
- Other critical infrastructure, including communication structures and emergency generators.

[294] City of Beaverton 2023 NHMP planning documentation
[295] City of Beaverton 2023 NHMP planning documentation

3.4. Historical Events

Hazard events that have affected the entire planning area since the 2017 NHMP update are detailed in Volume I, Section 2. The City has experienced impacts from widespread extreme heat events since the 2020 City of Beaverton NHMP.

One disaster declaration was issued by the City since the 2020 NHMP update. A disaster declaration for the COVID-19 pandemic was in effect from March 13, 2020, to March 31, 2021. Although pandemic is not a hazard included in this NHMP, this declaration is noted because FEMA provided support and Hazard Mitigation Grant Program funding during the event.

3.5. Overall Vulnerability

Based on the analysis completed by the Technical Committee, extreme heat, windstorm, including tornado, winter storm, drought, and earthquake present the highest relative risk to the City of Beaverton. These hazards can create widespread events, and all populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City can be vulnerable to these hazards.

Areas of greatest vulnerability to these hazards within the City include:

- Higher vulnerability populations, such as those with preexisting health conditions, older adults, children, and pregnant women. This may include those living in or spending time in the City's 18 assisted living facilities, 46 schools, and 18 medical facilities.
- Populations that are unhoused, do not have access to private transportation, and/or are without access to air conditioning, cooling equipment, sufficient heating, and clean water.
- People living, working, or spending time in heat islands within the City.
- Populations with limited income and financial resources.
- Populations whose primary language is not English.
- Industries that can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic impacts to the City, including loss of local revenue due to business and property tax losses, reduced future revenues, reduced recreation and tourism activity, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Critical facilities and infrastructure identified by the City, including 46 schools, 18 medical facilities, 7 city facilities, 18 assisted living facilities, 5 fire department facilities, 2 police facilities, one Clean Water Services field operations facility, and one arts center.[296]
- Older buildings and infrastructure not built to current building codes or seismic standards may be more vulnerable. This may include the 50 critical facilities known to be built prior to 1993, which are 6 assisted living facilities, 9 medical facilities, including a level II hospital, 5 city facilities, including the public works operations facility and the municipal court, 29 schools, and the Washington County Sheriff's Office East Precinct location.[297]

[296] City of Beaverton 2023 NHMP planning documentation
[297] City of Beaverton 2023 NHMP planning documentation

- There is one assisted living facility and one elementary school that are located on an active fault line.[298]
- Critical transportation infrastructure, including State and County highways, arterial streets, collector streets, neighborhood routes, local streets, and eight TriMet stations and bus and rail service equipment.
- Equipment at the City's five fire department facilities, two police facilities, and one Clean Water Services field operations facility.
- Water supply in the upper Tualatin River, the City's source of groundwater.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment and safe growth analysis examine the ability of the City to implement and manage a comprehensive mitigation strategy. Strengths, opportunities, and resources of the jurisdiction are identified to develop an effective hazard mitigation action plan. The capabilities identified in this assessment were evaluated collectively to develop feasible recommendations that support the implementation of effective mitigation activities.

A capability questionnaire was distributed to the City of Beaverton Technical Committee to initiate this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities. The Technical Committee also completed a safe growth analysis to identify potential gaps in growth guidance instruments and improvements that could be made to reduce vulnerability to future development.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances within the City that can prevent and reduce the impacts of hazards.

The City's Comprehensive Plan, Capital Improvement Plan, Local Emergency Operations Plan, Stormwater Management Plan, and Community Wildfire Protection Plan address natural hazards, identify projects that may be included in the mitigation strategy, and may serve as vehicles for implementing mitigation actions.

The City's Comprehensive Plan 2035, created in 2022, includes discussion of natural hazards and the need for increasing awareness about hazards and ways to mitigate them. Additionally, land use policies discourage development or redevelopment within natural hazard areas. The Comprehensive Plan also discusses the need to provide future growth through strategic infill, while also providing adequate space for expected future growth in areas located outside natural hazard areas.

The City's capital improvement program provides funding for hazard mitigation projects identified in this NHMP. The program also limits expenditures on projects that would encourage development in areas vulnerable to natural hazards. The City's infrastructure policies do not limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.

[298] City of Beaverton 2023 NHMP planning documentation

A Climate Action Plan, adopted in 2019, contains 86 actions across 5 framework categories designed to reduce community emissions and safeguard Beaverton from the impacts of higher temperatures. The plan serves as the guiding document for the city's climate action work and promotes mitigation efforts, such as planning for flooding, landslides, and wildfire.

The continuity of operations plans for some City departments were complete in response to the COVID-19 pandemic.

Transportation planning initiatives, including the Transportation System Plan, Active Transportation Plan, and Transportation Element of the City's Comprehensive Plan, discuss designing facilities to respect the characteristics of natural hazards. These initiatives may be used to identify projects that can be included in the mitigation strategy and can be used to implement mitigation actions. The Regional Disaster Preparedness Organization with Metro is working to update the regional Emergency Transportation Route maps, and the City is a part of this effort.

The City's corridor plans recognize the need to avoid areas susceptible to the impact of natural hazards and to mitigate natural hazards in such areas. Beaverton transportation planning initiatives, including the Transportation System Plan and Active Transportation Plan, limit access to identified hazard areas and are used to guide growth into safe locations. The City and its transportation plans do not have movement systems designed to function under disaster conditions, such as during an evacuation. The community also supports a Bicycle Advisory Committee to promote bicycling and related modes of active transportation within and around the City of Beaverton.

Land use planning and ordinances are adequately administered and enforced and are an effective measure for reducing hazard impacts. These include zoning, subdivision, floodplain, and natural hazard-specific ordinances and the utilization of flood insurance rate maps.

The City's Community Development Department leads and facilitates review of land use applications and enforces site plan review requirements. The City of Beaverton utilizes the most current building codes as they are adopted by the State of Oregon. The City's building code contains provisions to strengthen construction to withstand hazard forces, including efforts to elevate structures.

City zoning ordinances within the development code conform to the City's Comprehensive Plan by discouraging development or redevelopment within areas known to be affected by natural hazards. Ordinances include prohibiting development within wetlands, floodways, and floodplains, or filling areas thus identified. Community maps also include natural hazard overlay zones that establish conditions for land use within such hazard zones. Rezoning procedures recognize natural hazard areas as off limits to any zoning changes that would allow for increased activity or development in the area, but zoning changes allow greater intensity or density of use by using infill in currently established sections of the City.

The City's development code regulates subdivision proposals to minimize flood damage by including requirements for adequate drainage that will reduce exposure to current and future structures from flood damage by establishing base flood elevations. The City does support development of conservation subdivisions that devote at least half of potentially buildable land area to undivided, permanently protected open space; nor does it allow conservation subdivisions or cluster subdivisions in order to conserve environmental resources or permit density transfer where hazard areas exist.

City environmental systems discourage development in areas currently or potentially affected by hazards. Identified hazard areas are mapped. City policies, including land use policies, are designed to maintain and restore protective ecosystems. The City does not have policies that provide incentives to development that is located outside protective ecosystems.

Tualatin Valley Fire & Rescue (TVF&R) provides fire protection and emergency medical services to the City. TVF&R's Insurance Services Office (ISO) rating is two. Many City policies and procedures are related to and support the goals in this NHMP, safe growth objectives, and public safety. The monitoring

and implementation section of the NHMP covers these and all other hazard mitigation strategies discussed in the plan.

4.1.1. National Flood Insurance Program Compliance

Participation in the NFIP is based on a voluntary agreement between a community and FEMA. For communities that adopt a floodplain management ordinance to reduce flood risks to new construction, federally backed flood insurance is made available to property owners in the community. Compliance with the NFIP, however, extends beyond participation in the program. The three basic components of the NFIP include floodplain identification and mapping risk, responsible floodplain management, and making flood insurance available to property owners.

An RL property is a property insured under the NFIP that the program has paid at least two claims of more than $1,000 in any 10-year period since 1978, regardless of any change(s) of ownership during that period. As of September 30, 2021, there are six City-identified RL properties in the City. FEMA notes that there are seven properties; however, one is outside City limits. There are no severe repetitive loss (SRL) properties in the City.

All but one of the RL properties experienced two losses each. The other RL property has experienced three losses. There are no clusters or concentrations of RL properties within the City; however, two of the properties are neighboring homes that suffered losses during the same event. The second loss for each of these two properties occurred at different times.

4.1.1.1. National Flood Insurance Program Details

Insurance Summary

There are currently 275 NFIP policies in force in the City with coverage totaling $80,376,300. A total amount of $448,027 has been paid on 31 claims, and no substantial damage claims have been paid.

There are 355 structures exposed to the 1% annual chance of flooding within the community.[299]

Staff Resources

There are no barriers to running an effective NFIP program in the City. The City's NFIP Coordinator is certified and works in the Community Development Department. The planner who executes floodplain management functions also handles development applications outside the floodplain. NFIP administration services in the City include permit review for new development in the floodplain and alterations, GIS management of floodplain data and determining the base flood elevation, education with homeowners and property owners, coordination with the Community Development Department on structural reviews, and review of capital projects affecting the floodplain.

Compliance History

The City is in good standing with the NFIP and there are no outstanding compliance issues. The most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC) was on May 25, 2016.

The City will continue to maintain NFIP compliance during the next five years of NHMP implementation by enforcing floodplain management requirements, including addressing flood concerns that may arise in developing new construction and making substantial improvements to structures located within SFHAs;

[299] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

maintaining and using floodplain mapping as part of the City's land management plan; and making code amendments needed to maintain compliance.

Regulation

The City entered the NFIP on February 1, 1974, and retains both digital and paper flood insurance rate maps (FIRMs). Floodplain development regulations meet the minimum FEMA and state requirements.

To receive a permit for development within the floodplain, the applicant must provide the following information in addition to that normally required for a building permit: elevation of the lowest floor, and certification showing that floodproofing has been maintained on the structure. The City Engineer may also require the applicant to provide a detailed hydrologic data report and an environmental assessment report. There are also established construction standards for property built in SFHAs. Section 8.02.140 of the City's building code includes a Structural Specialty Code Appendix G Flood-Resistant Construction, which provides comprehensive regulations aimed at minimizing public and private losses due to flood conditions in specific flood hazard areas through the management of flood hazard areas.

Community Rating System

The City does not participate in the NFIP Community Rating System program.

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions.

The City's Planning Commission is the decision-making authority for applications that deal with uses of land. The commission also advises the City Council on development code text amendments, zone changes, and applications to amend the City's Comprehensive Plan. The Mitigation Technical Committee works together effectively to update and maintain the NHMP.

The Public Works Operations and Maintenance Division administers maintenance programs to reduce risk, including tree trimming and landscaping, street inspections, underground sanitary sewer and storm drainage pipes, and water quality facilities. The City also has in place multiple effective mutual aid agreements and planning partnerships, including intergovernmental agreements, the Oregon Water/Wastewater Agency Response Network, Washington County Emergency Management Cooperative, the Regional Disaster Preparedness Organization, and the Cooperative Public Agencies of Washington County.

The City of Beaverton has adequate staffing levels to enforce regulations. Staff are trained on hazards and mitigation efforts, and coordination on mitigation initiatives with staff is effective. The Chief Building Official is part of the Community Development Department and is a full-time position. This department also employs full-time staff dedicated to building inspection, planning and zoning, site development, transportation planning, and floodplain management. The Emergency Management Program includes full-time staff and reports directly to one of the Assistant City Managers.

Staff with the capacity to support the mitigation strategy work in multiple City departments. Such staff includes planners and engineers with an understanding of natural hazards; engineers and professionals trained in construction practices related to buildings and infrastructure; staff with education or expertise to assess vulnerability to hazards; and GIS staff and coordinators.

The Climate Action Task Force serves as a community engagement forum for climate action. It enhances the City Council's awareness of community perspectives related to climate change and provides feedback on the potential impact of climate action-related projects and activities on members of the community affected by natural hazards such as those included in this NHMP.

Additionally, the City's many technical capabilities include assets that have been used to assess or mitigate risk and are available to do so in the future. Warning systems include the Everbridge Public Warning Platform and Washington County's OR-Alert mass notification alert system. Grant writing is completed by individual departments as needed. The City maintains a robust GIS program that has created mapping products specific to each department. Hazard data and information can be pulled from a variety of sources, including historical records and DOGAMI.

4.3. Education and Outreach Assessment

Education and outreach programs and methods currently in place were assessed to determine the City's capabilities. These programs and their communications channels may be used to implement mitigation activities and communicate hazard-related information.

The City of Beaverton Emergency Management Program participates in public engagement, education, and outreach efforts using a variety of methods. Mitigation and preparedness resources for businesses, communities, older adults, and special needs populations are available on the City's website, and the City's social media accounts and "Your City" newsletter are utilized to increase awareness and publicize educational material.

Additionally, the City involves residents in mitigation efforts through the support of a Community Emergency Response Team (CERT), Neighborhood Association Committee, Homeowners Owners Associations, and the Beaverton Committee for Community Involvement. There are also Neighborhood Emergency Preparedness Fairs, where both English- and Spanish-language print materials and hazard guidance are distributed. The Neighborhood Association Committee's Neighborhood Matching Grant Program is available to fund resilience projects and related efforts.

4.4. Financial Assessment

The City has access to, or is eligible to potentially use, the following funding resources for hazard mitigation initiatives:

- Capital improvements project funding
- Authority to levy taxes for specific purposes
- Fees for water, sewer, gas, and/or electric services
- Impact fees for new development
- Stormwater utility fees
- Incurrence of debt through general obligation bonds and/or special tax bonds
- Incurrence of debt through private activities
- Federal funding sources, including the Office of Housing and Urban Development (HUD) Community Development Block Grant (CDBG); the Department of Homeland Security's Urban Areas Security Initiative (UASI); FEMA's Building Resilient Infrastructure and Communities (BRIC) program; FEMA's Hazard Mitigation Assistance Grants; and the Department of Homeland Security's State Homeland Security Program (SHSP)
- State funding programs, including the State Preparedness and Incident Response Equipment (SPIRE) Grant Program

4.5. Capability Expansion and Improvement

Actions that can expand and improve existing authorities, plans, policies, and resources for mitigation include continuing to update City plans as necessary to ensure they are current and reflect the needs of

the community; budgeting for mitigation actions; passing policies and procedures that support mitigation actions; and adopting and implementing stricter mitigation regulations.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iii), §201.6(c)(3)(iv), and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) directs local mitigation plans to describe a jurisdiction's hazard mitigation actions and to establish a strategy for implementing current and proposed actions. As such, all requirements set forth in 44 CFR provide guidance for developing state and local mitigation plans that lead to the creation and support of the mitigation strategy.

5.1. Mitigation Goals

The Washington County NHMP Steering Committee reviewed and evaluated goals outlined in the 2017 Washington County NHMP; the 2020 City of Beaverton NHMP; the 2011 LHMPs for the Cities of Cornelius and Forest Grove; and the 2020 State of Oregon NHMP. The goals from each plan were grouped by topic and synthesized to create the seven goals detailed in Volume I, Section 3. These goals are also the basis of the Washington County NHMP and discuss what the Steering Committee intends to accomplish by implementing this plan.

5.2. Mitigation Successes

Beaverton Purple Pipe[300]

The Beaverton Purple Pipe program is a water system that will route cleaned, non-potable stormwater for irrigation and stream recharge to irrigate green spaces like parks, school grounds, and yards. The program waters green spaces and conserves chlorinated, fluoridated high-quality water for drinking and other consumable uses.

As of June 2022, approximately 3.5 miles of Purple Pipe have been installed in the South Cooper Mountain area. The distribution system is anticipated to be built-out in this area over a five-year period. Also as of June 2022, design of the stormwater treatment system to filter and treat raw stormwater received by the Sterling Park Stormwater Detention Facility and other associated improvements is complete. Construction is anticipated to begin in September 2022 to achieve substantial completion by June 2023.

Willamette Water Supply

The Willamette Water Supply will provide seismic resiliency and a separate source of drinking water with separate transmission pipeline and water storage facilities

[300] City of Beaverton. (n.d.). Beaverton Purple Pipe. https://beavertonoregon.gov/1523/Beaverton-Purple-Pipe

5.3. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on the requirements in 44 CFR §201.6(c)(4)(ii), the vulnerability and capabilities assessment for the City was carefully reviewed and considered when developing the mitigation actions for this plan. The City's Technical Committee will establish a process in which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into the existing local planning strategies.

Once the plan is adopted, the committee will coordinate implementation with the responsible parties in the City and with external stakeholders as needed. The primary means for integrating mitigation strategies will be through the revision, update, and implementation of plans and regulations as feasible, including the City's Comprehensive Plan, Capital Improvement Plan, and land development regulation.

The members of the City's Technical Committee will remain charged with ensuring the goals and strategies of new and updated local planning documents for their jurisdictions and special districts are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.3.1. Comprehensive Plan

The most extensive update to the City's Comprehensive Plan occurred in 2002. Plan elements are being updated as necessary to reflect the current and future condition and needs of the community, including recent development, demographic trends, and projected growth. Typically, elements are updated every 10 years. Additional details about hazard mitigation will be added to plan elements as they are updated, as applicable.

5.3.2. Building and Zoning Codes

The City's building code implements and enforces the State of Oregon building codes. These codes include project specifications to mitigate against the potential effects of earthquakes, expansive soils, and flooding, and will be reviewed and amended, as necessary. Ongoing City GIS analyses include studying the age of buildings located in Beaverton against major changes to the building code in an effort to mitigate against seismic hazards. This involves modifying the building code as needed.

5.3.3. Public Engagement, Education, and Outreach

The City of Beaverton Emergency Management Program will continue to participate in public engagement, education, and outreach efforts using a variety of methods. Mitigation and preparedness resources for businesses, communities, older adults, and those with special needs are available on the City's website and the City's social media accounts. The "Your City" newsletter is utilized to increase awareness and publicize the availability of educational material. Hard copies of such material is offered in City buildings with a high-traffic volume to reach persons who may not have access to the Internet.

Additionally, the City will continue to involve residents in the Community Emergency Response Team (CERT), Neighborhood Association Committees, Homeowners Owners Associations, and the Beaverton Committee for Community Involvement. Neighborhood Emergency Preparedness Fairs offer the opportunity to share English- and Spanish-language material, and the Neighborhood Association Committee's Neighborhood Matching Grant Program will continue to be available for projects that promote resiliency.

5.3.4. Land Development Regulations

The City's land development code, implemented by the Community Development Department, regulates residential land use districts, commercial land use districts, employment and industrial land use districts, and multiple other land use districts. This code includes specifications for the range of built and natural environmental projects and includes landscape, open space, and natural areas design standards, floodplain regulations, habitat friendly development practices, trees and vegetation, utility undergrounding, and natural resources.[301]

Updates to this code and additions for other areas of hazard mitigation strategies can be integrated into future amendment efforts, as appropriate.

5.3.5. Floodplain Management Program and/or National Flood Insurance Program

The City of Beaverton Community Development Department and Emergency Management staff will continue to review information about RL properties and incorporate new findings into the City's mitigation strategy, as appropriate. The City's floodplain management program is implemented through the City's code. Updates to the codes relating to floodplains and additions for other areas of hazard mitigation can be integrated into future amendment efforts.

5.3.6. Stormwater Management Plans and Procedures

The City will review and update stormwater codes, including Chapters 4.06 and 4.07, as needed to support mitigation goals.

5.3.7. Emergency Plans That Address Evacuation and Sheltering

The City works with Washington County on sheltering efforts as needed and will continue to do so.

5.3.8. Funding Opportunities

The City of Beaverton Emergency Management Program will continue to review annual, post-disaster, and stand-alone grant opportunities for potential mitigation project funding opportunities. Various City departments develop Capital Improvement Programs and review them on an annual basis. The NHMP Steering Committee will work with these departments to identify action items from the City's Capital Improvement Plan that may be integrated into appropriate sections of the plan.

[301] City of Beaverton. (2022). Beaverton Development Code. https://online.encodeplus.com/regs/beaverton-or/doc-viewer.aspx#secid--1

6. Action Items

The City of Beaverton's action items in the 2020 NHMP were determined by the 2020 City of Beaverton planning team. Action items listed therein and the status of each action are outlined in Section 6.1 below.

New action items for the 2023 NHMP were determined by the City's Technical Committee and based on the review of the community's risk assessment; the City's existing capabilities; and the status of previously identified mitigation action items. This comprehensive range of actions considers existing local plans and regulations; structure and infrastructure projects; natural systems protections; and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.2 and 6.3 below. Additional information about how these actions were developed, evaluated, and prioritized is in Volume I, Section 3.

6.1. Status of City of Beaverton Action Items from the 2020 City of Beaverton NHMP

Table 63: Status of Action Items from the 2020 NHMP

Action Item Number*	Action Item Description	Hazard(s) Addressed	Current Status
Short-Term 2	Reduce non-structural hazards in homes, schools, businesses, and government offices.	Earthquake	Ongoing
Short-Term 3	Pursue structural mitigation of critical facilities, infrastructure, public buildings, and schools for the earthquake threat.	Earthquake	Ongoing
Short-Term 4	Improve technical data and analysis of earthquake hazards.	Earthquake	Current
Long-Term 1	Establish a program aimed at helping private property owners and businesses preform structural retrofitting.	Earthquake	Ongoing
Long-Term 3	Develop public/private partnerships to pursue efficient methods to retrofit structures.	Earthquake	Ongoing
Long-Term 4	Improve local capabilities to preform earthquake building safety evaluations.	Earthquake	Ongoing

Action Item Number*	Action Item Description	Hazard(s) Addressed	Current Status
Long-Term 5	Provide information to Beaverton residents about earthquakes and opportunities to mitigate earthquake hazards in their homes.	Earthquake	Current
Short-Term 2	Analyze each repetitive loss property to identify viable mitigation options.	Flooding	Ongoing
Short-Term 3	Develop mitigation and preparedness measures for critical public infrastructure and facilities located in flood hazard areas.	Flooding	Ongoing
Long-Term 1	Develop acquisition and management strategies to preserve open space in the floodplain.	Flooding	Ongoing
Long-Term 1	Improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in those areas.	Landslide	Current
Long-Term 2	Limit activities in identified hazard areas through regulation and public outreach.	Landslide	Ongoing
Long-Term 3	Protect existing development in landslide-prone areas.	Landslide	Ongoing
Long-Term 3	Develop and maintain a comprehensive impacts database and when possible, map historical severe weather events in Beaverton.	Severe Weather**	Ongoing
Short-Term 1	Identify critical facilities and industries that may be affected by ashfall and collaborate with them on ashfall emergency response.	Volcano, Volcanic Ash	Ongoing
Short-Term 2	Collaborate with U.S. Geological Survey Cascades Volcano Observatory and related agencies to increase awareness of volcanic response efforts through ashfall-related messages.	Volcano, Volcanic Ash	Ongoing
Short-Term 2	Identify and pursue funding opportunities to develop and implement local mitigation activities.	Multi-Hazard	Ongoing
Short-Term 3	Develop public and private partnerships to foster natural hazard program coordination and collaboration within the Beaverton Urban Service Boundary.	Multi-Hazard	Ongoing
Short-Term 4	Encourage Beaverton households and businesses to purchase natural hazard insurance.	Multi-Hazard	Ongoing
Long-Term 1	Increase technical knowledge of natural hazards and mitigation strategies in Beaverton and implement policies and programs based on this knowledge.	Multi-Hazard	Ongoing

Action Item Number*	Action Item Description	Hazard(s) Addressed	Current Status
Long-Term 3	Create and maintain a system to support populations with special needs within Beaverton's city limits.	Multi-Hazard	Ongoing

* Number given to action item in 2020 City of Beaverton NHMP
** Not a hazard in the 2023 Washington County NHMP

6.2. City of Beaverton Action Items: 2023 Washington County NHMP

Table 64: City of Beaverton Action Items

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
Short-Term 1*	Identify funding sources for implementing earthquake mitigation in Beaverton.	Earthquake	
Long-Term 1	Harden and improve the City water system.	Earthquake	
Long-Term 2	Improve and replace the City sewer system.	Earthquake	
Long-Term 3	Improve, replace, and expand the City stormwater system.	Earthquake	
Long-Term 2*	Provide flood event education and outreach to households and businesses.	Flooding	
Long-Term 5*	Update the City code to improve risk reduction and prevention of natural hazard impacts.	Flooding	
Long-Term 6*	Create a regional partnership to reduce flood loss across the region.	Flooding	
Long-Term 2*	Establish a plan for ash removal following a volcanic event.	Volcanic ash	

* Number given to action item in 2020 City of Beaverton NHMP

6.3. Mitigation Action Information Worksheets

Table 65: Identify Funding Sources for Implementing Earthquake Mitigation

Mitigation Action Information			
Title of action	Identify Funding Sources for Implementing Earthquake Mitigation		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☒		Natural systems protection ☒ Public education/awareness ☒
Action description	Research and identify viable funding sources for implementing a range of earthquake mitigation strategies throughout the City.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Understanding the variety of funding sources that are available for earthquake mitigation actions and strategies may increase the number of mitigation projects that can be completed within the City.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☒	Goal 4 ☐ Goal 5 ☒ Goal 6 ☒	Goal 7 ☐
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	To be determined		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Implementation of earthquake mitigation projects that result in the protection of people and property throughout the City.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 66: Harden and Improve the City Water System

Mitigation Action Information			
Title of action	Harden and Improve the City Water System		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Make the City's water supply more resilient to earthquake hazards by seismically hardening and improving the system.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Water is critical for public drinking, firefighting, and sanitation and ensuring it is resilient against earthquake hazards it vital to community health and recovery.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	To be determined		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)			**Financial Benefit(s) (Est. Cost x 6)**
Reduction of risk to people and property from earthquakes and lack of water.			To be determined

Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 67: Improve and Replace the City Sewer System

Mitigation Action Information			
Title of action	Improve and Replace the City Sewer System		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Assess the seismic strength of the City's sewer system and develop improvements accordingly.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	The City's sewer system could be vulnerable to seismic activity. If damaged, the system could release untreated water or sewage into the City.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	To be determined		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)			**Financial Benefit(s) (Est. Cost x 6)**
Decrease or eliminate earthquake risk to City's sewer system.			To be determined

Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 68: Improve, Replace, and Expand the City Stormwater System

Mitigation Action Information			
Title of action	Improve, Replace, and Expand the City Stormwater System		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Assess the seismic strength of the City's stormwater system and develop improvements accordingly.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	The City's stormwater system could be vulnerable to seismic activity. If damaged, the system could release untreated water into the City and increase flooding hazards.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	To be determined		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)			**Financial Benefit(s) (Est. Cost x 6)**
Decrease or eliminate earthquake risk to City's stormwater system.			To be determined
Project Timeline			

Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 69: Provide Flood Event Education and Outreach to Households and Businesses

Mitigation Action Information	
Title of action	Provide Flood Event Education and Outreach to Households and Businesses
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	1. Identify and map vulnerable populations. 2. Create flood education and outreach aimed at specific populations (i.e. schools, households, businesses, etc.). 3. Identify and provide mitigation guidance to owners of properties at risk from flooding. 4. Recruit individuals to speak to households, and businesses/employees about flood issues. 5. Develop a "Clean Stream" sponsorship program, using the "Friends of Fanno Creek" model. Erect signage recognizing individuals, households, businesses, and organizations committed to the on-going care of a waterway section. 6. Raise awareness level of property owners and developers that impacts upstream result in impacts downstream, and lack of stormwater best management practices can result in an increase in flooding events. 7. Educate private property owners on restoring natural systems within the floodplain to manage riparian areas and wetlands for flood abatement. 8. Erect "monuments" over piped creeks throughout the city and floodplain elevation makers to bring flood awareness to home and business owners who live near them. 9. Educate public on the need for them to maintain their private water quality and water detention facilities. Internal partners: Emergency Management Public Works Department, and Community Development Department. External partners: Clean Water Services, Tualatin River Watershed Council, Tualatin Riverkeepers, Insurance Information Service of Oregon and Idaho, Washington County, Department of Land Conservation and Development, and Oregon Department of Emergency Management
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Outreach to homeowners and vulnerable populations increases whole community flood mitigation in the City.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☒ Goal 7 ☒ Goal 2 ☒ Goal 5 ☐ Goal 3 ☒ Goal 6 ☐

Integration into other initiatives	To be determined
Alignment with existing plans and policies	To be determined

Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA

Estimated Cost	To be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Increased flood mitigation throughout the City for people and property.	To be determined

Project Timeline
Expected Timeline for Completion
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 70: Update the City Code to Improve Risk Reduction and Prevention of Natural Hazard Impacts

Mitigation Action Information	
Title of action	Update the City Code to Improve Risk Reduction and Prevention of Natural Hazard Impacts
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	1. Remove barriers in City codes and planning regulations that prevent best management practices in urban design. 2. Protect critical and essential facilities against flood damage at the time of initial construction. 3. Consider increasing regulations for all new fill, grading, and dredging in floodplain areas. 4. Regulate to prevent construction of flood barriers which will unnaturally divert floodwaters or increase flood hazards. 5. Review and update City flood ordinance. Provide additional, more stringent standards designed to encourage sound floodplain management, reduce flood risks, and potentially allow property owners to obtain flood insurance at a lower premium rate. 6. Write and implement new code requiring developers to install permeable surfaces to reduce stormwater runoff volume and encourage aquifer recharging via increased stormwater percolation. 7. Consider adopting stricter elevation requirements for development within the floodplain. 8. Develop codes and ordinances to require owners of private water quality and water detention facilities to maintain them so that they can perform their required function and engineered capacity. Internal partners: Community Development and Public Works Department. External partners: Clean Water Services, Natural Resources Conservation Service, Soil and Water Conservation District, Washington County, and other cities.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Create mitigation to flooding before construction or renovation of buildings to increase resiliency in the City.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☒ Goal 7 ☐ Goal 2 ☒ Goal 5 ☒ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	To be determined

Alignment with existing plans and policies	To be determined
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Increased flood mitigation throughout the City for people and property.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 71: Create a Regional Partnership to Reduce Flood Loss Across the Region

Mitigation Action Information	
Title of action	Create a Regional Partnership to Reduce Flood Loss Across the Region
Type of action	Plans/regulations ☒ Natural systems protection ☒ Structure and infrastructure project ☒ Public education/awareness ☒
Action description	1. Work flood issues on a regional basis to avoid moving flood problems to other jurisdictions. 2. Create a regional process for naming un-named streams. 3. Work with regional partners including the City, Clean Water Services, and the State Floodplain Manager to improve floodplain data for the City that will support conducting future full risk analyses in Beaverton. Internal partners: Community Development and Public Works Department. External partners: Clean Water Services, Natural Resources Conservation Service, Soil and Water Conservation District, Washington County, and other cities.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Working at the regional level will help to conduct future full risk flooding analyses in Beaverton.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☒ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	To be determined
Alignment with existing plans and policies	To be determined
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Understanding the full flood risk of the City will allow for proper mitigation against the hazard citywide through plans/regulations, structure and infrastructure projects, natural systems protection, and public education and awareness actions.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 72: Establish a Plan for Ash Removal Following a Volcanic Event

Mitigation Action Information	
Title of action	Establish a Plan for Ash Removal Following a Volcanic Event
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	1. Educate residents on what they can do to assist in clean-up and debris removal efforts following a volcanic event. 2. Assist the public in removing ash by developing a system for ash removal. 3. Develop public and private partnerships to ensure proper clean-up. Internal partners: Emergency Management, Public Works Department, and Recycling/Sustainability. External partners: Washington County and solid waste haulers.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☒ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Volcanic ash from nearby volcanic activity could impact the City, its population, and its operations.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☒ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be determined
Alignment with existing plans and policies	To be determined
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management.
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Coordinated response to volcanic ash removal will speed up clean up and recovery.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Annex B: City of Cornelius

1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for the City of Cornelius was the Fire Division Chief-Fire and Life Safety.

1.2. Annex Organization

This annex has six sections that satisfy mitigation requirements in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

The information provided in this annex is for the City of Cornelius alone. All pertinent information that is not identified in this annex is identified in other sections of this NHMP or within the respective appendices.

1.3. NHMP Adoption Process

Once the Washington County NHMP received the designation “Approvable Pending Local Adoption” from the Federal Emergency Management Agency (FEMA), the City presented the plan to City Council for final public comment and local adoption. A copy of the resolution was inserted into the NHMP and is held on file in the City of Cornelius and Washington County.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

City officials recognize the benefits of having a long-term, all-hazards approach to mitigating natural hazards. The passage of the Disaster Mitigation Act of 2000 (DMA 2000) enabled City officials to recognize the benefits of having a long-term, all-hazards approach to hazard mitigation and mitigating natural hazards. The City's involvement in the Washington County NHMP represents the collective efforts of the NHMP Steering Committee members, all participating local Technical Committee members, the public, and stakeholders.

The City developed this annex in accordance with guidance outlined in 44 CFR §201.6(c)(5) of DMA 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in the geographical area of the City.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP. An open involvement process was established for the public and all stakeholders, which provided an opportunity for everyone to be involved in the planning process and make their views known.

Two teams worked simultaneously on this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of points of contact from each plan participant. The group met to discuss countywide topics, including hazards and mitigation strategies. The points of contact were the leads of their local Technical Committee.
2. **Local Technical Committee:** Each plan participant had a Technical Committee that consisted of the Steering Committee representative for that jurisdiction or special district as well as designated representatives from within the organization. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. Technical Committee of the City of Cornelius

This annex within the NHMP was developed by the City of Cornelius's local Technical Committee with support from IEM, a consulting firm hired to assist with the planning process. The efforts of the committee were led by the City of Forest Grove's Fire Division Chief, Fire and Life Safety, throughout 2022. The cities of Cornelius and Forest Grove share many staff and planning initiatives, including members of the 2023 NHMP Technical Committee.

Table 73: City of Cornelius Technical Committee Members for the 2023 NHMP*

Job Title and Department	Role in Committee and Planning Process
Fire Division Chief – Fire and Life Safety, City of Forest Grove Fire Department	General oversight, hazard identification, and plan development.
Fire Chief/Emergency Management Coordinator, City of Forest Grove Fire Department	Hazard identification and plan development.

*Note: The cities of Cornelius and Forest Grove shared Technical Committee members.

IEM also supported or led the following activities associated with the development, approval, and adoption of the plan:

1. Facilitated the NHMP update process.
2. Based on committee direction and stakeholder and community input, prepared the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.

3. Submitted the proposed plan to the State of Oregon Department of Emergency Management (OEM) and FEMA for review and approval, and completed edits or revisions requested by these organizations.
4. Coordinated the plan adoption processes with the City, OEM, and FEMA.

2.3. Public Participation

Public participation is an important component of this NHMP and also a required element as outlined in 44 CFR §201.6(c)(5), FEMA's mitigation planning guidance. Public participation offered community members the opportunity to voice their ideas, interests, and opinions about hazards that affect them and the best way to mitigate hazard impacts. As the City implements the mitigation actions identified in this annex, there will be additional opportunities for public participation.

Plan participants used a survey to collect information about community perceptions of natural hazards and priorities. The Steering and Technical Committees used the results to inform their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP. See Appendix B of the NHMP for additional information about the survey and opportunities for public comment.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist the City of Cornelius in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards.

3.1. Changes in Development Since the 2011 NHMP Update

(In compliance with 44 CFR §201.6(d)(3))

The population of the City has grown approximately 14% since 2010. Based on the 2021 population, the density of residents is 6,749 people per square mile. This is an increase of approximately 815 people per a square mile since 2010.

There has been an increase in single-family residential development to meet the demand of population growth. The City has also been focused on increasing availability of industrial warehouse and land to increase employment opportunities and meet local demand. There has been a focus on updating and retrofitting infrastructure, specifically transportation systems, to increase community resiliency. The continued partnership between the cities of Cornelius and Forest Grove allows the cities to pool resources, including staff, to implement mitigation strategies.

3.2. Community Profile

This section provides information on City-specific characteristics. Additional discussion of the planning area's community characteristics is outlined in Appendix A of the NHMP.

Some community characteristics may suggest how natural hazards may impact communities and how communities choose to plan for natural hazard mitigation. Identifying and considering the City-specific

assets during the planning process may assist in identifying appropriate measures for natural hazard mitigation.

The following table reflects the community demographics in the City. This information was gathered from the U.S. Census, Portland State University, and the City of Cornelius.

Table 74: Community Demographics*

Population	Total	Percent Change
2010 population[302]	11,869	
2021 population[303]	13,498	14%
2035 forecasted population[304]	18,102	+34%
Race and Ethnicity[305]	**Total**	**Percent of Population**
White alone	8,162	64%
Hispanic/Latino/a/x of any race	6,069	48%
Two or more races	584	5%
Asian alone	326	3%
Black or African American alone	175	1%
American Indian and Alaska Native alone	25	0.2%
Native Hawaiian and Other Pacific Islander alone	0	0%
Language Spoken at Home[306]	**Percent of Population**	
English only	54%	
Spanish	43%	
Asian and Pacific Island languages	2%	
Indo-European languages	0.4%	
Other languages	0.5%	

[302] United States Census Bureau. (2010, April 1). QuickFacts Cornelius City, Oregon. Accessed September 9, 2022, from https://www.census.gov/quickfacts/fact/table/corneliuscityoregon,US/PST045221
[303] Portland State University Population Research Center. (2022). 2021 Certified Population Estimates, July 1. https://www.pdx.edu/population-research/population-estimate-reports
[304] Oregon ISO. (2013, January 15). 2035 Forecast of Population by City and County. https://www.oregonmetro.gov/sites/default/files/2014/05/29/population_housing_forecasts_by_city_county.pdf
[305] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Demographic and Housing Estimates, Table DP05. Accessed September 9, 2022, from https://data.census.gov/cedsci/table?q=Cornelius%20oregon&tid=ACSDP5Y2020.DP05
[306] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Language Spoken at Home, Table S1601. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Cornelius%20oregon%20language&tid=ACSST5Y2020.S1601

Vulnerable Age Groups[307]	Percent of Population
Less than 15 years of age	13%
65 years and older	13%
Disability Status of Non-Institutionalized Civilians[308]	**Percent of Population**
Total	12%
Less than 17 years of age	3%
65 years and older	86%

* Due to how respondents identify and answer questions, there may be overlapping responses, and results may equal greater than 100% of the population. Percentages are rounded.

3.2.1. Geography, Topography, and Climate

The City of Cornelius is located toward the middle of Washington County and lies along the Tualatin Valley Highway between the City of Forest Grove to the west and the City of Hillsboro to the east. Cornelius is surrounded by rolling hills, farms, and vineyards. It is closer to the mountains in the western portion of the county and therefore can experience slightly different weather patterns and hazard frequency and severity than other NHMP participants. The City has a total area of two square miles.

The climate for Cornelius is moderate. Temperatures range from highs of about 81 °F in July and lows of about 34 °F in January. The City averages 42 inches of rain and 3 inches of snow, on average, per year. There are approximately 140 sunny days and 157 days of some type of precipitation per year in the City.

3.2.2. Transportation, Infrastructure, and Housing

3.2.2.1. Transportation

The City has a mix of transportation systems, including pedestrian, bicycle, transit, motor vehicle, truck freight, and rail freight options. Critical transportation routes in Cornelius include State Highway 8, known locally as the Tualatin Valley Highway (TV Highway), the primary east–west highway. Northwest Highway 47 runs north–south just to the west of Cornelius, merging with Highway 26 northwest of the City. Cornelius Pass Road is an arterial road over Cornelius Pass in the Tualatin Mountains and extends several miles to the south. What used to be a country road handles approximately 11,000+ drivers each day, with 1,500 of the vehicles being tractor-trailers.

The Tri-County Metropolitan Transit District (TriMet) is the regional transit provider for the Portland Metro area and operates one bus route within the City. TriMet has multiple stops every day and connects to the Metropolitan Area Express (MAX) light rail system in the City of Hillsboro.

3.2.2.2. Infrastructure

The City of Cornelius's critical and vulnerable facilities listed below in Table 75 may be vulnerable to one or more natural hazards .

[307] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Age and Sex, Table S0101. Accessed September 9, 2022, from https://data.census.gov/cedsci/table?q=cornelius%20oregon%20age
[308] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Disability Characteristics, Table S1810. Accessed September 9, 2022, from https://data.census.gov/cedsci/table?q=Cornelius%20oregon%20disability

Table 75: Critical Facility and Asset Inventory

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Cornelius City Hall	Infrastructure or Facility	1355 N. Barlow Street	Not vulnerable to landslides, flood, dam failure, or wildfire.
Public Safety Building (Police/Fire)	Infrastructure or Facility	1311 N. Barlow Street	Not vulnerable to landslides, flood, dam failure, or wildfire.
City of Cornelius Public Works Operations Center	Infrastructure or Facility	1300 S. Kodiak Circle	Not vulnerable to landslides, flood, dam failure, or wildfire.
City of Cornelius Public Library	Infrastructure or Facility	1370 N. Adair Street	
City of Cornelius Reservoir	Infrastructure or Facility	N. Barlow Street and 18th Avenue	Not vulnerable to landslides, flood, dam failure, or wildfire.
City of Cornelius Water Distribution System	Infrastructure or Facility	Citywide	Not vulnerable to landslides or flood. Includes three master meter connections, 32 miles of buried pipelines, a 1.5-million-gallon concrete storage tank, and a booster pump station, in addition to the reservoir.
Echo Shaw Elementary School	Infrastructure or Facility	914 Linden Street	
Free Orchards Elementary School	Infrastructure or Facility	2499 S. Beech Street	
Cornelius Elementary	Infrastructure or Facility	200 N. 14th Avenue	
Forest Hills Lutheran Private School	Infrastructure or Facility	4221 SW Golf Course Road	
Swallowtail Waldorf School	Infrastructure or Facility	460 S. Heather Street	
Virginia Garcia Cornelius Wellness Center	Infrastructure or Facility	1151 N. Adair Street	
Serenity Valley Adult Care Homes	Infrastructure or Facility	3995 SW Lafollett Road	
Cornelius Place Senior Living	Infrastructure or Facility	1310 N. Adair Street	
Forest Hills 55+ Lifestyle Community	Infrastructure or Facility	570 N. 10th Avenue	
City of Cornelius Parks System	Natural Resource	Citywide	This covers the entire parks system, roughly 24 parks in total.

3.2.2.3. Housing

Housing characteristics are an important factor in mitigation planning. The information below shows that most housing units are owner-occupied and consist of one-unit buildings built before 1999. The older the housing, the more at risk it can be to damage from natural hazards such as earthquakes and windstorms, including tornadoes.

Table 76: Housing Characteristics*

Households	Total
Total households[309]	4,153
Units in Housing Structure[310]	**Percent of Housing**
One-unit structures	82%
Structures with two or more units	12%
Manufactured homes and all other types	7%
Year Housing Structure Built[311]	**Percent of Housing**
Pre-1979	38%
1980–1999	44%
2000 to present	18%
Housing Tenure and Vacancy	**Percent of Housing**
Owner-occupied[312]	76%
Renter-occupied[313]	24%
Vacant[314]	1%

* Due to how respondents answer questions there may be overlapping responses and results may equal greater than 100%. Percentages are rounded.

[309] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=Cornelius%20oregon%20housing&tid=ACSST5Y2020.S1101
[310] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=Cornelius%20oregon%20housing&tid=ACSST5Y2020.S1101
[311] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Physical Housing Characteristics for Occupied Housing Units, Table S2504. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=Cornelius%20oregon%20housing&t=Year%20Structure%20Built&tid=ACSST5Y2020.S2504
[312] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=Cornelius%20oregon%20housing&tid=ACSST5Y2020.S1101
[313] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=Cornelius%20oregon%20housing&tid=ACSST5Y2020.S1101
[314] United States Census Bureau. (2021, July 1). 2020 Decennial Census Occupancy Status, Table H1. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=Cornelius%20oregon%20housing

3.2.3. Economy

Cornelius has seen a job market increase of 0.9% over the past year, with future job growth expected to be 43.8% in the next 10 years. The City's economy has a footprint in manufacturing (13.6%), retail trade (11.7%), and wholesale trade (10%), with those industries being their strongest employers. Cornelius is home to Sheldon Manufacturing, Lewis Controls, Summit Foods, and Summit Natural Energy, among others. The City also has a strong agriculture sector.

Cornelius has available industrial warehouse and land, including 180,000 square feet of warehouse space on 13 acres, 21 acres of Oregon-certified shovel ready land, and 71 acres of additional developable industrial land within the Urban Growth Boundary. The City also offers Enterprise Zone tax incentives to businesses that provide a property tax exemption for industrial businesses and certain hotels and motels that make a minimum of $50,000 of new investments in real property and/or equipment and create new jobs. Nearly all General Industrial (M-1)-zoned properties inside the City of Cornelius are eligible, as are many properties under the Core Commercial Employment (CE) zone.[315]

Table 77: Income Characteristics[316]*

Households by Income Category	Percent of Households
Less than $5,000	1%
$5,000 to $9,999	1%
$10,000 to $14,999	1%
$15,000 to $19,999	5%
$20,000 to $24,999	3%
$25,000 to $34,999	8%
$35,000 to $49,999	14%
$50,000 to $74,999	21%
$75,000 to $99,999	15%
$100,000 to $149,999	21%
$150,000 or more	11%
Median Household Income	
$72,788	

* Due to how respondents answer questions, there may be overlapping responses, and results may equal greater than 100%. Percentages are rounded.

[315] City of Cornelius Community Development and Planning. (n.d.). Forest Grove/Cornelius Enterprise Zone. https://www.ci.cornelius.or.us/cdp/page/forest-grovecornelius-enterprise-zone

[316] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Financial Characteristics, Table S2503. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=Cornelius%20oregon%20income&tid=ACSST5Y2020.S2503

3.3. Natural Hazard Profiles

The City of Cornelius's Technical Committee utilized the OEM's hazard analysis methodology to examine hazard vulnerability and probability by collecting information about history, probability, vulnerability, and maximum threat for each hazard that impacts the City. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants.

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Volume I, Section 2.

All natural hazards included in the NHMP have the potential to impact the City. The scores for each hazard that impacts the City are presented below.

Table 78: Natural Hazard Risk Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	Low	Medium	Medium	Low	83
Drought	High	High	Medium	High	186
Earthquake: Cascadia (3–5-minute event)	Low	High	High	Medium	201
Earthquake: Crustal (1-minute event)	Low	High	High	Medium	201
Extreme heat	Medium	Medium	Medium	Medium	148
Flooding, including channel migration and streambed erosion	Low	Low	Low	Low	48
Landslide	Medium	Medium	Low	Medium	118
Volcanic ash	Low	Medium	Medium	Low	99
Wildland fire	High	High	High	High	240
Windstorm, including tornado	High	High	High	High	240
Winter storm	High	High	High	High	240

Full descriptions of each hazard are provided in Volume I, Section 2. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description in this annex and in Volume I, Section 2.

The timeframe of data collected during the planning process for the City was from January 1, 2011, to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the City's Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events since the 2011 NHMP update, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are presented in the same order, as applicable: populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

3.3.1. Dam Failure

Due to geographic location and topography, the City cannot be directly impacted by dam failure. Any impacts in the City due to dam failure are identified as secondary and confined to the 100-year floodplain. Potential impacts of and vulnerabilities to dam failure are identified below.

3.3.1.1. Potential Impacts

The potential impacts from a dam failure event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- If Scoggins Dam were to fail, the City of Cornelius could potentially be impacted, depending on the size and scope of the failure. The small areas of the southernmost portion of the City are within the established 100-year floodplain of the Tualatin River.[317]

3.3.1.2. Vulnerabilities

Built environment, critical facility, and natural environment vulnerabilities to a dam failure event consist of:

- Buildings, facilities, and parks in the 100-year floodplain of the Tualatin River, including portions of neighborhoods on the southern edge of the City, a small portion of the Echo Shaw Elementary property, Harleman Park, and Steamboat Park.[318] These areas could potentially see flooding if Scoggins Dam failed.

[317] City of Cornelius. (n.d.). Cornelius Web Mapping Application. https://corneliusor.maps.arcgis.com/apps/View/index.html?appid=d4a90a50cfea4000a209912a4ee4d851
[318] City of Cornelius. (n.d.). Cornelius Web Mapping Application. https://corneliusor.maps.arcgis.com/apps/View/index.html?appid=d4a90a50cfea4000a209912a4ee4d851

3.3.2. Drought

Drought typically occurs as a regional event and often affects more than one city and county simultaneously. The City of Cornelius buys its water from the City of Hillsboro; however, the City stores surface water in the winter months when precipitation is highest and demand for water is lowest in an underground aquifer storage and recovery system. This has increased the City's water reserves and is more cost-effective that an aboveground storage system. Potential impacts of and vulnerabilities to drought are identified below.

3.3.2.1. Potential Impacts

The potential impacts from a drought event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Reduction or loss of water supply, water use restrictions, and lack of potable water supply.
- Health effects, including increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions.
- Reduced economic productivity or business closures in such industries as agriculture, livestock, recreation, energy, tourism, timber, and fisheries.
- Supply chain restrictions, including food shortages.
- Loss of power or reduced availability of electricity due to infrastructure damage and high demand.
- Property and infrastructure damage due to expansive soils, which are clay-based soils that expand and contract based on the amount of moisture in the soil.
- Damage to natural environments, including low water levels in lakes, rivers, and other water bodies, reduced plant growth, local species reduction or extinction, increased water temperature, and deteriorated water quality, which may result in fish kills and increased waterborne pollutants.
- Concurrent hazards, including extreme heat, wildfire, flooding, and landslides.

3.3.2.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to drought. These include:

- People in the City with preexisting health conditions, those without access to clean water, children, pregnant women, and older adults. This may include those living in or spending time in the City's three assisted living facilities, five schools, and Virginia Garcia Cornelius Wellness Center medical facility.
- Those who are employed in water-dependent sectors, such as agriculture and recreation, may experience a reduction in income.
- The City purchases treated water from the City of Hillsboro as its sole source. This water source could be vulnerable to drought impacts.
- Critical infrastructure and facilities vulnerable to winter storms include five schools, the Virginia Garcia Cornelius Wellness Center medical facility, four city facilities, three assisted living facilities, the City's Public Safety Building, the City's water aquifer storage and recovery system, the City's water distribution system, Clean Water Services's sewage transmission lines and pump stations, and the City's parks system.
- Critical transportation infrastructure, including State Highway 8, arterial roads, and the TriMet bus service.

- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments, such as those in the City's parks system.

3.3.3. Earthquake

The City of Cornelius could experience earthquakes that originate from the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek Fault Zone. Damage from liquefaction due to the type of soil in the City is also possible. Potential impacts of and vulnerabilities to earthquake are identified below.

3.3.3.1. Potential Impacts

The potential impacts from an earthquake event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Mental health impacts, including post-traumatic stress disorder.
- Public health hazards resulting from disruption of drinking water and wastewater systems.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to ground utilities; residential, public, and private buildings; and transportation systems above and below.
- Disruption of essential infrastructure systems, such as power systems, public utilities, and telecommunications.
- Blocked roads and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction.
- Downed or damaged power lines that can lead to wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Change in water flows, including paths of rivers and streams.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards initiated by an earthquake, including flood, wildland fire, and landslide.

3.3.3.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to earthquakes. These include:

- Critical infrastructure and facilities vulnerable to earthquake include five schools, the Virginia Garcia Cornelius Wellness Center medical facility, four city facilities, three assisted living facilities, the City's Public Safety Building, one water reservoir, the City's water distribution system, Clean Water Services's sewage transmission lines and pump stations, and the City's parks system.
  - The Public Safety Building is not seismically retrofitted.
- Underground infrastructure, such as pipelines and utility lines, buildings, and roads are vulnerable to damage from liquefaction due to the type of soil in the City. This includes one water reservoir, the City's water distribution system, and Clean Water Services's sewage transmission lines and pump stations located in the City.
- Buildings with very high or high collapse potential include residential and commercial buildings constructed prior to 1990.
- Critical transportation infrastructure, including State Highway 8, arterial roads, and the TriMet bus service. This includes bridges that are not seismically retrofitted.
- There are facilities that store hazardous materials within the City, which can become a secondary hazard during or after an earthquake.
- Equipment at the City's Public Safety Building and Public Works Operations Center.
- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments, such as those in the City's parks system.
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.
  - Using 2022 Hazus®-MH information on a Gales Creek Fault 6.7 magnitude earthquake, the City has a higher estimated loss ratio compared to other participants due to the level of shaking likely to occur.[319]
- Using 2022 Hazus-MH information, it is estimated a 6.7 magnitude Gales Creek Fault earthquake event would result in 536 yellow-tagged buildings, 141 red-tagged buildings, and $117,743,000 in total economic losses.[320]
- A 2018 Oregon Department of Geology and Mineral Industries (DOGAMI) report shows that a:
  - Cascadia Subduction Zone magnitude 9.0 earthquake in "dry" soil conditions could result in $80,000,000 in building repair costs, 36,000 tons of debris, 118 long-term displaced residents, and up to 78 deaths;
  - Cascadia Subduction Zone magnitude 9.0 earthquake in "wet" soil conditions could result in $159,000,000 in building repair costs, 62,000 tons of debris, 1,089 long-term displaced residents, and up to 213 deaths;
  - Portland Hills Fault magnitude 6.8 earthquake in "dry" soil conditions could result in $52,000,000 in building repair costs, 20,000 tons of debris, 37 long-term displaced residents, and up to 35 deaths; and

[319] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[320] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

- Portland Hills Fault magnitude 6.8 earthquake in “wet” soil conditions could result in $125,000,000 in building repair costs, 45,000 tons of debris, 894 long-term displaced residents, and up to 157 deaths. [321]

[321] Oregon Department of Geology and Mineral Industries. (2018). Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-18-02/O-18-02_report.pdf

3.3.4. Extreme Heat

Due to a rise in the frequency and severity of extreme heat events and the impacts from those events, the NHMP Steering Committee chose to include this hazard for the first time in the Washington County NHMP. Potential impacts of and vulnerabilities to extreme heat are identified below.

3.3.4.1. Potential Impacts

The potential impacts from an extreme heat event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, heat stroke, and death.
- Extended operational hours of County staff and additional resources needed for response to the event, including the operation of daytime cooling centers and overnight cooling shelters.
- Strain on or loss of water supply due to increased demand.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic losses from decreased worker efficiency and effectiveness and time lost on the job when workers take more frequent or longer breaks to avoid overheating.
- Economic impacts from closure of outdoor activities and events, such as farmers markets and concerts.
- Property damage, such as roof expansions, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding.
- Disruption of essential infrastructure systems from overheated and damaged utilities, including power, water, transportation, and communication systems.
- Impacts to roadways as heat expands concrete or causes cracking and buckling. Public transit can also be impacted due to melted cables, sagging wires, and warping tracks.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Impacts to greenspaces, such as scorch and sunscald of new foliage, branches or tops of trees dying, and significant stress and die-off of native trees, particularly Douglas fir and cedar. These impacts are intensified if drought is also occurring.
- Concurrent hazards include drought and wildland fire.

3.3.4.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to extreme heat.

Populations substantially vulnerable to extreme heat include:

- People who work or spend a significant amount of time outdoors, including those in construction, landscaping, maintenance and repair, roofing, and solid waste collection.
- People who live and/or work in buildings without air conditioning or cooling equipment.

- People living, working, or spending time in heat islands within the City.
- People living outdoors or in the upper floors of multi-family housing units.
- Populations with higher heat sensitivity, including older adults, infants and children, pregnant women, people with preexisting or chronic diseases, and those who take certain medications that affect thermoregulation or block nerve impulses. This may include those living in or spending time in the City's three assisted living facilities, five schools, and Virginia Garcia Cornelius Wellness Center medical facility.
- People with limited mobility and no access to cooling systems who may not be able to travel to cooling centers or shelters.
- People who live in social isolation, including linguistic isolation or those living alone with few social relationships.
- People with mental health conditions. Extreme heat can be associated with higher levels of aggression, violence, and suicidal behavior.
- Factors including race and ethnicity, income, and educational attainment are correlated with heat-related illness.

Additional vulnerabilities to extreme heat include:

- Critical infrastructure and facilities vulnerable to extreme heat include five schools, the Virginia Garcia Cornelius Wellness Center medical facility, four city facilities, three assisted living facilities, the City's Public Safety Building, one water reservoir, the City's water distribution system, Clean Water Services's sewage transmission lines and pump stations, and the City's parks system.
- Critical transportation infrastructure, including State Highway 8, arterial roads, and the TriMet bus service.
- Bridge infrastructure is vulnerable to thermal expansion of bridge joints and paved surfaces and deterioration of steel, asphalt, protective cladding, coats, and sealants.
- Asphalt pavement is vulnerable to accelerated deterioration through softening, rutting, and migration of liquid asphalt.
- Vehicles, including first responder vehicles, are vulnerable to engine overheating and tire deterioration.
- Equipment at the City's Public Safety Building and Public Works Operations Center.
- Other critical infrastructure, including communication structures and emergency generators.
- Aboveground utility and power lines can droop or sag and create a heightened fire risk.
- Limited number of cooling centers and shelters.
- Plants, animals, ecosystems, and natural environments, such as those in the City's parks system, are vulnerable to high rates of mortality due to excessive heat.

3.3.5. Flooding, Including Channel Migration and Streambed Erosion

The City experiences localized flooding typically from October through April; however, historically, it has not been significant or severe. Potential impacts of and vulnerabilities to flooding are identified below.

3.3.5.1. Potential Impacts

The potential impacts from a flooding event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Need for widespread search and rescue operations, including water rescues.
- Displaced residents in need of sheltering.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal economic impacts from loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.5.2. Vulnerabilities

Population, economic, built environment, critical facility, infrastructure, and natural environment vulnerabilities to a flooding event include:

- Populations without access to private transportation.
- Homes, structures, populations, and Ryland City Park in the 100-year floodplain area along Council Creek.[322]

[322] City of Cornelius. (n.d.). Cornelius Web Mapping Application. https://corneliusor.maps.arcgis.com/apps/View/index.html?appid=d4a90a50cfea4000a209912a4ee4d851

- Buildings, facilities, and parks in the 100-year floodplain of the Tualatin River include portions of neighborhoods on the southern edge of the City, a small portion of the Echo Shaw Elementary property, Harleman Park, and Steamboat Park.[323]
- Critical transportation infrastructure, including State Highway 8, arterial roads, and the TriMet bus service.
- Properties without flood insurance.
- Natural environments, such as those in the City's parks system.
- Flood loss estimates determined by Hazus-MH include[324]:
  - 10-year flood scenario
    - Number of buildings lost: 1
    - Loss estimate: $2,000
  - 50-year flood scenario
    - Number of buildings lost: 1
    - Loss estimate: $7,000
  - 100-year flood scenario
    - Number of buildings lost: 1
    - Loss estimate: $8,000
  - 500-year flood scenario
    - Number of buildings lost: 5
    - Loss estimate: $64,000

[323] City of Cornelius. (n.d.). Cornelius Web Mapping Application. https://corneliusor.maps.arcgis.com/apps/View/index.html?appid=d4a90a50cfea4000a209912a4ee4d851
[324] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

Table 79: Land Use Type in the 100-Year Floodplain in the City of Cornelius

Land Use Type	Total Parcels in 100-Year Floodplain	Total Value of Exposed Parcels	Total Area in Jurisdiction (Acres)	Total Area in the 100-Year Floodplain (Acres)	Percentage of Area in the 100-Year Floodplain
Agriculture	1	$500,120	60.6	1.43	2.4%
Commercial	3	$2,243,910	185.96	7.31	3.9%
Forest	0	$0	0	0	0%
Industrial	0	$0	16.91	0	0%
Multi-Family Residential	0	$0	14.88	0	0%
Public	35	$3,636,570	139.03	41.33	29.7%
Rural	0	$0	0	0	0%
Single-Family Residential	89	$47,178,660	574.33	73.97	12.9%
Vacant	8	$369,300	56.87	7.5	13.2%
Other	11	$889,260	130.17	8.96	6.9%
Total	**147**	**$54,787,820**	**1178.75**	**140.5**	**11.9%**

Table 80: Facilities in Cornelius within FEMA-Mapped Floodplains

Building Classification	Buildings within Cornelius	Buildings within 100-Year Floodplain
Total Buildings	3,853	4
Percentage of Buildings within Cornelius	100%	0.1%

3.3.6. Landslide

Portions of the City are at low risk of landslides, and the City has a lower landslide risk than the county as a whole. Potential impacts of and vulnerabilities to landslides are identified below.

3.3.6.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a landslide event are identified below. The type, magnitude, and extent of these can vary based on the scale of the event.

- Residential development in the area of Council Creek on the northern side of the City is potentially vulnerable to landslides.
- Per DOGAMI, 0% of building value within the City has a very high susceptibility to landslide exposure, 0.3% of building value within the City has a high susceptibility, and 5.7% of building value within the City has a moderate susceptibility to landslides.[325]

[325] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.3.7. Volcanic Ash

Volcanic activity is possible from mountains near the county. It is anticipated that ashfall from a volcanic eruption has the potential to impact the City, although the scale and types of impacts and vulnerabilities may differ depending on which volcano erupts, the level of eruption, and the wind direction during and after eruption. Potential impacts of and vulnerabilities to volcanic ash are identified below.

3.3.7.1. Potential Impacts

Though unlikely, the impacts of a significant ash fall can be substantial. Impacts may include:

- Indirect injuries and deaths, such as those sustained during ash cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation. This includes public water systems that rely on outdoor reservoirs.
- The need to shelter individuals to protect them from poor air quality, including houseless persons and persons displaced from their residences due to poor residential air filtration systems.
- Delayed emergency response times due to decreased visibility and increased traffic hazards.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and cleanup activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.7.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to volcanic ash. These include:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults. This may include those living in or spending time in the City's three assisted living facilities, five schools, and Virginia Garcia Cornelius Wellness Center medical facility.
- People without access to effective dust masks, eye protection, and drinking water and food uncontaminated by volcanic ash.

- Critical infrastructure and facilities vulnerable to volcanic ash include five schools, the Virginia Garcia Cornelius Wellness Center medical facility, four city facilities, three assisted living facilities, the City's Public Safety Building, one water reservoir, the City's water distribution system, Clean Water Services's sewage transmission lines and pump stations, and the City's parks system.
- Older buildings and infrastructure not built to withstand the weight and impacts from large amounts of volcanic ash, including manufactured homes and buildings and the people who live or work in them.
- Critical transportation infrastructure, including State Highway 8, arterial roads, and the TriMet bus service.
- Equipment at the City's Public Safety Building and Public Works Operations Center.
- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments, such as those in the City's parks system.

3.3.8. Wildland Fire

Although the City of Cornelius could experience a wildland–urban interface event, historically it is more likely to be affected by smoke and poor air quality due to wildland fires outside its boundaries. Significant wildland fire or wildland fire smoke events, their potential impacts, and vulnerabilities to wildland fire are identified below.

3.3.8.1. Significant Events

The City has not been directly impacted by a wildland fire event since adoption of the 2011 NHMP. However, in September 2020, multiple wildfires occurred concurrently in the county, outside the county, and outside the state, and the City experienced significant smoke from the fires. The Air Quality Index around the City was between 199 and 317, with particulate matter 2.5 micrometers or smaller ($PM_{2.5}$).

3.3.8.2. Potential Impacts

The potential impacts from a wildfire event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Exposure to wildfire smoke, which can lead to eye, nose, and throat irritation and the worsening of chronic heart and lung diseases.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to blocked transportation routes and debris, congested transportation routes due to evacuations, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Strain on or loss of water supply due to increased demand.
- Economic impacts to governments, including costs for fire suppression, staff, equipment, supplies, transportation and mobilization of first responders, evacuations, sheltering operations, post-fire recovery, and rebuilding costs associated with government-owned buildings, property, and infrastructure.
- Economic impacts, including loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity. Scoggins Valley Park receives one million visitors a year, most during summer, which is when wildland fires tend to occur.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.

- Debris from trees and damaged property, causing blocked roads and rail transportation routes.
- Downed or damaged power lines. This impact may be compounded since powerline failures can lead to additional wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including air and water quality issues. Landslide and erosion issues are common following a wildland fire.

3.3.8.3. Vulnerabilities

Given the dynamic nature of wildland fires, all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City of Cornelius are vulnerable to this hazard. These include:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults. This may include those living in or spending time in the City's three assisted living facilities, five schools, and Virginia Garcia Cornelius Wellness Center medical facility.
- Populations without access to private transportation.
- First responders and other personnel working directly on fire protection, suppression, and patrols or near a wildfire can experience burns, smoke exposure, heat-related impacts such as heat stroke, heat exhaustion, dehydration, physical fatigue, mental health challenges, injuries, and death.
- Critical infrastructure and facilities vulnerable to wildland fire include five schools, the Virginia Garcia Cornelius Wellness Center medical facility, four city facilities, three assisted living facilities, the City's Public Safety Building, one water reservoir, the City's water distribution system, Clean Water Services's sewage transmission lines and pump stations, and the City's parks system.
- Drinking water sources and water treatment infrastructure, food supplies and availability, and access to medical resources or care may also be impacted by wildfire and can cause health impacts on a large scale.
- Homes, businesses, and infrastructure adjacent to the wooded areas near the outskirts of the City.
- Critical transportation infrastructure, including State Highway 8, arterial roads, and the TriMet bus service.
- Equipment at the City's Public Safety Building and Public Works Operations Center.
- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments, such as those in the City's parks system.
- Per analysis of the Oregon State University–Extension Service Fire Program and Wildland Fire Associates dataset, there are 9 buildings with a total value of $169,300 at high risk of wildland fire, 0 buildings at moderate wildland fire risk, and 118 buildings with a total value of $272,780 at

low wildland fire risk.[326] Additionally, a community risk profile completed by DOGAMI shows 27 residents may be potentially displaced due to a wildland fire event.[327]

[326] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[327] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.3.9. Windstorm, Including Tornado

The City of Cornelius is located closer to the mountains on the western side of the county than other participants and tends to experience more windstorm events and higher wind gusts than other areas in the county. Potential impacts of and vulnerabilities to windstorms are identified below.

3.3.9.1. Potential Impacts

The potential impacts from a windstorm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property, causing blocked roads and rail transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.9.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to windstorms, including tornadoes. These include:

- Critical infrastructure and facilities vulnerable to winter storms include five schools, the Virginia Garcia Cornelius Wellness Center medical facility, four city facilities, three assisted living facilities, the City's Public Safety Building, one water reservoir, the City's water distribution system, Clean Water Services's sewage transmission lines and pump stations, and the City's parks system.
- Older buildings and infrastructure not built to withstand high winds, including manufactured homes and buildings and the people who live or work in them.

- Critical transportation infrastructure, including State Highway 8, arterial roads, and the TriMet bus service.
- Equipment at the City's Public Safety Building and Public Works Operations Center.
- Other critical infrastructure, including communication structures and emergency generators.
- Aboveground utility and power lines.
- Natural environments, such as those in the City's parks system.

3.3.10. Winter Storm

The City of Cornelius is located closer to the mountains on the western side of the county than other participants and tends to get more snow than other areas in the County. Additionally, because of the location of the City, it is not prioritized for snow removal by the state, which can lead to delays in clearing roadways during and after a winter storm event. Potential impacts of and vulnerabilities to winter storms are identified below.

3.3.10.1. Potential Impacts

The potential impacts from a winter storm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths, including from carbon monoxide poisoning, falls from slick or icy conditions, frostbite, and hypothermia.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components.
- Stranded travelers due to ice, snow, and transportation impacts.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- An increased number of house fires due to unsafe alternate heating methods.
- Significant property damage and loss of water due to frozen or damaged pipes or the thawing of frozen pipes.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property, causing blocked roads and rail transportation routes.
- Downed or damaged power lines can lead to wildfires, and tree debris can create fuel load for wildfire.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including flooding.

3.3.10.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to winter storms. These include:

- People who do not have access to sufficient heating, insulated clothing, or dry living conditions, including unhoused populations.
- Older adults and infants, people who take certain medications, people who have certain medical conditions, and people who have been drinking alcohol are at increased risk for hypothermia. This may include those living in or spending time in the City's three assisted living facilities, five schools, and Virginia Garcia Cornelius Wellness Center medical facility.
- People improperly using generators and heating devices.
- Populations with disabilities may be more affected due to mobility issues.
- Critical infrastructure and facilities vulnerable to winter storms include five schools, the Virginia Garcia Cornelius Wellness Center medical facility, four city facilities, three assisted living facilities, the City's Public Safety Building, one water reservoir, the City's water distribution system, Clean Water Services's sewage transmission lines and pump stations, and the City's parks system.
- Older buildings and infrastructure not built to withstand the weight and impacts from large amounts of snow and ice.
- Critical transportation infrastructure, including State Highway 8, arterial roads, and the TriMet bus service.
- Equipment at the City's Public Safety Building and Public Works Operations Center.
- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments, such as those in the City's parks system.

3.4. Historical Events

The timeframe of data collected during the planning process for the City of Cornelius was January 1, 2011, to February 22, 2022. Hazard events that impacted the entire planning area during this timeframe are detailed in Volume I, Section 2. During this period, the City experienced impacts from wildland fire and wildland fire smoke.

The City has not issued any disaster declarations since the 2011 NHMP update.

3.5. Overall Vulnerability

Based on the analysis completed by the Technical Committee, wildland fire, windstorm, including tornado, winter storm, earthquake, and drought present the highest relative risk to the City of Cornelius. These hazards can create widespread events, and all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City can be vulnerable to these hazards.

Areas of greatest vulnerability to these hazards within the City include:

- Populations with higher vulnerability, such as those with preexisting health conditions, older adults, children, and pregnant women. This may include those living in or spending time in the City's three assisted living facilities, five schools, and Virginia Garcia Cornelius Wellness Center medical facility.
- Populations that are unhoused, do not have access to private transportation, and/or are without access to air conditioning, cooling equipment, sufficient heating, and clean water.
- People living, working, or spending time in heat islands within the City.
- Populations with limited income and financial resources.
- Populations whose primary language is not English.
- Industries that can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic impacts to the City, including loss of local revenue due to business and property tax losses, reduced future revenues, reduced recreation and tourism activity, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Critical infrastructure and facilities vulnerable to wildland fire, including five schools, the Virginia Garcia Cornelius Wellness Center medical facility, four city facilities, three assisted living facilities, the City's Public Safety Building, one water reservoir, the City's water distribution system, Clean Water Services's sewage transmission lines and pump stations, and the City's parks system.
    - Older buildings and infrastructure not built to current building codes or seismic standards may be more vulnerable. The Public Safety Building is not seismically retrofitted.
- Critical transportation infrastructure, including State Highway 8, arterial roads, and the TriMet bus service.
- Equipment at the City's Public Safety Building and Public Works Operations Center.
- Other critical infrastructure, including communication structures, emergency generators, and aboveground utility and power lines.
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.

- Facilities that store hazardous materials within the City, which can become a secondary hazard during or after an earthquake.
- The City purchases treated water from the City of Hillsboro as its sole source. This water source could be vulnerable to hazard events.
- Natural environments, such as those in the City's parks system.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment and safe growth analysis examine the ability of the City to implement and manage a comprehensive mitigation strategy. Strengths, opportunities, and resources of the jurisdiction are identified to develop an effective hazard mitigation action plan. The capabilities identified in this assessment were evaluated collectively to develop feasible recommendations, which support the implementation of effective mitigation activities.

A capability questionnaire was distributed to the City of Cornelius's Technical Committee to initiate this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities. The Technical Committee also completed a safe growth analysis to identify potential gaps in growth guidance instruments and improvements that could be made to reduce vulnerability to future development. It is important to note that the City of Cornelius and the City of Forest Grove work in tandem in many areas of responsibility so that when one is responsible for a duty, that duty covers both cities.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances within the City that can prevent and reduce the impacts of hazards.

The City's Comprehensive Plan addresses the elements of citizen involvement, urbanization, land use, transportation, and natural and cultural resources. The plan discusses natural hazards and potential mitigation strategies. If the plan were to be updated, it could be used to implement mitigation strategies and actions. Many of the goals and policies in the City's Comprehensive Plan are related to those in this NHMP and safe growth objectives. The monitoring and implementation section of the NHMP covers these and all other hazard mitigation strategies discussed in the plan. Safety is explicitly included in the Comprehensive Plan's growth and development policies. The City has a future land use map in their Comprehensive Plan, and their land use policies discourage development or redevelopment within natural hazard areas. The City's Comprehensive Plan addresses limited space for expected future growth in areas located outside natural hazard areas.

The City does not have a capital improvement plan, and the City's capital improvement program does not provide funding for hazard mitigation projects identified in this NHMP; however, the program limits expenditures on projects that would encourage development in areas vulnerable to natural hazards. The City's infrastructure policies limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.

The City does not have an economic development plan or community wildfire protection plan. The local emergency operations plan covers Cornelius and Forest Grove and was created in 2014.

The City does not have a continuity of operations plan. A Transportation System Plan is in place with an Amendment adopted in 2020. The plan does not specifically address natural hazards or identify projects that can be included in the mitigation strategy; however, incorporating mitigation efforts into projects identified in the plan could be considered. The Cornelius Transportation System Plan limits access to identified hazard areas and is used to guide growth into safe locations. The City and the plan do not have movement systems designed to function under disaster conditions, such as during an evacuation.

Land use planning and ordinances are adequately administered and enforced and are an effective measure for reducing hazard impacts. These include zoning, subdivision, floodplain, and natural hazard-specific ordinances and the utilization of flood insurance rate maps (FIRMs). The City's zoning code is found within the Cornelius Municipal Code (CMC), Chapter 18, and addresses the mitigation of flooding hazards through the City's Floodplain District in CMC Chapter 18, Section 90.[328] The City has subdivision regulations that restrict the subdivision of land within or adjacent to natural hazard areas. FIRMs were updated by FEMA in 2016.

The City has zoning ordinances that conform to the Comprehensive Plan in terms of discouraging development or redevelopment within natural hazard areas, including prohibiting development within, or filling of, wetlands, floodways, and floodplains. The ordinance also contains natural hazard overlay zones that set conditions for land use within such hazard zones. Rezoning procedures recognize natural hazard areas as off limits to any zoning changes that would allow for increased activity or development in the area. The City has subdivision regulations that restrict the subdivision of land within or adjacent to natural hazard areas and regulations that allow density transfer where hazard areas exist. City regulations do not provide for conservation subdivisions or cluster subdivisions to conserve environmental resources. The City's building code contains provisions to strengthen or elevate construction to withstand hazard forces, and the City has an adopted evacuation and shelter plan to deal with emergencies from natural hazards. The small-area or corridor plans in the City recognize the need to avoid or mitigate natural hazards, and economic development or redevelopment strategies include provisions for mitigation of natural hazards.

The City has environmental systems that protect development from hazards identified and mapped and policies that maintain and restore protective ecosystems, including land use policies. The City does not have environmental policies that provide incentives to development that is located outside protective ecosystems. Chapter VI of the Cornelius Comprehensive Plan, Natural and Cultural Resources, has the goal "to maintain and improve the quality of local natural and cultural resources. To conserve energy and promote use of renewable energy resources. To provide protection from and minimize property damage and/or loss of lives from natural hazards and disasters."[329]

The City's Community Development and Planning Department leads and facilitates review of land use applications and enforces site plan review requirements. The City of Cornelius utilizes the most current building codes as they are adopted by the State of Oregon, including the Oregon Structural Specialty Code, Oregon Plumbing Specialty Code, Oregon Mechanical Specialty Code, Oregon Residential Specialty Code, Oregon Manufactured Dwelling Standards, Oregon Energy Efficiency Specialty Code, Oregon Electrical Specialty Code, Oregon Fire Code, and Appendix J, Grading, of the Oregon Structural Specialty Code.[330] Cornelius Fire & Rescue has an Insurance Services Office (ISO) rating of 4.

[328] Cornelius Municipal Code. (n.d.). Title 18: Zoning. https://www.codepublishing.com/OR/Cornelius/#!/Cornelius18/Cornelius18.html
[329] City of Cornelius. (1988, January). Cornelius Comprehensive Plan. https://www.ci.cornelius.or.us/sites/default/files/fileattachments/community_development_amp_planning/page/521/comp_plan_final_updated_2019_20190617.pdf
[330] Cornelius Municipal Code. (n.d.). Chapter 15.05: Building Code. https://www.codepublishing.com/OR/Cornelius/#!/Cornelius15/Cornelius1505.html#15.05

4.1.1. National Flood Insurance Program Compliance

Participation in the National Flood Insurance Program (NFIP) is based on a voluntary agreement between a community and FEMA. For communities that adopt a floodplain management ordinance to reduce flood risks to new construction, federally backed flood insurance is made available to property owners in the community. Compliance with the NFIP, however, extends beyond participation in the program. The three basic components of the NFIP include floodplain identification and risk mapping, responsible floodplain management, and flood insurance.

A repetitive loss (RL) property is a property insured under the NFIP for which the program has paid at least two claims of more than $1,000 in any 10-year period since 1978, regardless of any change(s) of ownership during that period. As of September 30, 2021, the City of Cornelius had no identified RL property in the City.

4.1.1.1. National Flood Insurance Program Details

Insurance Summary

There are currently 10 NFIP policies in force in the City. A total amount of $3,784.71 has been paid on one loss. The dollar amount of coverage in the City was not available at the time this NHMP was published. Identifying this information is an improvement for the next planning cycle.

There are three structures exposed to the 1% annual chance of flooding within the community.[331]

Staff Resources

There are no barriers to running an effective NFIP program in the City. The City of Cornelius Community Development Department and emergency preparedness personnel (in tandem with the City of Forest Grove) administer the program. This staff facilitates permit review and education and outreach. Cornelius does not have a floodplain administrator on staff.

Compliance History

The City is in good standing with the NFIP, and there are no outstanding compliance issues. The City is in good standing with the NFIP, and there are no outstanding compliance issues. The date of the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC) was not available at the time this NHMP was published. Identifying this information is an improvement for the next planning cycle.

The City will continue NFIP compliance during the next five years of NHMP implementation by enforcing floodplain management requirements, maintaining and using floodplain mapping, and undertaking any code amendments needed to maintain compliance.

Regulation

The City entered into the NFIP on November 5, 1976, and has both digital and paper FIRMs. The initial FIRM was identified on January 6, 1982, and the current effective map date is November 4, 2016. Floodplain development regulations meets the minimum FEMA and state requirements, and updated floodplain management policies and regulations were adopted in 2016.

Community Rating System

The City does not participate in the Community Rating System.

[331] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff and their skills and tools that can be used for mitigation planning and implementing specific mitigation actions.

The City's Planning Commission is responsible for assisting the City Council to develop, maintain, update, and implement the City's Comprehensive Plan and development code provisions and to review and take action on development projects. The Community Development and Planning Department maintains compliance with Oregon's Statewide Planning Goals, provides support to the Planning Commission, and reviews projects for compliance with the City's codes and plans.

The City administers maintenance programs to reduce risk, including clearing drainage systems, and landscape maintenance of open spaces and rights of way. The City also has multiple effective mutual aid agreements and planning partnerships, including intergovernmental agreements and partnerships with the Washington County Emergency Management Cooperative and the Cooperative Public Agencies of Washington County.

The City of Cornelius contracts with the City of Forest Grove for building services. Forest Grove's Building Division is responsible for reviewing and approving plans, issuing permits and performing inspections for new construction, and performing alterations and repairs. It provides structural, plumbing, mechanical, fire, and life safety plan reviews and performs all required inspections, except electrical, related to both commercial and residential construction. The division has adequate staffing levels to enforce regulations, staff are trained on hazards and mitigation efforts, and coordination on mitigation initiatives with staff is effective. The Chief Building Official is part of the Forest Grove Building Division and is a full-time position.

The Cornelius Public Works Department contains Engineering Department staff. The staff reviews and approves construction plans for subdivisions, partitions, streets, sanitary sewers, and storm drainage construction projects. They also design projects, prepare bid documents for public works maintenance projects, and provide project management for public improvements.

The geographic information system (GIS) database is developed and maintained by Engineering Department staff. The department also maintains and updates the record maps for all City utilities, rights-of-way, easements, land division plots, and City base maps.

The City's Fire Marshal serves as its Emergency Manager and covers emergency management and preparedness duties and initiatives. There is not a floodplain administrator or surveyor on City staff.

Multiple City departments have staff who can support implementation of the mitigation strategy, including planners and engineers with an understanding of natural hazards, engineers and professionals trained in construction practices related to buildings and infrastructure, and staff with education or expertise to assess vulnerability to hazards. Community Development and Planning Department staff work on current and long-range planning, economic development, and building and code enforcement needs in coordination with regional and state partners.

Additionally, the City has many technical capabilities that have been used to assess or mitigate risk and could be used in future efforts. Warning systems include Everbridge and OR-Alert in partnership with Washington County. Grant writing is completed by individual departments as needed. Hazard data and information can be pulled from a variety of sources, including GIS mapping software, historical records, and DOGAMI.

4.3. Education and Outreach Assessment

Education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information were assessed to determine the City's capabilities.

The Forest Grove and Hillsboro School Districts serve the City. The districts have ongoing public education programs that include fire and earthquake drills and fire safety coloring and activity sheets. School district facilities are also used as shelters, as needed.

Nonprofit organizations and community groups in the City can assist with implementing future mitigation actions, including those that provide food security resources and healthcare, sheltering and emergency assistance, extreme heat sheltering, and emergency management-specific groups. These partners include the Red Cross, local churches, and the Washington County Emergency Management Cooperative.

4.4. Financial Assessment

The City has access to or is eligible to potentially use the following funding resources for hazard mitigation initiatives:

- Capital improvements project funding
- Authority to levy taxes for specific purposes
- Fees for water, sewer, gas, and/or electric services
- Incurrence of debt through general obligation bonds and/or special tax bonds
- Federal funding sources, including the Community Development Block Grant and Hazard Mitigation Assistance Grants
- State funding programs, including the funding for disaster and emergency preparedness efforts

4.5. Capability Expansion and Improvement

Actions that can expand and improve existing authorities, plans, policies, and resources for mitigation include continuing to update City plans as necessary to ensure they are current and reflect the needs of the community; continuing to seek out a variety of funding sources and increase grant writing capabilities; creating and implementing additional public education and outreach offerings; establishing a Community Emergency Response Team; and solidifying staffing capabilities and training the new staff, as required.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iii), §201.6(c)(3)(iv), and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) directs local mitigation plans to describe hazard mitigation action and establish a strategy to implement those actions. Therefore, all other requirements for a local mitigation plan lead to and support the mitigation strategy.

5.1. Mitigation Goals

The Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 City of Beaverton NHMP, 2011 Cities of Cornelius and Forest Grove NHMPs, and 2020 State of Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals detailed in Volume I, Section 3. These goals are the basis of this plan and summarize what the Steering Committee will accomplish by implementing this plan.

5.2. Mitigation Successes

City of Cornelius Underground Water Storage and Aquifer[332]

In 2022, the City completed a decade-long effort to build an aquifer storage and recovery system to increase the City's water reserves. The aquifer holds 80 million gallons of water. This water is purchased from the City of Hillsboro and is stored in the winter months when precipitation is highest and demand for water is the lowest. In the summer months when water is in highest demand, the water is pumped into the reservoir and into the City's distribution system.

The City first received $800,000 in state funding for the project in 2013, completed test drilling into the underlying basalt rock in 2015, and in 2021 began injecting water into the system. Although the system is efficient, it does not pump fast enough to be relied upon during emergencies. The City also has a two-million-gallon reservoir, Water Park, and is in the process of planning a second.

5.3. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on mitigation plan requirement 44 CFR §201.6(c)(4)(ii), the vulnerability and capabilities assessment for the City was carefully reviewed and considered when developing the mitigation actions for this plan. The City's Technical Committee will establish a process in which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into the existing local planning strategies.

Once the plan is adopted, the committee will coordinate implementation with the responsible parties in the City and with external stakeholders as needed. The primary means for integrating mitigation strategies will be through the revision, update, and implementation of plans and regulations, such as the City's Comprehensive Plan, building codes, and land development regulations, as feasible.

The members of the City's Technical Committee will remain charged with ensuring the goals and strategies of new and updated local planning documents for their jurisdictions and special districts are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.3.1. Comprehensive Plan

The City of Cornelius's Comprehensive Plan is amended as needed, with the last ordinance added in June of 2019.[333] City personnel assigned with emergency preparedness and management duties will

[332] Mullan, D. (2022, February 8). *Cornelius Stores 80 Million Gallons of Water Underground*. https://pamplinmedia.com/fgnt/36-news/535607-428805-cornelius-stores-80-million-gallons-of-water-underground
[333] City of Cornelius. (1988, January). Cornelius Comprehensive Plan. https://www.ci.cornelius.or.us/sites/default/files/fileattachments/community_development_amp_planning/page/521/comp_plan_final_updated_2019_20190617.pdf

determine the best way to integrate the hazard mitigation goals into the City's Comprehensive Plan, as applicable.

5.3.2. Building and Zoning Codes

The City's building and construction codes are located in the CMC, Chapter 15. The City has adopted many state codes, including the Oregon Structural Specialty Code, Oregon Plumbing Specialty Code, Oregon Mechanical Specialty Code, Oregon Residential Specialty Code, Oregon Manufactured Dwelling Standards, Oregon Energy Efficiency Specialty Code, Oregon Electrical Specialty Code, Oregon Fire Code, and Appendix J, Grading, of the Oregon Structural Specialty Code.[334]

The City's zoning code is found within the CMC, Chapter 18, and addresses the mitigation of flooding hazards through the City's Floodplain District in CMC Chapter 18, Section 90.[335] Updates to this section and additions for other areas of hazard mitigation strategies can be integrated into future CMC amendment efforts.

The City will continue to enforce building and zoning codes and review and update codes to address the evolving needs of the City, as applicable.

5.3.3. Public Engagement, Education, and Outreach

The mission of community engagement will be incorporated into future outreach projects. City of Cornelius personnel assigned with emergency preparedness duties will continue public engagement campaigns during National Preparedness Month. Additionally, personnel will host educational opportunities at civic events, such as civic association meetings and neighborhood fairs, to showcase hazard mitigation opportunities, like flood protection programs and rainwater harvesting, and will provide general preparedness tips.

5.3.4. Land Development Regulations

The City's land development regulations are addressed in Sections 17 and 18 in the City's code. Land use permits are reviewed by city staff to ensure compliance with the City code and the City's Comprehensive Plan.[336] Additionally, the City's Planning Commission plays an integral role in addressing the growth-related issues of the City. The Planning Commission's responsibilities include assisting the City Council to develop, maintain, update, and implement the City Comprehensive Plan and development code provisions and review and take action on development projects.[337] The City will continue to enforce land development regulations and review and update these regulations to address the evolving needs of the City, as applicable.

5.3.5. Floodplain Management Program and/or National Flood Insurance Program

The City of Cornelius Community Development Department and emergency preparedness personnel (in tandem with the City of Forest Grove) will continue to review any RL properties and incorporate any new

[334] Cornelius Municipal Code. (n.d.). Chapter 15.05: Building Code. https://www.codepublishing.com/OR/Cornelius/#!/Cornelius15/Cornelius1505.html#15.05
[335] Cornelius Municipal Code. (n.d.). Title 18: Zoning. https://www.codepublishing.com/OR/Cornelius/#!/Cornelius18/Cornelius18.html
[336] City of Cornelius. (n.d.). Community Development and Planning, Community Development. https://www.ci.cornelius.or.us/cdp
[337] City of Cornelius. (n.d.). Planning Commission, Cornelius Planning Commission. https://www.ci.cornelius.or.us/pc

findings into the City's mitigation strategy, as appropriate. To date, the City of Cornelius has no RL properties.

The City's floodplain management program is implemented through CMC Chapter 18, Section 90. Updates to this section and additions for other areas of hazard mitigation can be integrated into future CMC amendment efforts.[338]

5.3.6. Stormwater Management Plans and Procedures

The City of Cornelius does not have a Stormwater Management Plan; however, the City does fully comply with Clean Water Services's surface water management requirements and will continue to do so.

5.3.7. Emergency Plans That Address Evacuation and Sheltering

Evacuation and sheltering are addressed in the Cornelius and Forest Grove Emergency Operations Plan in annex FA 2, Human Services.[339] This annex provides information regarding the response to the need for mass care and sheltering, human services, and public health support for victims of natural and technological emergencies and disasters. This annex will be reviewed and updated as needed to meet the needs of the City and its residents.

In the Cities, nongovernmental/faith-based organizations such as the Red Cross provide sheltering, emergency food supplies, counseling services, and other vital support services to support response and promote the recovery of disaster victims. Nongovernmental and faith-based organizations also collaborate with responders, governments at all levels, and other agencies and organizations.

5.3.8. Enforcement of Existing Policies

The City will continue to enforce the policies that are in place and include hazard mitigation elements, including building and zoning codes, land development regulations, and NFIP regulations.

5.3.9. Funding Opportunities

City emergency preparedness personnel will continue to monitor local, state, and federal funding opportunities that could be utilized for hazard mitigation. This includes Hazard Mitigation Assistance opportunities and non-traditional mitigation funding sources.

[338] City of Cornelius. (n.d.). Community Development Planning, Floodplain Management. https://www.ci.cornelius.or.us/cdp/page/floodplain-management

[339] City of Cornelius and City of Forest Grove. (2014, July). Cities of Cornelius and Forest Grove, Washington County, Oregon, Emergency Operations Plan. https://www.forestgrove-or.gov/sites/default/files/fileattachments/fire/page/3051/cornelius-forestgroveeop_fullplan_july2014.pdf

6. Action Items

The City of Cornelius' action items in the 2011 NHMP were determined by the 2011 planning team. The action items from the previous plan and the status of each action are in Section 6.1 below.

All action items from the 2011 NHMP were determined as still valid and necessary by the City's Technical Committee based on the review of its risk assessment, its existing capabilities, and the status of its previous action items. Action items from the 2011 NHMP are being retained for the 2023 update, with some being in progress in addition to being retained.

This comprehensive range of actions includes local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.1 and 6.2 below. Additional information about how these actions were developed, evaluated, and prioritized is in Volume I, Section 3.

The cities of Cornelius and Forest Grove share many staff, planning initiatives, and resources. Therefore, the cities action items are presented together. This is also how action items were presented in the 2011 NHMP.

6.1. Status of City of Cornelius Action Items from the 2011 NHMP

Table 81: Status of Action Items from 2011 NHMP

Action Item Number	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
1	Coordinate with Washington County and the Oregon Department of Transportation (ODOT) to assess the seismic stability of bridges surrounding the communities of Forest Grove and Cornelius and seek funding to reinforce or replace bridges as needed (also applies to flooding concerns).	Earthquake and Flood		Retain for 2023 NHMP Update
2	Assess the seismic and flood risk of the Dairy Creek Bridge.	Earthquake and Flood		Retain for 2023 NHMP Update

Action Item Number	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
3	Coordinate with Clean Water Services (CWS) to assess the seismic strength of the sewage treatment system and develop improvements accordingly as part of the sewage system's current update efforts.	Earthquake	CWS has begun upgrading their regional facility in a multi-year project.	In progress. Retain for 2023 NHMP Update
4	Coordinate with local school district(s) to seek funding to assess and seismically retrofit school buildings that are vulnerable to collapse.	Earthquake	School bond measure is on November 2022 ballot.	In progress. Retain for 2023 NHMP Update
5	Seek funding to assess and seismically retrofit critical facilities (police stations, fire stations, and hospitals) that are vulnerable to collapse.	Earthquake	A new city office is under construction in 2022; existing city hall will see some upgrades as part of this neighboring building project.	In progress. Retain for 2023 NHMP Update
6	Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices through public education.	Earthquake	This is an ongoing discussion item for all city educational staff and has recently been relaunched, after the pandemic limited our education efforts.	In progress. Retain for 2023 NHMP Update
7	Assess Forest Grove's downtown businesses' vulnerability to an earthquake and encourage businesses to develop business continuity and recovery plans.	Earthquake		Retain for 2023 NHMP Update
8	Assess the seismic vulnerability of the Forest Grove Water Treatment Plant as well as the distribution and transmission systems.	Earthquake	City staff have developed a water resiliency plan that is in the final stages of being written	In progress. Retain for 2023 NHMP Update
9	Coordinate with Pacific University to seek funding to assess and seismically retrofit campus buildings that are vulnerable to collapse.	Earthquake		Retain for 2023 NHMP Update
10	Continue compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinances.	Flood		Retain for 2023 NHMP Update

Action Item Number	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
11	When updated flood insurance rate maps for the Tualatin River become available, adopt the updated maps.	Flood		Retain for 2023 NHMP Update
12	Acquire more detailed data on landslide hazards to better understand risk and be able to set more effective thresholds for the requirement of geotechnical reports.	Landslide		Retain for 2023 NHMP Update
13	Coordinate with CWS, Washington County, rural fire districts, and the Department of Forestry to mitigate wildfire risk outside of city limits.	Wildland Fire	Countywide wildfire plan is being updated soon; meetings have just begun.	In progress. Retain for 2023 NHMP Update
14	Explore opportunities to utilize city park land on the edges of town as wildfire buffers.	Wildland Fire	The City Parks Department took actions in 2022 to mitigate wildfire hazards on city-owned land at the wildland–urban interface.	In progress. Retain for 2023 NHMP Update
15	Coordinate with utility providers to educate the public about the role of proper tree pruning and stability in preventing damage during windstorms.	Windstorm, including tornado	This is an ongoing educational effort offered by the City's light and power agency.	In progress. Retain for 2023 NHMP Update
16	Coordinate with Pacific University to conduct an assessment of all on-campus trees to determine their stability, to aid in preventing damage during severe weather.	Windstorm, including tornado, and Winter Storm	Pacific University has its own arborist plan in place for the maintenance of trees on campus.	In progress. Retain for 2023 NHMP Update
17	Continue to educate citizens about ways to weatherize their homes and how to operate emergency heating equipment safely.	Winter Storm	This is an ongoing seasonal education topic offered by city communications staff.	In progress. Retain for 2023 NHMP Update
18	Maintain regular assessments of the health of trees in Forest Grove's downtown to prevent damage to buildings and utilities from falling trees.	All Hazards		In Retain for 2023 NHMP Update

Action Item Number	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
19	Update the existing Facilities Master Plan that assesses the need for new or updated facilities and incorporates natural hazard vulnerabilities and mitigation measures for reducing vulnerability.	All Hazards		Retain for 2023 NHMP Update
20	Encourage residents to prepare and maintain 72-hour kits.	All Hazards	This is part of the City's normal educational offerings.	In progress. Retain for 2023 NHMP Update
21	Coordinate with utility providers to address lack of broadband Internet redundancy in the community.	All Hazards		Retain for 2023 NHMP Update
22	Review the City of Forest Grove's comprehensive plan and development codes for opportunities to more effectively reduce risks to new development.	All Hazards		Retain for 2023 NHMP Update

6.2. Mitigation Action Information Worksheets

Table 82: Bridge Seismic Stability Assessment, Reinforcement, and Replacement

Mitigation Action Information			
Title of action	Bridge Seismic Stability Assessment, Reinforcement, and Replacement		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	Coordinate with Washington County and ODOT to assess the seismic stability of bridges surrounding the communities of Forest Grove and Cornelius and seek funding to reinforce or replace as needed. Also applies to flooding concerns. Work with Washington County and ODOT to conduct seismic assessment of bridges leading into and out of Forest Grove and Cornelius. Prioritize any actions that need to be taken to address any seismic concerns and coordinate with Washington County, ODOT, and the OEM seismic grants coordinator to find appropriate funding sources. Bridges to be considered: B Street Bridge at Gales Creek, Susbauer Bridge at Dairy Creek, and Fern Hill Road Bridge across the Tualatin River		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Several bridges have either earthquake or flood risk and when impacted, isolate large portions of the community and limiting access to emergency services and basic supplies. Coordinating efforts with Washington County and ODOT to assess the seismic stability of the bridges and seeking funding to reinforce or replace as needed will provide more reliable access and provide continuous service in both communities.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Transportation Objective 1 to provide a balanced transportation system. Connection to the City of Cornelius' Transportation Plan Goals.		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	City Engineers		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s) (Est. Cost x 6)**	
Decrease or eliminate earthquake or flood risk to several bridges, which will maintain transportation access for large portions of the communities and emergency services.		To be determined	
Project Timeline			
Expected Timeline for Completion			
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 83: Assessment of Seismic and Flood Risk of the Dairy Creek Bridge

Mitigation Action Information			
Title of action	Assessment of Seismic and Flood Risk of the Dairy Creek Bridge		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Dairy Creek Bridge is a vital transportation connection in and out of the communities and that it is likely vulnerable to both earthquakes and flooding. Work with Washington County and ODOT to conduct seismic and flooding assessment of the bridge. Prioritize any actions that need to be taken to address any seismic and flood concerns and coordinate with Washington County, ODOT, and the OEM seismic grants coordinator to find appropriate funding sources.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Decrease or eliminate earthquake or flood risk to the bridge, which will maintain transportation access for large portions of the communities and emergency services.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Transportation Objective 1 to provide a balanced transportation system. Connection to the City of Cornelius' Transportation Plan Goals.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	City Engineers		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Decrease or eliminate earthquake or flood risk to the bridge, which will maintain transportation access for large portions of the communities and emergency services.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 84: Assessment of Clean Water Services Sewage Treatment System

Mitigation Action Information			
Title of action	Assessment of Clean Water Services Sewage Treatment System		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Coordinate with Clean Water Services to assess the seismic strength of the sewage treatment system and develop improvements accordingly as part of the sewage system's current update efforts.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Sewage treatment plant could be vulnerable to seismic activity. If damaged, the treatment plant could release raw sewage into neighboring streams.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Public Safety & Municipal Services Objective 1 to continue to deliver services.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	City Engineers		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)			**Financial Benefit(s) (Est. Cost x 6)**
Decrease or eliminate earthquake risk to sewage treatment plant.			To be determined

Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 85: Assessment of Seismic Risk and Retrofitting of School Buildings

Mitigation Action Information	
Title of action	Assessment of Seismic Risk and Retrofitting of School Buildings
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Assess the "probability of collapse" for school buildings previously identified by DOGAMI as having a "high" or "very high" probability of collapse rating. Coordinate with local school district(s) to seek funding to assess and seismically retrofit school buildings that are vulnerable to collapse. Further assess those buildings rated at a "high" risk of collapse. Prioritize any actions that need to be taken to address any seismic concerns and coordinate with school district(s) and OEM seismic grants coordinator to find appropriate funding sources. Publicize and improve awareness of the earthquake risk using existing education and outreach efforts. Use FEMA's procedures document for developing scopes of work for seismic structural and non-structural retrofit projects. Identify opportunities to pair mitigation with energy retrofit dollars. Coordinate with the private Community School to identify alternative locations that are not unreinforced masonry.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Assessing the "probability of collapse" for these school buildings and conducting seismic retrofits will reduce the vulnerability of these buildings by preventing damage to life and property.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☒ Goal 5 ☐ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	To be determined.
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – People and Community Building Objective 1 to develop strong community partnerships to support education.

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Community Development		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s) (Est. Cost x 6)**	
Decrease or eliminate earthquake risk to school buildings and those who are in them.		To be determined	
Project Timeline			
Expected Timeline for Completion			
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 86: Assessment of Seismic Risk and Retrofitting of Critical Facilities

Mitigation Action Information			
Title of action	Assessment of Seismic Risk and Retrofitting of Critical Facilities		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Assess the "probability of collapse" for critical facilities previously identified by DOGAMI. This includes public school buildings, acute inpatient care facilities, fire stations, police stations, sheriffs' offices, and other law enforcement agency buildings. Further assess these critical facility buildings. Prioritize any actions that need to be taken to address any seismic concerns and coordinate with OEM seismic grants coordinator to find appropriate funding sources. Use FEMA's procedures document for developing scopes of work for seismic structural and non-structural retrofit projects.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Assessing the "probability of collapse" for these buildings and conducting seismic retrofits will reduce the vulnerability of these buildings by preventing damage to life and property and ensuring continuous operations capacity for critical facilities.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Public Safety and Municipal Services Objectives 1- 4.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development		

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of the vulnerability of critical facilities by preventing damage to life and property and ensuring continuous operations capacity for critical facilities.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 87: Reduction of Nonstructural and Structural Earthquake Hazards

Mitigation Action Information	
Title of action	Reduction of Nonstructural and Structural Earthquake Hazards
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices through public education. Develop informational brochures about individual mitigation opportunities and post on the websites of the cities, include in the water bill, and make available on the front counters at the police, public works, and community development departments. Include recommendations regarding non-structural retrofits in these brochures. Use the following modes of communication or events to educate the public: Quarterly Newsletter, Website, Flyers, National Night Out, and Safety Fair. CERT can also assist in promoting this type of outreach.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Seismic hazards pose a real and serious threat to many communities in Oregon, requiring local governments, planners, and engineers to consider their community's safety. Earthquake damage occurs because we have built structures that cannot withstand severe shaking. Buildings, ports, and lifelines (highways, telephone lines, gas, water, etc.) suffer damage in earthquakes. Damage and loss of life can be very severe if structures are not designed to withstand shaking, are on ground that amplifies shaking, or ground which liquefies due to shaking. Nonstructural retrofits protect building contents with little cost and effort. Examples of retrofits include: • Securing water heaters, large appliances, bookcases, pictures and bulletin boards; • Latching cabinet doors; and • Using safety film on windows.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be determined.

Alignment with existing plans and policies	To be determined.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Fire
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Educating the public to reduce risk from earthquakes.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 88: Seismic Assessment of Downtown Forest Grove Businesses

Mitigation Action Information	
Title of action	Seismic Assessment of Downtown Forest Grove Businesses
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☒
Action description	Assess the vulnerability to Forest Grove downtown businesses to an earthquake and encourage businesses to develop business continuity and recovery plans. Determine what resources are available to help assess the risk and what grant and loan opportunities are available to businesses owners to help mitigate. Encourage business owners to have a recovery plan and provide examples of what a plan looks like through the Chamber of Commerce. Bring in a business continuity specialist to speak to Chamber members.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	The City of Forest Grove downtown corridor is a major business and tourist center for the City. Loss of this area would be devastating to the Forest Grove economy. The buildings are at extreme risk due to their age and the potential for an earthquake in the area. Most are unreinforced masonry buildings. Evaluating these buildings would give the City a better understanding of the mitigation necessary.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be determined.
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Historic Preservation Objective 1 to preserve, protect, and enhance historic assets; Economic Development Objectives 1-3. Connection to City of Forest Grove's Comprehensive Plan – Chapter V Economy local goals. Assists in implementing the initiatives and goals of the Forest Grove Economic Development Commission Strategic Plan.

Mitigation Action Implementation Plan		
Priority	Low ☐ Medium ☒ High ☐	
Lead position, office, department, or division responsible for implementation	Chamber of Commerce	
Potential Funding Sources		
Non-Federal Funding Sources	**Federal Funding Sources**	
General Fund	BRIC and FMA grants through FEMA	
Estimated Cost	To be determined	
Estimated Benefit		
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**	
Reduction of risk to people and property from earthquakes.	To be determined	
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 89: Seismic Assessment of Forest Grove Water Treatment Plant

Mitigation Action Information			
Title of action	Seismic Assessment of Forest Grove Water Treatment Plant		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Assess the seismic vulnerability of the Forest Grove water treatment plant as well as the distribution and transmission systems. Conduct a seismic evaluation of the Forest Grove Water Treatment Plant.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Water is critical for public drinking, firefighting, and sanitation. This plant serves both Forest Grove and Cornelius.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☒ Goal 6 ☐	Goal 7 ☒
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Public Safety and Municipal Services Objective 1. Connection to City of Forest Grove's Comprehensive Plan – Chapter XII Public Facilities and Services.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Engineering		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of risk to people and property from earthquakes and lack of water.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 90: Seismically Assess Pacific University Campus Buildings

Mitigation Action Information	
Title of action	Seismically Assess Pacific University Campus Buildings
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Coordinate with Pacific University to seek funding to assess and seismically retrofit campus buildings that are vulnerable to collapse. Work with Oregon Independent College Association (OICA), Department of Education (DOE), Oregon Department of Emergency Management (OEM) and other partners to determine funding sources. Prioritize any actions that need to be taken to address any seismic concerts and coordinate with the university and other partners (OEM, etc.) to develop funding and action plans. Use FEMA's procedures document for developing scopes of work for seismic structural and non-structural retrofit projects.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Pacific University has many buildings on their Forest Grove campus that are of significant age. There has been no formal analysis conducted on any of these buildings to determine their seismic stability. A significant at-risk population exists on campus. An analysis needs to be completed to support planning and funding for future seismic retrofits to reduce the potential for collapse and the risk to population.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be determined.
Alignment with existing plans and policies	To be determined.

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Community Development		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s) (Est. Cost x 6)**	
Reduction of risk to people and property on campus from earthquakes.		To be determined	
Project Timeline			
Expected Timeline for Completion			
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 91: Compliance with the National Flood Insurance Program

Mitigation Action Information			
Title of action	Compliance with the National Flood Insurance Program		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Continue compliance with the National Flood Insurance Program (NFIP) through the enforcement of local floodplain ordinances. 1) Actively participate with DLCD and FEMA during Community Assistance Visits. The Community Assisted Visit (CAV) is a scheduled visit to a community participating in the NFIP for the purpose of: 1) conducting a comprehensive assessment of the community's floodplain management program; 2) assisting the community and its staff in understanding the NFIP and its requirements; and 3) assisting the community in implementing effective flood loss reduction measures when program deficiencies or violations are discovered. • Conduct an assessment of the cities' floodplain ordinances to ensure they reflect current flood hazards. • Coordinate with the county to ensure that floodplain ordinances and NFIP regulations are maintained and enforced. Continue to assess the need for updated ordinances. • Mitigate areas that are prone to flooding and/or have the potential to flood.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	The National Flood Insurance Program provides communities with federally backed flood insurance to homeowners, renters, and business owners, provided that communities develop and enforce adequate floodplain management ordinances. The benefits of adopting NFIP standards for communities are a reduced level of flood damage in the community and stronger buildings that can withstand floods. According to the NFIP, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined.		

Alignment with existing plans and policies	To be determined.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Community Development
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of flood risk to people and property.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 92: Adoption of Updated Flood Insurance Rate Maps

Mitigation Action Information			
Title of action	Adoption of Updated Flood Insurance Rate Maps		
Type of action	Plans/regulations ☒		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☐
Action description	When updated Flood Insurance Rate Maps for the Tualatin River become available, adopt the updated maps. When the final maps become available, the cities will adopt the new map using their existing protocols for adopting this type of map.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	The City of Forest Grove and Cornelius has Flood Mitigation Rate Maps current as of 1982. Clean Water Services has been working with FEMA to update the maps for the Tualatin River. These maps are currently in draft form and updated versions will more accurately reflect flood risk.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of flood risk to people and property.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 93: Acquire More Detailed Landslide Data and Update Development Codes

Mitigation Action Information			
Title of action	Acquire More Detailed Landslide Data		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Acquire more detailed data on landslide hazards to better understand risk and be able to set more effective thresholds for the requirement of geotechnical reports. Consult with Department of Geology and Mineral Industries on availability of new data. Seek funding for a study if the necessary data is not available. Review existing requirements in the development code based on newly acquired data. Update development code based on new data.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☒	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Current landslide data is not effective in identifying landslide risk. More detailed data would allow for refining geotechnical report requirements in the development code. Having this data will allow the cities to more effectively limit future development in landslide prone areas.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		

Mitigation Action Implementation Plan		
Priority	Low ☐ Medium ☒ High ☐	
Lead position, office, department, or division responsible for implementation	Community Development	
Potential Funding Sources		
Non-Federal Funding Sources	**Federal Funding Sources**	
General Fund	BRIC and FMA grants through FEMA	
Estimated Cost	To be determined	
Estimated Benefit		
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**	
Reduction of landslide risk to people and property.	To be determined	
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 94: Mitigate Wildfire Risk Outside of City Limits

Mitigation Action Information			
Title of action	Mitigate Wildfire Risk Outside of City Limits		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Coordinate with Clean Water Services, Washington County, rural fire districts, and the Department of Forestry to mitigate wildfire risk outside of City limits. Coordinate efforts with the Washington County Community Wildfire Protection Plan Steering Committee and Washington County Emergency Management.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	There is a concern that wildfires beginning in Washington County on the urban fringe could easily spread to the cities. Working together with the County may result in the identification of wildfire mitigation efforts that will reduce the chance of fires spreading from the County into one or both of the cities.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Fire		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of wildfire risk to people and property.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 95: Use Existing Park Land as a Wildfire Buffer

Mitigation Action Information	
Title of action	Use Existing Park Land as a Wildfire Buffer
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Explore opportunities to utilize City park land on the edges of town as wildfire buffers. Review vegetative requirements of CWS and Metro to ensure that wildfire mitigation efforts are not in direct conflict with existing requirements. Evaluate the codes of both cities to determine opportunities for wildfire mitigation. Identify mitigation alternatives for those park lands. Seek funding to implement the optimal mitigation alternative.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	There is a concern that wildfires beginning in Washington County on the urban fringe could easily spread to the cities. There may be opportunities to use existing park land on the City's fringe as a wildfire buffer.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☒ Goal 5 ☒ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	To be determined.
Alignment with existing plans and policies	To be determined.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Fire

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of wildfire risk to people and property.	To be determined

Project Timeline
Expected Timeline for Completion
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 96: Public Education About Tree Pruning

Mitigation Action Information			
Title of action	Public Education About Tree Pruning		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	Coordinate with utility providers to educate the public about the role of proper tree pruning and stability in preventing damage during windstorms. Review regulations and standards for easement and right of way maintenance and provide training to foresters and logging crews. Educate homeowners in pruning of vegetation, tree care safety, and proper tree care for trees bordering utility corridors and public rights of way via Safety Fair, Website, or Quarterly Newsletter. Coordinate with arboricultural groups, public agencies, and utilities to promote proper tree pruning and care practices that can reduce the risk of tree failure and property damage. Common messages refined by state level entities such as the Oregon Department of Forestry (ODF) and Oregon State University Extension can help provide continuity and efficiency across the state.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	High winds can topple trees and break limbs which in turn can result in power outages and disrupt telephone, computer, and TV and radio service, and compromise the functioning of the communities' utilities such as the wastewater and water treatment plants. While the Public Works and utility companies manage trees in public areas, private property owners are responsible for trees on their property. Educating property owners about how to properly prune their trees to prevent power outages and damage to their property can help reduce impacts of windstorm events. Forest Grove and Cornelius have experienced severe windstorm events in the past and is vulnerable to windstorm events.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	

Integration into other initiatives	To be determined.
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Public Safety and Municipal Services Objectives 1 and 2.

Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Community Development

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA

Estimated Cost	To be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of risk from windstorms, including tornado, to people and property.	To be determined

Project Timeline
Expected Timeline for Completion
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 97: Assessment of Trees on the Pacific University Campus

Mitigation Action Information	
Title of action	Assessment of Trees on the Pacific University Campus
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Coordinate with Pacific University to conduct an assessment of all on-campus trees to determine their stability to aid in preventing damage during severe weather. Coordinate with university facilities staff and their landscape contractor to conduct the assessment and develop a plan for proper pruning, care and maintenance, especially as it relates to utility service on campus.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	High winds can topple trees and break limbs which in turn can result in power outages and disrupt telephone, computer, and TV and radio service. Personal injury to community members is also a potential. While the Public Works and utility companies manage trees in public areas, private property owners are responsible for trees on their property. Conducting a proper assessment and performing proper pruning/care, can help reduce impacts of windstorm events. The campus has experienced severe windstorm events in the past and is vulnerable to windstorm events.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be determined.
Alignment with existing plans and policies	To be determined.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Community Development

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of risk to people and property from trees downed by windstorms, including tornados.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 98: Public Education About Home Weatherization

Mitigation Action Information	
Title of action	Public Education About Home Weatherization
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Educate residents about ways to weatherize their homes, as well as safe emergency heating equipment. • Use energy audits, cash rebates, and tax credits to help homeowners weatherize their homes. • Coordinate efforts with home improvement businesses to educate citizens about weatherizing homes and providing safe emergency heating equipment. • Coordinate education efforts with Portland General Electric to education citizens about weatherization. • Coordinate with the local Fire Districts to develop a list of emergency heating information. • Advertise weatherization tax credits to serve as an incentive for people to weatherize their homes and reduce their heating bills. • Brochures can be provided at Community Development counters.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Severe winter storms can bring extreme cold, snow, and ice, causing power outages and breaks in un- insulated water lines. Power outages can lead to heat loss, potentially harming citizens. Educating citizens about ways to weatherize their homes, as well as safe emergency heating equipment, can reduce the effects of extreme cold and inform residents of how to properly heat their homes in the event of a power outage. Cornelius has a higher than average percentage of residents with disabilities, many of whom are especially vulnerable to power outages and lack backup sources of heat and water. Educating these citizens about ways to weatherize their homes and safe emergency heating equipment they can use will reduce the vulnerability of these populations.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be determined.

Alignment with existing plans and policies	To be determined.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Fire and Forest Grove Power and Light
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of risk from winter storms to people, especially vulnerable populations.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 99: Tree Health Assessment

Mitigation Action Information			
Title of action	Tree Health Assessment		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☐		Natural systems protection ☒ Public education/awareness ☐
Action description	Maintain regular assessments of the health of trees in the cities to prevent damage to buildings and utilities from falling trees. Contact Washington County's certified Arborist to see if they would be willing to perform this service. Develop a list of agencies, organizations, etc., who would be able to provide assistance in assessing tree health on their property.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☒ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	There are trees in the cities that could damage businesses and utilities. Regularly assessing the health of trees will prevent damage to buildings and utilities from falling trees.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☒	Goal 4 ☐ Goal 5 ☒ Goal 6 ☐	Goal 7 ☒
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Public Safety and Municipal Services Objectives 1 and 2.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development/Parks		

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of risk from windstorms, including tornado, to people and property.	To be determined

Project Timeline
Expected Timeline for Completion
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 100: Update Facilities Master Plan

Mitigation Action Information			
Title of action	Update Facilities Master Plan		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐	Natural systems protection ☐ Public education/awareness ☐	
Action description	Update existing Facilities Master Plan so that it assesses the need for new or updated facilities and includes natural hazard vulnerabilities and mitigation measures for reducing vulnerability. Coordinate development of the Facilities Master Plan with information found in this mitigation plan annex. In the facilities plan, identify the number of buildings and facilities in specific hazard areas, the potential dollar losses to the facilities, and the methodology used to develop the estimates. This will meet the requirements of the Disaster Mitigation Act of 2000. Seek funding for retrofitting buildings and infrastructure in hazard areas to reduce vulnerability		
Hazard(s) addressed	Dam failure ☒ Drought ☒ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☒ Volcanic ash ☒ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Facility master plans assess current City facilities and City-wide facility needs and provide recommendations for further improvements. Currently the cities of Forest Grove and Cornelius do not have Facilities Master Plans that provide an overall assessment of City-owned facilities. Creating a plan that assesses the need for new or updated facilities and incorporates natural hazard vulnerabilities and mitigation measures for reducing vulnerability, will improve City services and reduce the City's overall vulnerability to natural hazard events. In addition, buildings and facilities in hazard areas may be eligible for Pre-Disaster Mitigation funding.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☒	Goal 4 ☐ Goal 5 ☒ Goal 6 ☐	Goal 7 ☒
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		

Mitigation Action Implementation Plan		
Priority	Low ☐ Medium ☒ High ☐	
Lead position, office, department, or division responsible for implementation	Forest Grove Administrative Services and Cornelius Development Operations	
Potential Funding Sources		
Non-Federal Funding Sources	**Federal Funding Sources**	
General Fund	BRIC and FMA grants through FEMA	
Estimated Cost	To be determined	
Estimated Benefit		
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**	
Reduction of risk from all hazards to City facilities.	To be determined	
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 101: Public Preparedness Education

Mitigation Action Information			
Title of action	Public Preparedness Education		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☐		Natural systems protection ☐ Public education/awareness ☒
Action description	Encourage citizens to prepare for all hazards and maintain 72-hour kits. Provide educational material and examples of how to assemble 72-hour kits to residents of the City and employees. Outreach and awareness campaigns need to be carefully organized and developed to ensure that residents receive critical information. Distribute information through the City's newsletter. Alternatively, post information about 72-hour kits on the City's website. During National Emergency Preparedness Month or National Night Out, use first responders and community members to host educational presentations to groups within the community to encourage individuals to put together their own kit. Materials must be made available in multiple languages. Resources like www.preparedness.gov or www.72hours.org can provide content needs for 72-hour kits.		
Hazard(s) addressed	Dam failure ☒ Drought ☒ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☒ Volcanic ash ☒ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	The cities of Forest Grove and Cornelius are vulnerable to a number of natural hazards that could disrupt services. In a major disaster, utilities transportation networks, and businesses could be disrupted, and it may take days until vital services are restored. Preparing a 72-hour kit can help community members survive on their own without relying too heavily on emergency services.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☒	Goal 4 ☐ Goal 5 ☒ Goal 6 ☐	Goal 7 ☒
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Fire		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s) (Est. Cost x 6)**	
Reduction of risk to people and property from all hazards.		To be determined	
Project Timeline			
Expected Timeline for Completion			
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 102: Broadband Redundancy

Mitigation Action Information			
Title of action	Broadband Redundancy		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒	Natural systems protection ☐ Public education/awareness ☐	
Action description	Coordinate with utility providers to address lack of broadband redundancy in the community. Work with utility providers to identify alternatives to add redundancy to the existing broadband system. Identify potential funding sources for the redundancy systems.		
Hazard(s) addressed	Dam failure ☒ Drought ☒ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☒ Volcanic ash ☒ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Currently, there is no redundancy to the broadband network in the cities of Forest Grove and Cornelius. This can create communication and connectivity problems before, during, and after natural hazard events.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☒	Goal 4 ☐ Goal 5 ☒ Goal 6 ☐	Goal 7 ☒
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Forest Grove IT		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Broadband redundancy during natural hazard events.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 103: Review of Comprehensive Plan and Development Codes

Mitigation Action Information			
Title of action	Review of Comprehensive Plan and Development Codes		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐	Natural systems protection ☐ Public education/awareness ☐	
Action description	Review the City of Forest Grove's comprehensive plan and development codes for opportunities to more effectively reduce risks to new development. Incorporate new hazard information in the Comprehensive Plan's Periodic Review process. Review latest vulnerability assessment information and policies that address hazards. Information can be obtained from the risk assessment portion of the Washington County Natural Hazard Mitigation Action Plan and other state agencies.		
Hazard(s) addressed	Dam failure ☒ Drought ☒ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☒ Volcanic ash ☒ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	The City's Comprehensive Plans provided the legal framework and long-term vision for implementing plans and land use regulations, this is one of the best places to implement mitigation because risks can be eliminated before development occurs.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☒ Goal 5 ☒ Goal 6 ☒	Goal 7 ☒
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Statewide Planning Goal 2 (Land Use Planning) requires local governments to create comprehensive plans that "shall include identification of issues and problems, inventories, and other factual information for each applicable statewide planning goal…" Furthermore, Goal 7 of Oregon's Land Use Planning Goals requires that local governments "shall adopt comprehensive plans (inventories, policies, and implementing measures) to reduce risk to people and property from natural hazards."		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Community Development		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s) (Est. Cost x 6)**	
Eliminating risk from natural hazards before development occurs.		To be determined	
Project Timeline			
Expected Timeline for Completion			
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Annex C: City of Forest Grove

1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for the City of Forest Grove was the Fire Division Chief-Fire and Life Safety.

1.2. Annex Organization

This annex has six sections that satisfy mitigation requirements in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

The information provided in this annex is for the City of Forest Grove alone. All pertinent information that is not identified in this annex is identified in other sections of this NHMP or within the respective appendices.

1.3. NHMP Adoption Process

Once the Washington County NHMP received the designation “Approvable Pending Local Adoption” from the Federal Emergency Management Agency (FEMA), the City presented the plan to City Council for final public comment and local adoption. A copy of the resolution was inserted into the NHMP and is held on file in the City of Forest Grove and Washington County.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

City officials recognize the benefits of having a long-term, all-hazards approach to mitigating natural hazards. The passage of the Disaster Mitigation Act of 2000 (DMA 2000) enabled City officials to recognize the benefits of having a long-term, all-hazards approach to hazard mitigation and mitigating natural hazards. The City's involvement in the Washington County NHMP represents the collective efforts of the NHMP Steering Committee members, all participating local Technical Committee members, the public, and stakeholders.

The City developed this annex in accordance with guidance outlined in 44 CFR §201.6(c)(5) of DMA 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in the geographical area of the City.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP. An open involvement process was established for the public and all stakeholders, which provided an opportunity for everyone to be involved in the planning process and make their views known.

Two teams worked simultaneously on this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of points of contact from each plan participant. The group met to discuss countywide topics, including hazards and mitigation strategies. The points of contact were the leads of their local Technical Committee.
2. **Local Technical Committee:** Each plan participant had a Technical Committee that consisted of the Steering Committee representative for that jurisdiction or special district as well as designated representatives from within the organization. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. Technical Committee of Forest Grove

This annex within the NHMP was developed by the local Technical Committee for the City of Forest Grove with support from IEM, a consulting firm hired to assist with the planning process. The efforts of the committee were led by the City's Fire Division Chief-Fire and Life Safety throughout 2022. The cities of Cornelius and Forest Grove share many staff and planning initiatives, including members of the 2023 NHMP Technical Committee.

Table 104: City of Forest Grove Technical Committee Members for the 2023 NHMP

Job Title and Department	Role in Committee and Planning Process
Fire Division Chief – Fire and Life Safety, City of Forest Grove Fire Department	General oversight, hazard identification, and plan development
Fire Chief/Emergency Management Coordinator, City of Forest Grove Fire Department	Hazard identification and plan development

* Note: The cities of Cornelius and Forest Grove shared Technical Committee members.

IEM also supported or led the following activities associated with the development, approval, and adoption of the plan:

1. Facilitated the NHMP update process.
2. Based on committee direction and stakeholder and community input, prepared the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.

3. Submitted the proposed plan to the State of Oregon Department of Emergency Management (OEM) and FEMA for review and approval, and completed edits or revisions requested by these organizations.
4. Coordinated the plan adoption processes with the City, OEM, and FEMA.

2.3. Public Participation

Public participation is an important component of this NHMP and also a required element as outlined in 44 CFR §201.6(c)(5), FEMA's mitigation planning guidance. Public participation offered community members the opportunity to voice their ideas, interests, and opinions about hazards that affect them and the best way to mitigate hazard impacts. As the City implements the mitigation actions identified in this annex, there will be additional opportunities for public participation.

Plan participants used a survey to collect information about community perceptions of natural hazards and priorities. The Steering and Technical Committees used the results to inform their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP. See Appendix B of the NHMP for additional information about the survey and opportunities for public comment.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist the City in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards.

3.1. Changes in Development Since the 2011 NHMP Update

(In compliance with 44 CFR §201.6(d)(3))

The population of the City has grown approximately 25% since 2010. Based on the 2021 population, the density of residents is 4,572 people per square mile. This is an increase of approximately 899 people per square mile since 2010.

There has been an increase in housing to meet the demand of population growth. The City has also been focused on increasing economic growth and increasing private investment in the community. Business facility vacancy rates are dropping, and new commercial developments totaling $23.6 million, in addition to $100.7 million in industrial construction, are in the works. The City approved nine residential projects, exceeding $100 million and delivering 780 additional housing units, including the 78-unit Jesse Quinn mixed-use project in the heart of downtown.[340]

Forest Grove's continued partnership with the City of Cornelius allows the cities to pool resources, including staff, to implement mitigation strategies.

[340] Hurt, N. (2019, July 3). *Forest Grove: A New Home for Businesses.* https://www.oregonbusiness.com/article/sponsored/item/18805-forest-grove-a-new-home-for-businesses

3.2. Community Profile

This section provides information on City-specific characteristics. Additional discussion of the planning area's community characteristics is outlined in Appendix A of the NHMP.

Some community characteristics may suggest how natural hazards may impact communities and how communities choose to plan for natural hazard mitigation. Identifying and considering the City-specific assets during the planning process may assist in identifying appropriate measures for natural hazard mitigation.

The following table reflects the community demographics and vulnerable facilities in the City. This information was gathered from the U.S. Census, Portland State University, and the City of Forest Grove.

Table 105: Community Demographics*

Population	Total	Percent Change
2010 population[341]	21,083	
2021 population[342]	26,242	+25%
2035 forecasted population[343]	27,370	+4%
Race and Ethnicity[344]	**Total**	**Percent of Population**
White alone	20,281	82%
Hispanic/Latino/a/x of any race	5,916	24%
Two or more races	2,041	8%
Asian alone	650	3%
Black or African American alone	256	1%
American Indian and Alaska Native alone	157	1%
Native Hawaiian and Other Pacific Islander alone	14	<1%
Language Spoken at Home[345]	**Percent of Population**	
English only	81%	
Spanish	17%	
Asian and Pacific Island languages	1%	
Indo-European languages	1%	
Other languages	<1%	

[341] United States Census Bureau. (2010, April 1). QuickFacts Forest Grove, Oregon. Accessed September 15, 2022, from https://www.census.gov/quickfacts/forestgrovecityoregon
[342] Portland State University Population Research Center. (2022). 2021 Certified Population Estimates, July 1. https://www.pdx.edu/population-research/population-estimate-reports
[343] Oregon Metro. (2013, January 15). 2035 Forecast of Population by City and County. Accessed September 15, 2022, from https://www.oregonmetro.gov/sites/default/files/2014/05/29/population_housing_forecasts_by_city_county.pdf
[344] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Demographic and Housing Estimates, Table DP05. Accessed September 15, 2022, from https://data.census.gov/cedsci/table?q=forest%20grove%20oregon&tid=ACSDP5Y2020.DP05
[345] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Language Spoken at Home, Table S1601. Accessed September 15, 2022, from https://data.census.gov/cedsci/table?q=Forest%20Grove%20oregon%20language

Vulnerable Age Groups[346]	Percent of Population
Less than 15 years of age	12%
65 years and older	15%
Disability Status of Non-Institutionalized Civilians [347]	**Percent of Population**
Total	15%
Less than 17 years of age	9%
65 years and older	107.5%**

* Due to how respondents identify and answer questions, there may be overlapping responses, and results may equal greater than 100% of the population. Percentages are rounded.
** Margin of error is ±7.5.

3.2.1. Geography, Topography, and Climate

The City of Forest Grove is located on the western edge of the Portland metropolitan area and the Willamette Valley in central Washington County. The City is bordered by the City of Cornelius on the east, and the two cities partner on many governmental operations. The City has a total area of 5.88 miles, of which 0.14 square miles is water.

Forest Grove is more rural than other NHMP participants. It is surrounded by rolling hills, evergreen forests, and vineyards and is near the foothills of the Coastal Mountain Range. The City is located within the watershed of the Tualatin River and is a gateway to the Tillamook Forest to the west.

The climate in Forest Grove is mild, with a high of approximately 52 °F in January and a high of 82.2 °F in July. The normal annual precipitation is 44.58 inches.

3.2.2. Transportation, Infrastructure, and Housing

3.2.2.1. Transportation

Critical transportation routes in Forest Grove include Oregon Route 8, known locally as the Tualatin Valley Highway (TV Highway), the primary east–west highway. Highway 47 runs north and south on the eastern side of the City and connects with Highway 26 to the north.

The Tri-County Metropolitan Transit District (TriMet) provides light rail and bus transfer commuter service with stops every 15 minutes via line 57. Connections include Hillsboro, Beaverton, Cornelius, Portland, and east Multnomah County. GroveLink is a public transportation service for the City, linking residents with downtown locations, Ride Connection, and TriMet bus line 57.

3.2.2.2. Infrastructure

The City of Forest Grove's critical and vulnerable facilities listed below in Table 106 may be vulnerable to one or more natural hazards.

[346] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Age and Sex, Table S0101. Accessed September 15, 2022 , from https://data.census.gov/cedsci/table?q=Forest%20Grove%20oregon%20age
[347] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Disability Characteristics Estimates, Table S1810. Accessed September 15, 2022 , from https://data.census.gov/cedsci/table?q=forest%20grove%20oregon%20disability

Table 106: Critical Facility and Asset Inventory

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Forest Grove City Auditorium	Infrastructure or Facility	1915 Main Street	
Forest Grove City Hall	Infrastructure or Facility	1924 Council Street	Not vulnerable to dam failure, drought, landslide, or wildfire.
Forest Grove Police Station	Infrastructure or Facility	2101 Pacific Avenue	Not vulnerable to dam failure, drought, landslide, or wildfire.
Forest Grove Fire Station (Fire Station 4)	Infrastructure or Facility	1919 Ash Street	Not vulnerable to dam failure, drought, landslide, or wildfire.
Gales Creek Fire Station (Fire Station 7)	Infrastructure or Facility	52155 NW Old Wilson River Road	Not vulnerable to dam failure, drought, flood, or landslide.
Forest Grove Public Works Shop	Infrastructure or Facility	2551 23rd Avenue	Not vulnerable to dam failure, drought, flood, landslide, or wildfire.
Forest Grove Light and Power Shop	Infrastructure or Facility	1818 B Street	Not vulnerable to dam failure, drought, flood, landslide, or wildfire.
Forest Grove Light and Power Transmission System	Infrastructure or Facility	1818 B Street	Not vulnerable to drought, flood, or volcanic ash.
Forest Grove Aquatics Center	Infrastructure or Facility	2300 Sunset Drive	Not vulnerable to dam failure, drought, flood, landslide, or wildfire.
Forest Grove Water Treatment Plant/Reservoir	Infrastructure or Facility	501 Watercrest Road	Not vulnerable to dam failure or flood.
Forest Grove City Watershed and Transmission Lines	Infrastructure or Facility	Clear Creek – Oregon Coast Range	
Forest Grove School District Buildings	Infrastructure or Facility	Numerous locations	This covers the entire school district, comprising 12 buildings and facilities at present.
Clean Water Services Forest Grove Water Resource Recovery Facility	Infrastructure or Facility	1345 Fernhill Road	
Joint Water Commission Forest Grove Water Treatment Facility	Infrastructure or Facility	1924 Council Street	

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Frontier Communications Switch Center	Infrastructure or Facility	College Way, 9th and 20th	
Waste Management Forest Grove Transfer Station	Infrastructure or Facility	1525 B Street	
Pacific University and Associated Campus Buildings	Infrastructure or Facility, Cultural Resource, and Historical Property	2043 College Way	Not vulnerable to landslide. This covers the entire campus, all of the buildings, and its thousands of students/staff.
Jennings McCall Center Assisted Living Facility	Infrastructure or Facility	2300 Masonic Way	
Wynwood of Forest Grove Retirement Community	Infrastructure or Facility	3110 19th Avenue	Now called Brookdale Forest Grove.
Forest Grove Rehabilitation and Care Center	Infrastructure or Facility	3900 Pacific Avenue	
The Grove and The Gardens	Infrastructure or Facility	2112 Oak Street	
The Elms Retirement Center	Infrastructure or Facility	2030 Elm Street	
Marquis Forest Grove Post Acute Rehab	Infrastructure or Facility	3300 19th Avenue	
Marquis Vintage Suites	Infrastructure or Facility	3336 19th Avenue	
Forest Grove Beehive Assisted Living	Infrastructure or Facility	2122 Hawthorne Street	
Hawthorne House Memory Care	Infrastructure or Facility	2635 21st Avenue	
Forest Villa Senior Apartments	Infrastructure or Facility	2131 Quince Street	
The Homestead Senior Community	Infrastructure or Facility	4300 Settlers Loop	
Gales Creek Camp	Infrastructure or Facility	59425 NW Cedarbrook Lane	
Forest Grove Parks System	Natural Resource	Numerous locations	This covers the entire parks system, roughly 13 parks in total.
Clark Historic District	Historical Property	Residential blocks in Forest Grove	Not vulnerable to landslide or flood. Historic residential district.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Painters Woods Historic District	Historical Property	Residential blocks in Forest Grove	Not vulnerable to landslide or flood. Historic residential district.
Walker Naylor Historic District	Historical Property	Residential blocks in Forest Grove	Not vulnerable to landslide or flood. Historic residential district.
A.T. Smith House	Historical Property	South end of Elm Street	Home built in 1854 by the first Euro-American settlers in the area. It is on the National Register of Historic Places.
First Church of Christ, Scientist	Historical Property	1904 Pacific Avenue	Not vulnerable to landslide. Church built in 1914 and is on the National Register of Historic Places.

3.2.2.3. Housing

Housing characteristics are an important factor in mitigation planning. The information below shows that most housing units are owner-occupied and consist of one-unit buildings built before 1999. The older the housing, the more at risk it can be to damage from natural hazards, such as earthquakes and windstorms, including tornadoes.

Table 107: Housing Characteristics*

Households	Total
Total households[348]	8,601
Units in Housing Structure[349]	**Percent of Housing**
One-unit structures	66%
Structures with two or more units	29%
Manufactured homes and all other types	6%
Year Housing Structure Built[350]	**Percent of Housing**
Pre-1979	49%
1980–1999	26%
2000 to present	25%
Housing Tenure and Vacancy	**Percent of Housing**
Owner-occupied[351]	61%
Renter-occupied[352]	39%
Vacant[353]	4%

* Due to how respondents answer questions there may be overlapping responses and results may equal greater than 100%. Percentages are rounded.

[348] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 15, 2022, from https://data.census.gov/cedsci/table?q=forest%20grove%20oregon%20housing&tid=ACSST5Y2020.S1101,
[349] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 15, 2022, from https://data.census.gov/cedsci/table?q=forest%20grove%20oregon%20housing&tid=ACSST5Y2020.S1101
[350] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Physical Housing Characteristics for Occupied Housing Units, Table S2504. Accessed September 15, 2022, from https://data.census.gov/cedsci/table?q=forest%20grove%20oregon%20housing&tid=ACSST5Y2020.S2504
[351] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 15, 2022, from https://data.census.gov/cedsci/table?q=forest%20grove%20oregon%20housing&tid=ACSST5Y2020.S1101
[352] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 15, 2022, from https://data.census.gov/cedsci/table?q=forest%20grove%20oregon%20housing&tid=ACSST5Y2020.S1101
[353] United States Census Bureau. (2021, July 1). 2020 Decennial Census Occupancy Status, Table H1. Accessed September 15, 2022, from https://data.census.gov/cedsci/table?q=forest%20grove%20oregon%20housing&tid=DECENNIALPL2020.H1

3.2.3. Economy

Home to Pacific University, Forest Grove's diverse economic base includes high-tech, food and beverage processing, wood products, metalworking, education, and healthcare industries. Plentiful serviced land, low-cost structures, enterprise zone incentives, and a business-friendly government make Forest Grove a competitive location for business growth. The top five employment sectors in the City are educational services, manufacturing, health care and social assistance, accommodation and food services, and retail trade.[354] The City experienced an almost 14% employment growth from 2015–2019.[355]

Forest Grove has a thriving economy and is home to high-tech circuit board companies, food and beverage processing companies, and wood product companies. It also has a growing agriculture sector that focuses on nurseries and organic produce. The City also has tourist industry surrounding the Fern Hill Wetlands and Reservoir, Hagg Lake, vineyards, and an abundance of many recreational activities.[356]

Table 108: Income Characteristics[357]*

Households by Income Category	Percent of Households
Less than $5,000	4%
$5,000 to $9,999	2%
$10,000 to $14,999	4%
$15,000 to $19,999	2%
$20,000 to $24,999	7%
$25,000 to $34,999	7%
$35,000 to $49,999	11%
$50,000 to $74,999	18%
$75,000 to $99,999	15%
$100,000 to $149,999	18%
$150,000 or more	13%
Median Household Income	
$69,513	

* Due to how respondents answer questions, there may be overlapping responses, and results may equal greater than 100%. Percentages are rounded.

[354] City of Forest Grove. (2021, September). Forest Grove Economic Development Strategic Plan 2020 Annual Report. https://www.forestgrove-or.gov/sites/default/files/fileattachments/economic_development/page/219/econ_development_annual_report_2021s.2.pdf
[355] City of Forest Grove. (2021, September). Forest Grove Economic Development Strategic Plan 2020 Annual Report. https://www.forestgrove-or.gov/sites/default/files/fileattachments/economic_development/page/219/econ_development_annual_report_2021s.2.pdf
[356] City of Forest Grove. (2020). Forest Grove Economic Development Strategic Plan. https://www.forestgrove-or.gov/sites/default/files/fileattachments/economic_development/page/219/2020_economic_development_plan_final_v3.pdf
[357] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Financial Characteristics, Table S2503. Accessed September 15, 2022, from https://data.census.gov/cedsci/table?q=forest%20grove%20oregon%20income&tid=ACSST5Y2020.S2503

3.3. Natural Hazard Profiles

The Technical Committee for the City of Forest Grove utilized the OEM's hazard analysis methodology to examine hazard vulnerability and probability by collecting information about history, probability, vulnerability, and maximum threat for each hazard that impacts the City. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants.

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Volume I, Section 2.

All natural hazards included in the NHMP have the potential to impact the City. The scores for each hazard that impacts the City are presented below.

Table 109: Natural Hazard Risk Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	Low	Medium	Medium	Low	83
Drought	High	High	Medium	High	186
Earthquake: Cascadia (3–5-minute event)	Low	High	High	Medium	201
Earthquake: Crustal (1-minute event)	Low	High	High	Medium	201
Extreme heat	Medium	Medium	Medium	Medium	148
Flooding, including channel migration and streambed erosion	Low	Low	Low	Low	48
Landslide	Medium	Medium	Low	Medium	118
Volcanic ash	Low	Medium	Medium	Low	99
Wildland fire	High	High	High	High	240
Windstorm, including tornado	High	High	High	High	240
Winter storm	High	High	High	High	240

Full descriptions of each hazard are provided in Volume I, Section 2. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description in this annex and in Volume I, Section 2.

The timeframe of data collected during the planning process for the City was from January 1, 2011, to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the City's Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events since the 2011 NHMP update, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are presented in the same order, as applicable: populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

3.3.1. Dam Failure

The City of Forest Grove would be impacted if Scoggins Dam were to fail. The dam is located 5.5 miles from Forest Grove. It is a 151-foot-high structure that forms the Henry Hagg Lake. Potential impacts of and vulnerabilities to dam failure are identified below.

3.3.1.1. Potential Impacts

The potential impacts from a dam failure event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- If Scoggins Dam were to fail, areas in the southernmost portion of the City within the established 100-year flood risk area of the Tualatin River may flood. This is not a heavily built environment, and people and structures should not be adversely affected.[358]

3.3.1.2. Vulnerabilities

Built environment, critical facility, infrastructure, and natural environment vulnerabilities to a dam failure event include:

- Critical infrastructure and facilities, including Forest Grove City Auditorium, the Forest Grove Light and Power Transmission System, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities, Pacific University and associated campus buildings, 13 city parks, 12 assisted living and retirement communities, and 5 historical areas or properties.
  - The Clean Water Services Forest Grove Water Resource Recovery Facility is in the potential dam failure impact area. This facility provides wastewater treatment for the cities of North Plains, Banks, the western region of Hillsboro, the southeastern portion of Cornelius, and the northwestern portion of Forest Grove. The facility cleans approximately 4 million gallons of wastewater on an average day.[359]
  - The Joint Water Commission Water Treatment Plant could be vulnerable to flooding created by a Scoggins Dam failure event. The plant could be vulnerable to higher-than-normal water levels and damage to infrastructure due to debris flows, which could lead to changes in the amount of water available for use.
- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink, may be vulnerable. Stringtown Road, though outside of city limits, is prone to flooding (from both natural and urban flooding sources as well as dam failure) and contributes to access issues.
- Equipment at the City's utility facilities.
- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments and historical, mature landscaping and trees located throughout the City.

[358] City of Cornelius. (n.d.). Cornelius Web Mapping Application. https://corneliusor.maps.arcgis.com/apps/View/index.html?appid=d4a90a50cfea4000a209912a4ee4d851
[359] Clean Water Services. (2022). Locations. https://cleanwaterservices.org/about/locations/

3.3.2. Drought

Drought typically occurs as a regional event and often affects more than one city and county simultaneously. The City has multiple water provision and treatment facilities and has land used for agriculture and therefore may be impacted by drought differently than other NHMP participants. Potential impacts of and vulnerabilities to drought are identified below.

3.3.2.1. Potential Impacts

The potential impacts from a drought event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Reduction or loss of water supply, water use restrictions, and lack of potable water supply.
- Health effects, including increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions.
- Reduced economic productivity or business closures in such industries as agriculture, livestock, recreation, energy, tourism, timber, and fisheries.
- Supply chain restrictions, including food shortages.
- Loss of power or reduced availability of electricity due to infrastructure damage and high demand.
- Property and infrastructure damage due to expansive soils, which are clay-based soils that expand and contract based on the amount of moisture in the soil.
- Damage to natural environments, including low water levels in lakes, rivers, and other water bodies, reduced plant growth, local species reduction or extinction, increased water temperature, and deteriorated water quality, which may result in fish kills and increased waterborne pollutants.
- Concurrent hazards, including extreme heat, wildfire, flooding, and landslides.

3.3.2.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to drought. This includes:

- People in the City with preexisting health conditions, those without access to clean water, children, pregnant women, and older adults.
- Those who are employed in water-dependent sectors, such as agriculture and recreation, may experience a reduction in income.
- Water supply sources of the upper Tualatin River and its tributaries.
- Critical infrastructure and facilities, including Forest Grove City Auditorium, the Forest Grove Water Treatment Plant/Reservoir, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities, Pacific University and associated campus buildings, 13 city parks, 12 assisted living and retirement communities, and 5 historical areas or properties.
- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink.
- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments and historical, mature landscaping and trees located throughout the City.

3.3.3. Earthquake

The City could experience earthquakes that originate from the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek Fault Zone. It could also experience liquefaction and coseismic landslides as the result of an earthquake. Potential impacts of and vulnerabilities to earthquake are identified below.

3.3.3.1. Potential Impacts

The potential impacts from an earthquake event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Mental health impacts, including post-traumatic stress disorder.
- Public health hazards resulting from disruption of drinking water and wastewater systems.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to ground utilities; residential, public, and private buildings; and transportation systems above and below.
- Disruption of essential infrastructure systems, such as power systems, public utilities, and telecommunications.
- Blocked roads and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction.
- Downed or damaged power lines that can lead to wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Change in water flows, including paths of rivers and streams.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards initiated by an earthquake, including flood, wildland fire, and landslide.

3.3.3.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to earthquakes. These include:

- Critical infrastructure and facilities, including city hall, Forest Grove City Auditorium, Forest Grove Aquatics Center, one police station, two fire stations, the Forest Grove Public Works Shop, Forest Grove Light and Power, the Forest Grove Light and Power Transmission System, the Forest Grove Water Treatment Plant/Reservoir, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities, Pacific University and associated campus buildings, 13 city parks, 12 assisted living and retirement communities, and 5 historical areas or properties.
    - Public schools in the City with a high probability of collapse rating include Forest Grove High School, Neil Armstrong Middle School, and Tom McCall Upper Elementary East and West Campuses.
    - Some buildings at Pacific University are not retrofitted.
    - The police station and one fire station are not retrofitted. City hall is in the process of being retrofitted.
    - Underground infrastructure, such as pipelines and utility lines, buildings, and roads, are vulnerable to damage from liquefaction due to the type of soil in the City.
- Buildings with a very high or high probability of collapse rating include residential and commercial buildings constructed prior to 1990 and unreinforced masonry buildings.
    - The City's downtown corridor is a major business and tourist center. Loss of this area would be devastating to the Forest Grove economy. The buildings are extremely vulnerable due to their age and the potential for an earthquake in the area. Most are unreinforced masonry buildings. Liquefaction is also likely in much of downtown Forest Grove in a major earthquake event.
- Buildings in relatively high liquefaction-susceptible areas along Dairy Creek, Gales Creek, and the Tualatin River are at higher risk of damage from coseismic liquefaction-induced ground deformation.
- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink.
    - Several bridges have been identified by the City as vulnerable to earthquakes, and if impacted, could isolate large portions of the community and limit access to emergency services and basic supplies. This includes Dairy Creek Bridge on Highway 8, which is not seismically retrofitted.
- There are facilities that store hazardous materials within the City, which can become a secondary hazard during or after an earthquake.
- Equipment at the City's police and fire stations, the Public Works Shop, and utility facilities.
- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments and historical, mature landscaping and trees located throughout the City.
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.

  - Using 2022 Hazus®-MH information on a Gales Creek Fault 6.7 magnitude earthquake, the City has a higher estimated loss ratio compared to other participants due to the level of shaking likely to occur.[360]

- Using 2022 Hazus-MH information, it is estimated a 6.7 magnitude Gales Creek Fault earthquake event could result in 1,819 yellow-tagged buildings, 668 red-tagged buildings, and $584,634,000 in total economic losses.[361]
- A 2018 Oregon Department of Geology and Mineral Industries (DOGAMI) report shows that a:
  - Cascadia Subduction Zone magnitude 9.0 earthquake in “dry” soil conditions could result in $303,000,000 in building repair costs, 159,000 tons of debris, 492 long-term displaced residents, and up to 455 deaths;
  - Cascadia Subduction Zone magnitude 9.0 earthquake in “wet” soil conditions could result in $496,000,000 in building repair costs, 223,000 tons of debris, 2,238 long-term displaced residents, and up to 812 deaths;
  - Portland Hills fault magnitude 6.8 earthquake in “dry” soil conditions could results in $127,000,000 in building repair costs, 61,000 tons of debris, 115 long-term displaced residents, and up to 112 deaths; and
  - Portland Hills fault magnitude 6.8 earthquake in “wet” soil conditions could results in $259,000,000 in building repair costs, 107,000 tons of debris, 1,242 long-term displaced residents, and up to 358 deaths.[362]

[360] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[361] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[362] Oregon Department of Geology and Mineral Industries. (2018). Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-18-02/O-18-02_report.pdf

3.3.4. Extreme Heat

Due to a rise in the frequency and severity of extreme heat events and the impacts from those events, the NHMP Steering Committee chose to include this hazard for the first time in the Washington County NHMP. Potential impacts of and vulnerabilities to extreme heat are identified below.

3.3.4.1. Potential Impacts

The potential impacts from an extreme heat event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, heat stroke, and death.
- Extended operational hours of County staff and additional resources needed for response to the event, including the operation of daytime cooling centers and overnight cooling shelters.
- Strain on or loss of water supply due to increased demand.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic losses from decreased worker efficiency and effectiveness and time lost on the job when workers take more frequent or longer breaks to avoid overheating.
- Economic impacts from closure of outdoor activities and events, such as farmers markets and concerts.
- Property damage, such as roof expansions, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding.
- Disruption of essential infrastructure systems from overheated and damaged utilities, including power, water, transportation, and communication systems.
- Impacts to roadways as heat expands concrete or causes cracking and buckling. Public transit can also be impacted due to melted cables, sagging wires, and warping tracks.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Impacts to greenspaces, such as scorch and sunscald of new foliage, branches or tops of trees dying, and significant stress and die-off of native trees, particularly Douglas fir and cedar. These impacts are intensified if drought is also occurring.
- Concurrent hazards include drought and wildland fire.

3.3.4.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to extreme heat.

Populations substantially vulnerable to extreme heat include:

- People who work or spend a significant amount of time outdoors, including those in construction, landscaping, maintenance and repair, roofing, and solid waste collection.
- People who live and/or work in buildings without air conditioning or cooling equipment.

- People living, working, or spending time in heat islands within the City.
- People living outdoors or in the upper floors of multi-family housing units.
- Populations with higher heat sensitivity, including older adults, infants and children, pregnant women, people with preexisting or chronic diseases, and those who take certain medications that affect thermoregulation or block nerve impulses.
- People with limited mobility and no access to cooling systems who may not be able to travel to cooling centers or shelters.
- People who live in social isolation, including linguistic isolation or those living alone with few social relationships.
- People with mental health conditions. Extreme heat can be associated with higher levels of aggression, violence, and suicidal behavior.
- Factors including race and ethnicity, income, and educational attainment are correlated with heat-related illness.

Additional vulnerabilities to extreme heat include:

- Critical infrastructure and facilities, including city hall, Forest Grove City Auditorium, Forest Grove Aquatics Center, one police station, two fire stations, the Forest Grove Public Works Shop, Forest Grove Light and Power, the Forest Grove Light and Power Transmission System, the Forest Grove Water Treatment Plant/Reservoir, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities, Pacific University and associated campus buildings, 13 city parks, 12 assisted living and retirement communities, and 5 historical areas or properties.
- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink.
- Bridge infrastructure is vulnerable to thermal expansion of bridge joints and paved surfaces and deterioration of steel, asphalt, protective cladding, coats, and sealants.
- Asphalt pavement is vulnerable to accelerated deterioration through softening, rutting, and migration of liquid asphalt.
- Vehicles, including first responder vehicles, are vulnerable to engine overheating and tire deterioration.
- Equipment at the City’s police and fire stations, the Public Works Shop, and utility facilities.
- Other critical infrastructure, including communication structures and emergency generators.
- Aboveground utility and power lines can droop or sag and create a heightened fire risk.
- Natural environments and historical, mature landscaping and trees located throughout the City.
- Plants, animals, ecosystems, and natural environments are vulnerable to high rates of mortality due to excessive heat.

3.3.5. Flooding, Including Channel Migration and Streambed Erosion

The City experiences localized flooding typically from October through April; however, historically, it has not been significant or severe. Potential impacts of and vulnerabilities to flooding are identified below.

3.3.5.1. Potential Impacts

The potential impacts from a flooding event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Need for widespread search and rescue operations, including water rescues.
- Displaced residents in need of sheltering.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal economic impacts from loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.5.2. Vulnerabilities

Population, economic, built environment, critical facility, infrastructure, and natural environment vulnerabilities to a flooding event include:

- Populations without access to private transportation.
- Critical infrastructure and facilities, including city hall, Forest Grove City Auditorium, Forest Grove Aquatics Center, one police station, one fire station, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities, Pacific University and associated campus buildings, 13 city parks, 12 assisted living and retirement communities, and 5 historical properties.
- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink.

  - The following transportation routes have been identified as prone to flooding:
    - Highway 47 – Outside of city limits and controlled by the Oregon Department of Transportation
    - Dairy Creek Bridge on Highway 8 – Outside of city limits and controlled by the Oregon Department of Transportation
    - Stringtown Road – Outside of city limits, is prone to flooding, and contributes to access issues
    - Magnolia Street
    - Mountain View Lane
    - Fern Hill Road
    - Settlers Loop
- Equipment at the City's police and fire stations, the Public Works Shop, and utility facilities.
- Other critical infrastructure, including communication structures and emergency generators.
- There is one repetitive loss (RL) property within the City.
- Properties without flood insurance.
- Special flood hazard areas within the City.
- Floodplain area along Council Creek could be affected. Residential development in this area may be vulnerable.
- Natural environments and historical, mature landscaping and trees located throughout the City.
- Flood loss estimates determined by Hazus-MH include[363]:
  - 10-year flood scenario
    - Number of buildings lost: 1
    - Loss estimate: $0
  - 50-year flood scenario
    - Number of buildings lost: 2
    - Loss estimate: $2,000
  - 100-year flood scenario
    - Number of buildings lost: 2
    - Loss estimate: $3,000
  - 500-year flood scenario
    - Number of buildings lost: 20
    - Loss estimate: $579,000

[363] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

Table 110: Land Cover Type in the 100-Year Floodplain in the City of Forest Grove

Land Use Type	Total Parcels in the 100-Year Floodplain	Total Value of Exposed Parcels	Total Area in Jurisdiction (Acres)	Total Area in the 100-Year Floodplain (Acres)	Percentage of Area in the 100-Year Floodplain
Agriculture	5	$3,686,600	443.73	69.63	15.69%
Commercial	11	$19,488,270	319	50.7	15.89%
Forest	0	$0	29.29	0	0%
Industrial	1	$563,150	73.68	1.97	2.67%
Multi-Family Residential	0	$0	66.17	0	0%
Public	23	$35,265,570	653.28	216.64	33.16%
Single-Family Residential	59	$44,265,140	1305.39	64.3	4.93%
Vacant	11	$2,315,040	100.13	36.54	36.49%
Other	14	$780,980	252.59	12.44	4.93%
Total	**124**	**$107,364,750**	**3243.26**	**452.22**	**13.94%**

Table 8: Facilities in Forest Grove within FEMA-Mapped Floodplains

Building Classification	Buildings Within Forest Grove	Buildings Within 100-Year Floodplain
Total Buildings	8,234	46
Percentage of Buildings within Forest Grove	100	0.56%

3.3.6. Landslide

The northwestern portion of Forest Grove is highly susceptible to damage from landslides.[364] Potential impacts of and vulnerabilities to landslides are identified below.

3.3.6.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a landslide event are identified below. The type, magnitude, and extent of these can vary based on the scale of the event.

- Portions of the City of Forest Grove are exposed to landslide hazards. Areas in terrain with moderate to steep slopes or at the base of steep hillsides may be exposed to landslides. While these areas are highly prone to landslides, most of the populated areas are outside these zones because most of the buildings are on the relatively flat ground toward the center of the Tualatin Valley.
- Areas of concern include Council Creek, Jobs Ditch, Nature's Ridge, and David Hill. Residential development in these areas may be vulnerable.
- Critical infrastructure and facilities, including Forest Grove City Auditorium, the Forest Grove Light and Power Transmission System, the Forest Grove Water Treatment Plant/Reservoir, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities, 13 city parks, 12 assisted living and retirement communities, and 1 historical property.
- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink.
- Per DOGAMI, there are 13 buildings with a total value of $4,202,000 at very high susceptibility to landslide exposure, 578 buildings with a total value of $178,395,000 at high susceptibility to landslide exposure, and 1,135 buildings with a total value of $303,306,000 at moderate susceptibility to landslide exposure.[365] Additionally, a community risk profile completed by DOGAMI shows 1,817 residents may be potentially displaced due to a very high or high susceptibility landslide scenario.[366]
- Landslide hazard is ubiquitous in a large percentage of undeveloped land and may present challenges for future planning and mitigation efforts. Awareness of nearby areas of landslide hazard is beneficial for reducing risk for every community in Washington County.

[364] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[365] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[366] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.3.7. Volcanic Ash

Volcanic activity is possible from mountains near the County. It is anticipated that ashfall from a volcanic eruption has the potential to impact the City, although the scale and types of impacts and vulnerabilities may differ depending on which volcano erupts, the level of eruption, and the wind direction during and after eruption. Potential impacts of and vulnerabilities to volcanic ash are identified below.

3.3.7.1. Potential Impacts

Though unlikely, the impacts of a significant ashfall can be substantial. Impacts may include:

- Indirect injuries and deaths, such as those sustained during ash cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation. This includes public water systems that rely on outdoor reservoirs.
- The need to shelter individuals to protect them from poor air quality, including houseless persons and persons displaced from their residences due to poor residential air filtration systems.
- Delayed emergency response times due to decreased visibility and increased traffic hazards.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and cleanup activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.7.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to volcanic ash. These include:

- People in the City with chronic lung problems and preexisting health conditions, children, pregnant women, and older adults.
- People without access to effective dust masks, eye protection, and drinking water and food uncontaminated by ash.

- Critical infrastructure and facilities, including city hall, Forest Grove City Auditorium, Forest Grove Aquatics Center, one police station, two fire stations, the Forest Grove Public Works Shop, Forest Grove Light and Power, the Forest Grove Water Treatment Plant/Reservoir, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities, Pacific University and associated campus buildings, 13 city parks, 12 assisted living and retirement communities, and 5 historical areas or properties.
- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink.
- Older buildings and infrastructure not built to withstand the weight and impacts from large amounts of volcanic ash, including manufactured homes and buildings and the people who live or work in them.
- Equipment at the City's police and fire stations, the Public Works Shop, and utility facilities.
- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments and historical, mature landscaping and trees located throughout the City.

3.3.8. Wildland Fire

Although the City of Forest Grove could experience a wildland–urban interface event, historically it is more likely to be affected by smoke and poor air quality due to wildland fires outside its boundaries. Significant wildland fire or wildland fire smoke events, their potential impacts, and vulnerabilities to wildland fire are identified below.

3.3.8.1. Significant Events

The City has not been directly impacted by a wildland fire event since the update of the 2011 NHMP. However, in September 2014 the Scoggins Creek wildfire, located six miles west of Forest Grove, burned 211 acres and forced some home evacuations. Additionally, in September 2020, multiple wildfires occurred concurrently in the county, outside the county, and outside the state, and the City experienced significant smoke from the fires. The Air Quality Index around the City was between 199 and 317, with particulate matter 2.5 micrometers or smaller ($PM_{2.5}$).

3.3.8.2. Potential Impacts

The potential impacts from a wildfire event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Exposure to wildfire smoke, which can lead to eye, nose, and throat irritation and the worsening of chronic heart and lung diseases.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to blocked transportation routes and debris, congested transportation routes due to evacuations, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Strain on or loss of water supply due to increased demand.
- Economic impacts to governments, including costs for fire suppression, staff, equipment, supplies, transportation and mobilization of first responders, evacuations, sheltering operations, post-fire recovery, and rebuilding costs associated with government-owned buildings, property, and infrastructure.
- Economic impacts, including loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity. Scoggins Valley Park receives one million visitors a year, most during summer, which is when wildland fires tend to occur.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.

- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property, causing blocked roads and rail transportation routes.
- Downed or damaged power lines. This impact may be compounded since powerline failures can lead to additional wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including air and water quality issues. Landslide and erosion issues are common following a wildland fire.

3.3.8.3. Vulnerabilities

Given the dynamic nature of wildland fires, all populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to this hazard. This includes:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults.
- Populations without access to private transportation.
- First responders and other personnel working directly on fire protection, suppression, and patrols or near a wildfire can experience burns, smoke exposure, heat-related impacts such as heat stroke, heat exhaustion, dehydration, physical fatigue, mental health challenges, injuries, and death.
- Critical infrastructure and facilities, including the Forest Grove City Auditorium, one fire station, the Forest Grove Light and Power Transmission System, the Forest Grove Water Treatment Plant/Reservoir, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities, Pacific University and associated campus buildings, 13 city parks, 12 assisted living and retirement communities, and 5 historical areas or properties.
- Drinking water sources, food supplies and availability, and access to medical resources or care may also be impacted by wildfire and can cause health impacts on a large scale.
- Homes, businesses, and infrastructure adjacent to the wooded areas near the outskirts of the City.
- Per analysis of the Oregon State University–Extension Service Fire Program and Wildland Fire Associates dataset, there is one building with a total value of $250,000 at high risk of wildland fire exposure and 1,017 buildings with a total value of $310,077,000 at low wildland fire exposure risk.[367] There are no buildings identified as at moderate wildfire exposure risk. Additionally, a community risk profile completed by DOGAMI shows one resident may be potentially displaced due to a high or moderate risk wildland fire scenario.[368]

[367] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[368] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink.
- Equipment at the City's police and fire stations, the Public Works Shop, and utility facilities.
- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments and historical, mature landscaping and trees located throughout the City.

3.3.9. Windstorm, Including Tornado

Because of its more rural geography, the City tends to experience more frequent and higher magnitude windstorm events. Potential impacts of and vulnerabilities to windstorms are identified below.

3.3.9.1. Potential Impacts

The potential impacts from a windstorm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.9.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to windstorms, including tornadoes. This includes:

- Critical infrastructure and facilities, including city hall, Forest Grove City Auditorium, Forest Grove Aquatics Center, one police station, two fire stations, the Forest Grove Public Works Shop, Forest Grove Light and Power, the Forest Grove Light and Power Transmission System, the Forest Grove Water Treatment Plant/Reservoir, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities,

Pacific University and associated campus buildings, 13 city parks, 12 assisted living and retirement communities, and 5 historical areas or properties.

- Older buildings and infrastructure not built to withstand high winds, including manufactured homes and buildings.
- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink.
- Equipment at the City's police and fire stations, the Public Works Shop, and utility facilities.
- Other critical infrastructure, including communication structures and emergency generators.
- Aboveground utility and power lines.
- Natural environments and historical, mature landscaping and trees located throughout the City.

3.3.10. Winter Storm

Due to the City's location closer to the mountains on the west side of the county, it typically experiences more frequent and more severe winter storm events than other NHMP participants. Potential impacts of and vulnerabilities to winter storms are identified below.

3.3.10.1. Potential Impacts

The potential impacts from a winter storm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths, including from carbon monoxide poisoning, falls from slick or icy conditions, frostbite, and hypothermia.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components.
- Stranded travelers due to ice, snow, and transportation impacts.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- An increased number of house fires due to unsafe alternate heating methods.
- Significant property damage and loss of water due to frozen or damaged pipes or the thawing of frozen pipes.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged power lines can lead to wildfires, and tree debris can create fuel load for wildfire.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including flooding.

3.3.10.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to winter storms. These include:

- People who do not have access to sufficient heating, insulated clothing, or dry living conditions, including unhoused populations.
- Older adults and infants, people who take certain medications, people who have certain medical conditions, and people who have been drinking alcohol are at increased risk for hypothermia.
- People improperly using generators and heating devices.
- Populations with disabilities may be more affected due to mobility issues.
- Critical infrastructure and facilities, including city hall, Forest Grove City Auditorium, Forest Grove Aquatics Center, one police station, two fire stations, the Forest Grove Public Works Shop, Forest Grove Light and Power, the Forest Grove Light and Power Transmission System, the Forest Grove Water Treatment Plant/Reservoir, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities, Pacific University and associated campus buildings, 13 city parks, 12 assisted living and retirement communities, and 5 historical areas or properties.
- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink. Because of the City's more rural location, other areas of the county tend to be prioritized for snow removal.
- Older buildings and infrastructure not built to withstand the weight and impacts from large amounts of snow and ice. This includes historical structures and properties.
- Equipment at the City's police and fire stations, the Public Works Shop, and utility facilities.
- Other critical infrastructure, including communication structures and emergency generators.
- Natural environments and historical, mature landscaping and trees located throughout the City.

3.4. Historical Events

The timeframe of data collected during the planning process for the City of Forest Grove was January 1, 2011, to February 22, 2022. Hazard events that impacted the entire planning area during these dates are detailed in Volume I, Section 2. During this period, the City experienced impacts from wildland fire and wildland fire smoke.

The City has not issued any disaster declarations since the 2011 NHMP update.

3.5. Overall Vulnerability

Based on the analysis completed by the Technical Committee, wildland fire, windstorm, including tornado, winter storm, earthquake, and drought present the highest relative risk to the City of Forest Grove. These hazards can create widespread events, and all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City can be vulnerable to these hazards.

Areas of greatest vulnerability to these hazards within the City include:

- Populations with higher vulnerability, such as those with preexisting health conditions, older adults, children, and pregnant women. This may include those living in or spending time in the City's public school buildings and facilities.
- Populations that are unhoused, do not have access to private transportation, and/or are without access to air conditioning, cooling equipment, sufficient heating, and clean water.
- People living, working, or spending time in heat islands within the City.
- Populations with limited income and financial resources.
- Populations whose primary language is not English.
- Industries that can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic impacts to the City, including loss of local revenue due to business and property tax losses, reduced future revenues, reduced recreation and tourism activity, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Critical infrastructure and facilities, including city hall, Forest Grove City Auditorium, Forest Grove Aquatics Center, one police station, two fire stations, the Forest Grove Public Works Shop, Forest Grove Light and Power, the Forest Grove Light and Power Transmission System, the Forest Grove Water Treatment Plant/Reservoir, the Forest Grove City Watershed and Transmission Lines, the Clean Water Services Forest Grove Water Resource Recovery Facility, the Joint Water Commission Forest Grove Water Treatment Facility, 12 public school buildings and facilities, Pacific University and associated campus buildings, 13 city parks, 12 assisted living and retirement communities, and 5 historical areas or properties.
    - Older buildings and infrastructure not built to current building codes or seismic standards may be more vulnerable.
        - Public schools in the City with a "high" probability of collapse rating include Forest Grove High School, Neil Armstrong Middle School, and Tom McCall Upper Elementary East and West Campuses.
        - Some buildings at Pacific University are not retrofitted.
        - The police station and one fire station are not retrofitted. City hall is currently being retrofitted.
        - The City's downtown corridor is a major business and tourist center. Loss of this area would be devastating to the Forest Grove economy. The buildings are extremely vulnerable due to their age and the potential for an earthquake in the area. Most are unreinforced masonry buildings. Liquefaction is also likely in much of downtown Forest Grove in a major earthquake event.
        - Buildings in relatively high liquefaction-susceptible areas along Dairy Creek, Gales Creek, and the Tualatin River are at higher risk to damage from coseismic liquefaction-induced ground deformation.
- Critical transportation infrastructure, including State Highways 8 and 47, arterial roads, TriMet services, and GroveLink.
    - Several bridges have been identified by the City as vulnerable to earthquakes, and if impacted, could isolate large portions of the community and limit access to emergency services and basic supplies. This includes Dairy Creek Bridge on Highway 8 which is not seismically retrofitted.

- Equipment at the City's police and fire stations, the Public Works Shop, and utility facilities.
- Other critical infrastructure, including communication structures, emergency generators, and above ground utility and power lines. Underground infrastructure, such as pipelines and utility lines, buildings, and roads are also vulnerable to damage from liquefaction due to the type of soil in the City.
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property. Using 2022 Hazus-MH information on a Gales Creek Fault 6.7 magnitude earthquake, the City has a higher estimated loss ratio compared to other participants due to the level of shaking likely to occur.369
- There are facilities that store hazardous materials within the City, which can become a secondary hazard during or after an earthquake.
- The City's water sources.
- Natural environments and historical, mature landscaping and trees located throughout the City.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment and safe growth analysis examine the ability of the City to implement and manage a comprehensive mitigation strategy. Strengths, opportunities, and resources of the jurisdiction are identified to develop an effective hazard mitigation action plan. The capabilities identified in this assessment were evaluated collectively to develop feasible recommendations, which support the implementation of effective mitigation activities.

A capability questionnaire was distributed to the City of Forest Grove Technical Committee to initiate this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities. The Technical Committee also completed a safe growth analysis to identify potential gaps in growth guidance instruments and improvements that could be made to reduce vulnerability to future development. It is important to note that the City of Forest Grove and the City of Cornelius work in tandem in many areas of responsibility so that when one is responsible for a duty, that duty covers both cities.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances within the City that can prevent and reduce the impacts of hazards.

The City's Comprehensive Plan, Capital Improvement Plan, Economic Development Plan, local Emergency Operations Plan, Stormwater Management Plan, and Community Wildfire Protection Plan address natural hazards, identify projects that can be included in the mitigation strategy, and can be used to implement mitigation actions. Many of the goals and policies in the City's Comprehensive Plan are related to those in this NHMP and safe growth objectives. The monitoring and implementation section of the NHMP covers these and all other hazard mitigation strategies discussed in the plan. Safety is explicitly included in the Comprehensive Plan's growth and development policies. The City has a future land use map in their Comprehensive Plan, and their land use policies discourage development or

[369] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

redevelopment within natural hazard areas. The City's Comprehensive Plan addresses limited space for expected future growth in areas located outside natural hazard areas.

The City's Capital Improvement Program does not provide funding for hazard mitigation projects identified in this NHMP; however, the program limits expenditures on projects that would encourage development in areas vulnerable to natural hazards. The City's infrastructure policies limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.

The Forest Grove Transportation System Plan addresses natural hazards, identifies projects that can be included in the mitigation strategy, and can be used to implement mitigation actions. The Forest Grove Transportation System Plan limits access to identified hazard areas and is used to guide growth into safe locations. The City and the plan do not have movement systems designed to function under disaster conditions, such as during an evacuation.

Land use planning and ordinances are adequately administered and enforced and are an effective measure for reducing hazard impacts. These include zoning, subdivision, and building codes. The City has zoning ordinances that conform to the Comprehensive Plan in terms of discouraging development or redevelopment within natural hazard areas, including prohibiting development within, or filling of, wetlands, floodways, and floodplains. The ordinance also contains natural hazard overlay zones that set conditions for land use within such hazard zones. Rezoning procedures recognize natural hazard areas as off limits to any zoning changes that would allow for increased activity or development in the area. The City has subdivision regulations that restrict the subdivision of land within or adjacent to natural hazard areas and regulations that allow density transfer where hazard areas exist. City regulations do not provide for conservation subdivisions or cluster subdivisions to conserve environmental resources. The City's building code contains provisions to strengthen or elevate construction to withstand hazard forces, and the City has an adopted evacuation and shelter plan to deal with emergencies from natural hazards. The small-area or corridor plans in the City recognize the need to avoid or mitigate natural hazards, and economic development or redevelopment strategies include provisions for mitigation of natural hazards.

The City's Planning Division leads and facilitates review of land use applications and enforces site plan review requirements. The City of Forest Grove utilizes the most current building codes as they are adopted by the State of Oregon.[370] Forest Grove Fire & Rescue has an Insurance Services Office (ISO) rating of 4.

The City has environmental systems that protect development from hazards identified and mapped and policies that maintain and restore protective ecosystems, including land use policies. The City does not have environmental policies that provide incentives to development that is located outside protective ecosystems. Chapter 9 of the Forest Grove Comprehensive Plan, Natural Resources and Hazards, supports the Oregon Statewide Land Use Planning Goal 5 to "protect natural resources and conserve scenic and historic areas and open spaces."[371]

4.1.1. National Flood Insurance Program Compliance

Participation in the National Flood Insurance Program (NFIP) is based on a voluntary agreement between a community and FEMA. For communities that adopt a floodplain management ordinance to reduce flood risks to new construction, federally backed flood insurance is made available to property owners in the community. Compliance with the NFIP, however, extends beyond participation in the program. The three basic components of the NFIP include floodplain identification and risk mapping, responsible floodplain management, and flood insurance.

[370] City of Forest Grove. (n.d.). Planning Division. https://www.forestgrove-or.gov/planning
[371] City of Forest Grove. (2022). Forest Grove Comprehensive Plan. https://www.forestgrove-or.gov/sites/default/files/fileattachments/planning/page/7751/comp_plan_publication_2022_edition.pdf

An RL property is a property insured under the NFIP for which the program has paid at least two claims of more than $1,000 in any 10-year period since 1978, regardless of any change(s) of ownership during that period. There are no RL properties in the City.

4.1.1.1. National Flood Insurance Program Details

Insurance Summary

There are currently 12 NFIP policies in the City. The dollar amount of coverage in force and dollar amount of premiums paid annually was not available at the time this NHMP was published. Identifying this information is an improvement for the next planning cycle.

There have been 5 loss claims paid, with two of those paid in full, for a total amount of $75,194.38 paid.

There are 46 structures exposed to flood risk within the community.

Staff Resources

There are no barriers to running an effective NFIP program in the City. The City of Forest Grove Planning Division and emergency preparedness personnel administer the program. This staff facilitates permit review and education and outreach. The City has a floodplain administrator on staff.

Compliance History

The City is in good standing with the NFIP, and there are no outstanding compliance issues. The City is in good standing with the NFIP, and there are no outstanding compliance issues. The date of the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC) was not available at the time this NHMP was published. Identifying this information is an improvement for the next planning cycle.

The City will continue NFIP compliance during the next five years of NHMP implementation by enforcing floodplain management requirements, maintaining and using floodplain mapping, and undertaking any code amendments needed to maintain compliance.

Regulation

The City entered into the NFIP on March 1, 1974, and has both digital and paper flood insurance rate maps (FIRMs). The initial FIRM was identified on March 15, 1982, and the current effective map date is October 19, 2018. Floodplain development regulations meet or exceed the minimum FEMA and state requirements.

Community Rating System

The City does not participate in the Community Rating System.

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff and their skills and tools that can be used for mitigation planning and implementing specific mitigation actions.

The City's Planning Commission is responsible for assisting the City Council to develop, maintain, update, and implement the City's Comprehensive Plan and development code provisions and to review and take action on development projects. The Community Development and Planning Department maintains compliance with Oregon's Statewide Planning Goals, provides support to the Planning Commission, and reviews projects for compliance with the City's codes and plans.

Forest Grove Light and Power administers maintenance programs to reduce risk, including tree trimming near utility lines. The City's Public Works Department cleans streets and clears storm drains within the

City. The City also has multiple effective mutual aid agreements and planning partnerships, including intergovernmental agreements, and partnerships with the Washington County Emergency Management Cooperative and the Cooperative Public Agencies of Washington County.

Forest Grove's Building Division is responsible for reviewing and approving plans, issuing permits and performing inspections for new construction, and performing alterations and repairs. It provides structural, plumbing, mechanical, fire, and life safety plan reviews and performs all required inspections, except electrical, related to both commercial and residential construction. The division has adequate staffing levels to enforce regulations, staff are trained on hazards and mitigation efforts, and coordination on mitigation initiatives with staff is effective. The chief building official is part of the Forest Grove Building Division and is a full-time position. This division also has several other full-time positions, including city planners and a geographic information system (GIS) coordinator. The emergency management duties are handled by the Fire Marshal.

Additionally, the City has many technical capabilities that have been used to assess or mitigate risk and could be used in future efforts. Warning systems include Everbridge and OR-Alert in partnership with Washington County. Grant writing is completed by individual departments as needed. Hazard data and information can be pulled from a variety of sources, including GIS mapping software, historical records, and DOGAMI.

4.3. Education and Outreach Assessment

Education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information were assessed to determine the City's capabilities.

The Forest Grove School District serves the City. The district has ongoing public education programs that include fire and earthquake drills and fire safety coloring and activity sheets. School district facilities are also used as shelters, as needed.

Nonprofit organizations and community groups in the City can assist with implementing future mitigation actions, including those that provide sheltering and emergency assistance, extreme heat sheltering, and emergency management-specific groups. These partners include the Red Cross, local churches, and the Washington County Emergency Management Cooperative.

4.4. Financial Assessment

The City has access to or is eligible to potentially use the following funding resources for hazard mitigation initiatives:

- Capital improvements project funding
- Authority to levy taxes for specific purposes
- Fees for water, sewer, gas, and/or electric services
- Incurrence of debt through general obligation bonds and/or special tax bonds
- Federal funding sources, including the Community Development Block Grant and Hazard Mitigation Assistance Grants
- State funding programs, including the funding for disaster and emergency preparedness efforts
- Public or private partnership funding sources, including local funding from Waste Management Corporation's transfer station located in the City

4.5. Capability Expansion and Improvement

Actions that can expand and improve existing authorities, plans, policies, and resources for mitigation include continuing to update City plans as necessary to ensure they are current and reflect the needs of the community; continuing to seek out a variety of funding sources and increase grant writing capabilities; creating and implementing additional public education and outreach offerings; establishing a Community Emergency Response Team; and solidifying staffing capabilities and training the new staff, as required.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iii), §201.6(c)(3)(iv), , and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) directs local mitigation plans to describe hazard mitigation action and establish a strategy to implement those actions. Therefore, all other requirements for a local mitigation plan lead to and support the mitigation strategy.

5.1. Mitigation Goals

The Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 City of Beaverton NHMP, 2011 Cities of Cornelius and Forest Grove NHMPs, and 2020 State of Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals detailed in Volume I, Section 3. These goals are the basis of this plan and summarize what the Steering Committee will accomplish by implementing this plan.

5.2. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on mitigation plan requirement 44 CFR §201.6(c)(4)(ii), the vulnerability and capabilities assessment for the City was carefully reviewed and considered when developing the mitigation actions for this plan. The City's Technical Committee will establish a process in which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into the existing local planning strategies.

Once the plan is adopted, the committee will coordinate implementation with the responsible parties in the City and with external stakeholders as needed. The primary means for integrating mitigation strategies will be through the revision, update, and implementation of plans and regulations, such as comprehensive plans, capital improvement plans, and land development regulations, as feasible.

The members of the City's Technical Committee will remain charged with ensuring the goals and strategies of new and updated local planning documents for their jurisdictions and special districts are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.2.1. Comprehensive Plan

The City of Forest Grove's Comprehensive Plan is amended as needed, with the most recent amendment occurring in 2022.[372] City personnel assigned with emergency preparedness and management duties will determine the best way to integrate the hazard mitigation goals into the City's Comprehensive Plan, as applicable.

5.2.2. Building and Zoning Codes

The City's building and construction codes are located in the Forest Grove Municipal Code, Chapter 150. The City has adopted many state codes, including the Oregon Structural Specialty Code, Oregon Plumbing Specialty Code, Oregon Mechanical Specialty Code, Oregon Residential Specialty Code, Oregon One- and Two-Family Dwelling Specialty Code, and the current version of the Uniform Building Code Appendix Chapter 33 as published by the International Conference of Building Officials.[373]

The City's zoning code is found within the Forest Grove Municipal Code, Title XVII, Development Code, Article 3, Zoning Districts, and addresses natural resource area protection and improvement in accordance with Metro's Urban Growth Management Functional Plan.[374] Additionally, section 17.8.310 of the City's code addresses hazard areas, including floodplains and flood management areas.[375] Updates to this section and additions for other areas of hazard mitigation strategies can be integrated into future code amendment efforts.

The City will continue to enforce building and zoning codes and review and update codes to address the evolving needs of the City, as applicable.

5.2.3. Public Engagement, Education, and Outreach

The mission of community engagement will be incorporated into future outreach projects. City of Forest Grove personnel who are assigned with emergency preparedness duties will continue public engagement campaigns during National Preparedness Month. Additionally, personnel will host educational opportunities at civic events, such as civic association meetings and neighborhood fairs, to showcase hazard mitigation opportunities, like flood protection programs and rainwater harvesting, and will provide general preparedness tips.

5.2.4. Land Development Regulations

The City's land development regulations are addressed in the Forest Grove Municipal Code, Title XVII, Development Code.[376] Land use permits are reviewed by city staff to ensure compliance with the City code and the City's Comprehensive Plan. Additionally, The City's Planning Commission plays an integral role in the growth-related issues of the City. The Planning Commission's responsibilities include participating in the development of community plans, holding hearings, and interpreting state and local laws and codes related to community development plans for regulations for future growth.[377] The City will

[372] City of Forest Grove. (2022). Forest Grove Comprehensive Plan. https://www.forestgrove-or.gov/sites/default/files/fileattachments/planning/page/7751/comp_plan_publication_2022_edition.pdf
[373] Forest Grove Municipal Code. (n.d.). Chapter 150: Building Codes. https://codelibrary.amlegal.com/codes/forestgrove/latest/forestgrove_or/0-0-0-3895#JD_150.003
[374] Forest Grove Municipal Code. (n.d.). Section 17.5.005: Natural Resource Areas. https://codelibrary.amlegal.com/codes/forestgrove/latest/forestgrovedev_or/0-0-0-1693
[375] Forest Grove Municipal Code. (n.d.). Section 17.8.310: Hazard Areas. https://codelibrary.amlegal.com/codes/forestgrove/latest/forestgrovedev_or/0-0-0-3631
[376] Forest Grove Municipal Code. (n.d.). Title XVII: Development Code. https://codelibrary.amlegal.com/codes/forestgrove/latest/forestgrovedev_or/0-0-0-4
[377] City of Forest Grove. (n.d.). Planning Commission. https://www.forestgrove-or.gov/bc-pc

continue to enforce land development regulations and review and update these regulations to address the evolving needs of the City, as applicable.

5.2.5. Floodplain Management Program and/or National Flood Insurance Program

The City of Forest Grove's Community Development Department and emergency preparedness personnel will continue to review any RL properties and incorporate any new findings into the City's mitigation strategy, as appropriate. As of September 30, 2021, the City had one RL property.

The City's floodplain management program is implemented through section 17.8.310 of the City's code.[378] Updates to this section and additions for other areas of hazard mitigation can be integrated into future code amendment efforts, as appropriate.

5.2.6. Economic Development Plans and Policies

The City's 2020 Economic Development Strategic Plan identifies potential areas for mitigation integration, including the further development of downtown.[379] Forest Grove will continue to update and integrate mitigation policies into the current economic plans and policies as needed.

5.2.7. Stormwater Management Plans and Procedures

The Forest Grove Storm Drainage Master Plan was most recently updated in November 2007. It provides a conveyance system analysis and identifies capital improvement projects for system improvements.[380] The City will update this plan as needed to incorporate additional mitigation efforts and strategies as needed and appropriate.

5.2.8. Emergency Plans That Address Evacuation and Sheltering

Evacuation and sheltering are addressed in the Cornelius and Forest Grove Emergency Operations Plan in annex FA 2, Human Services.[381] This annex provides information regarding the response to the needs for mass care and sheltering, human services, and public health support for victims of natural and technological emergencies and disasters. This annex will be reviewed and updated as needed to meet the needs of the City and its residents.

In the cities, nongovernmental/faith-based organizations such as the Red Cross provide sheltering, emergency food supplies, counseling services, and other vital support services to support response and promote the recovery of disaster victims. Nongovernmental and faith-based organizations also collaborate with responders, governments at all levels, and other agencies and organizations.

[378] Forest Grove Municipal Code. (n.d.). Section 17.8.310: Hazard Areas. https://codelibrary.amlegal.com/codes/forestgrove/latest/forestgrovedev_or/0-0-0-3631
[379] City of Forest Grove. (2020). Economic Development Strategic Plan. https://www.forestgrove-or.gov/sites/default/files/fileattachments/economic_development/page/219/2020_economic_development_plan_final_v3.pdf
[380] City of Forest Grove. (2007 November). Storm Drainage Master Plan. https://www.forestgrove-or.gov/sites/default/files/fileattachments/engineering/page/14981/sw_master_plan_full_report.pdf
[381] City of Cornelius and City of Forest Grove. (2014 July). Cities of Cornelius and Forest Grove, Washington County, Oregon Emergency Operations Plan. https://www.forestgrove-or.gov/sites/default/files/fileattachments/fire/page/3051/cornelius-forestgroveeop_fullplan_july2014.pdf

5.2.9. Enforcement of Existing Polices

The City will continue to enforce the policies that are in place and include hazard mitigation elements, including building and zoning codes, land development regulations, and NFIP regulations.

5.2.10. Funding Opportunities

City emergency preparedness personnel will continue to monitor local, state, and federal funding opportunities that could be utilized for hazard mitigation. This includes Hazard Mitigation Assistance opportunities and non-traditional mitigation funding sources.

6. Action Items

The City of Forest Grove's action items in the 2011 NHMP were determined by the 2011 planning team. The action items from the previous plan and the status of each action are in Section 6.1 below.

All action items from the 2011 NHMP were determined as still valid and necessary by the City's Technical Committee based on the review of its risk assessment, its existing capabilities, and the status of its previous action items. Action items from the 2011 NHMP are being retained for the 2023 update, with some being in progress in addition to being retained.

This comprehensive range of actions includes local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.1 and 6.2 below. Additional information about how these actions were developed, evaluated, and prioritized is in Volume I, Section 3.

The cities of Forest Grove and Cornelius share many staff, planning initiatives, and resources. Therefore, the cities action items are presented together. This is also how action items were presented in the 2011 NHMP.

6.1. Status of City of Forest Grove Action Items from the 2011 NHMP

Table 9: Status of Action Items from 2011 NHMP

Action Item Number	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
1	Coordinate with Washington County and the Oregon Department of Transportation (ODOT) to assess the seismic stability of bridges surrounding the communities of Forest Grove and Cornelius and seek funding to reinforce or replace bridges as needed (also applies to flooding concerns).	Earthquake and Flood		Retain for 2023 NHMP Update
2	Assess the seismic and flood risk of the Dairy Creek Bridge.	Earthquake and Flood		Retain for 2023 NHMP Update

Action Item Number	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
3	Coordinate with Clean Water Services (CWS) to assess the seismic strength of the sewage treatment system and develop improvements accordingly as part of the sewage system's current update efforts.	Earthquake	CWS has begun upgrading their regional facility in a multi-year project.	In progress. Retain for 2023 NHMP Update
4	Coordinate with local school district(s) to seek funding to assess and seismically retrofit school buildings that are vulnerable to collapse.	Earthquake	School bond measure is on November 2022 ballot.	In progress. Retain for 2023 NHMP Update
5	Seek funding to assess and seismically retrofit critical facilities (police stations, fire stations, and hospitals) that are vulnerable to collapse.	Earthquake	A new city office is under construction in 2022; existing city hall will see some upgrades as part of this neighboring building project.	In progress. Retain for 2023 NHMP Update
6	Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices through public education.	Earthquake	This is an ongoing discussion item for all city educational staff and has recently been relaunched, after the pandemic limited our education efforts.	In progress. Retain for 2023 NHMP Update
7	Assess Forest Grove's downtown businesses' vulnerability to an earthquake and encourage businesses to develop business continuity and recovery plans.	Earthquake		Retain for 2023 NHMP Update
8	Assess the seismic vulnerability of the Forest Grove Water Treatment Plant as well as the distribution and transmission systems.	Earthquake	City staff have developed a water resiliency plan that is in the final stages of being written	In progress. Retain for 2023 NHMP Update
9	Coordinate with Pacific University to seek funding to assess and seismically retrofit campus buildings that are vulnerable to collapse.	Earthquake		Retain for 2023 NHMP Update
10	Continue compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinances.	Flood		Retain for 2023 NHMP Update

Action Item Number	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
11	When updated flood insurance rate maps for the Tualatin River become available, adopt the updated maps.	Flood		Retain for 2023 NHMP Update
12	Acquire more detailed data on landslide hazards to better understand risk and be able to set more effective thresholds for the requirement of geotechnical reports.	Landslide		Retain for 2023 NHMP Update
13	Coordinate with CWS, Washington County, rural fire districts, and the Department of Forestry to mitigate wildfire risk outside of city limits.	Wildland Fire	Countywide wildfire plan is being updated soon; meetings have just begun.	In progress. Retain for 2023 NHMP Update
14	Explore opportunities to utilize city park land on the edges of town as wildfire buffers.	Wildland Fire	The City Parks Department took actions in 2022 to mitigate wildfire hazards on city-owned land at the wildland–urban interface.	In progress. Retain for 2023 NHMP Update
15	Coordinate with utility providers to educate the public about the role of proper tree pruning and stability in preventing damage during windstorms.	Windstorm, including tornado	This is an ongoing educational effort offered by the City's light and power agency.	In progress. Retain for 2023 NHMP Update
16	Coordinate with Pacific University to conduct an assessment of all on-campus trees to determine their stability, to aid in preventing damage during severe weather.	Windstorm, including tornado, and Winter Storm	Pacific University has its own arborist plan in place for the maintenance of trees on campus.	In progress. Retain for 2023 NHMP Update
17	Continue to educate citizens about ways to weatherize their homes and how to operate emergency heating equipment safely.	Winter Storm	This is an ongoing seasonal education topic offered by city communications staff.	In progress. Retain for 2023 NHMP Update
18	Maintain regular assessments of the health of trees in Forest Grove's downtown to prevent damage to buildings and utilities from falling trees.	All Hazards		In Retain for 2023 NHMP Update

Action Item Number	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
19	Update the existing Facilities Master Plan that assesses the need for new or updated facilities and incorporates natural hazard vulnerabilities and mitigation measures for reducing vulnerability.	All Hazards		Retain for 2023 NHMP Update
20	Encourage residents to prepare and maintain 72-hour kits.	All Hazards	This is part of the City's normal educational offerings.	In progress. Retain for 2023 NHMP Update
21	Coordinate with utility providers to address lack of broadband Internet redundancy in the community.	All Hazards		Retain for 2023 NHMP Update
22	Review the City of Forest Grove's comprehensive plan and development codes for opportunities to more effectively reduce risks to new development.	All Hazards		Retain for 2023 NHMP Update

6.2. Mitigation Action Information Worksheets

Table 111: Bridge Seismic Stability Assessment, Reinforcement, and Replacement

Mitigation Action Information			
Title of action	Bridge Seismic Stability Assessment, Reinforcement, and Replacement		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	Coordinate with Washington County and ODOT to assess the seismic stability of bridges surrounding the communities of Forest Grove and Cornelius and seek funding to reinforce or replace as needed. Also applies to flooding concerns. Work with Washington County and ODOT to conduct seismic assessment of bridges leading into and out of Forest Grove and Cornelius. Prioritize any actions that need to be taken to address any seismic concerns and coordinate with Washington County, ODOT, and the OEM seismic grants coordinator to find appropriate funding sources. Bridges to be considered: B Street Bridge at Gales Creek, Susbauer Bridge at Dairy Creek, and Fern Hill Road Bridge across the Tualatin River		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Several bridges have either earthquake or flood risk and when impacted, isolate large portions of the community and limiting access to emergency services and basic supplies. Coordinating efforts with Washington County and ODOT to assess the seismic stability of the bridges and seeking funding to reinforce or replace as needed will provide more reliable access and provide continuous service in both communities.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Transportation Objective 1 to provide a balanced transportation system. Connection to the City of Cornelius' Transportation Plan Goals.		

Mitigation Action Implementation Plan		
Priority	Low ☐ Medium ☒ High ☐	
Lead position, office, department, or division responsible for implementation	City Engineers	
Potential Funding Sources		
Non-Federal Funding Sources	**Federal Funding Sources**	
General Fund	BRIC and FMA grants through FEMA	
Estimated Cost	To be determined	
Estimated Benefit		
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**	
Decrease or eliminate earthquake or flood risk to several bridges, which will maintain transportation access for large portions of the communities and emergency services.	To be determined	
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 112: Assessment of Seismic and Flood Risk of the Dairy Creek Bridge

Mitigation Action Information			
Title of action	Assessment of Seismic and Flood Risk of the Dairy Creek Bridge		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Dairy Creek Bridge is a vital transportation connection in and out of the communities and that it is likely vulnerable to both earthquakes and flooding. Work with Washington County and ODOT to conduct seismic and flooding assessment of the bridge. Prioritize any actions that need to be taken to address any seismic and flood concerns and coordinate with Washington County, ODOT, and the OEM seismic grants coordinator to find appropriate funding sources.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Decrease or eliminate earthquake or flood risk to the bridge, which will maintain transportation access for large portions of the communities and emergency services.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Transportation Objective 1 to provide a balanced transportation system. Connection to the City of Cornelius' Transportation Plan Goals.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	City Engineers		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Decrease or eliminate earthquake or flood risk to the bridge, which will maintain transportation access for large portions of the communities and emergency services.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 113: Assessment of Clean Water Services Sewage Treatment System

Mitigation Action Information			
Title of action	Assessment of Clean Water Services Sewage Treatment System		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Coordinate with Clean Water Services to assess the seismic strength of the sewage treatment system and develop improvements accordingly as part of the sewage system's current update efforts.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Sewage treatment plant could be vulnerable to seismic activity. If damaged, the treatment plant could release raw sewage into neighboring streams.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☒ Goal 6 ☒	Goal 7 ☐
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Public Safety & Municipal Services Objective 1 to continue to deliver services.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	City Engineers		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)			**Financial Benefit(s) (Est. Cost x 6)**
Decrease or eliminate earthquake risk to sewage treatment plant.			To be determined

Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 114: Assessment of Seismic Risk and Retrofitting of School Buildings

Mitigation Action Information			
Title of action	Assessment of Seismic Risk and Retrofitting of School Buildings		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Assess the "probability of collapse" for school buildings previously identified by DOGAMI as having a "high" or "very high" probability of collapse rating. Coordinate with local school district(s) to seek funding to assess and seismically retrofit school buildings that are vulnerable to collapse. Further assess those buildings rated at a "high" risk of collapse. Prioritize any actions that need to be taken to address any seismic concerns and coordinate with school district(s) and OEM seismic grants coordinator to find appropriate funding sources. Publicize and improve awareness of the earthquake risk using existing education and outreach efforts. Use FEMA's procedures document for developing scopes of work for seismic structural and non-structural retrofit projects. Identify opportunities to pair mitigation with energy retrofit dollars. Coordinate with the private Community School to identify alternative locations that are not unreinforced masonry.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Assessing the "probability of collapse" for these school buildings and conducting seismic retrofits will reduce the vulnerability of these buildings by preventing damage to life and property.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☒	Goal 4 ☐ Goal 5 ☐ Goal 6 ☒	Goal 7 ☐
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – People and Community Building Objective 1 to develop strong community partnerships to support education.		

Mitigation Action Implementation Plan		
Priority	Low ☐ Medium ☒ High ☐	
Lead position, office, department, or division responsible for implementation	Community Development	
Potential Funding Sources		
Non-Federal Funding Sources	**Federal Funding Sources**	
General Fund	BRIC and FMA grants through FEMA	
Estimated Cost	To be determined	
Estimated Benefit		
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**	
Decrease or eliminate earthquake risk to school buildings and those who are in them.	To be determined	
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 115: Assessment of Seismic Risk and Retrofitting of Critical Facilities

Mitigation Action Information			
Title of action	Assessment of Seismic Risk and Retrofitting of Critical Facilities		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	Assess the "probability of collapse" for critical facilities previously identified by DOGAMI. This includes public school buildings, acute inpatient care facilities, fire stations, police stations, sheriffs' offices, and other law enforcement agency buildings. Further assess these critical facility buildings. Prioritize any actions that need to be taken to address any seismic concerns and coordinate with OEM seismic grants coordinator to find appropriate funding sources. Use FEMA's procedures document for developing scopes of work for seismic structural and non-structural retrofit projects.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Assessing the "probability of collapse" for these buildings and conducting seismic retrofits will reduce the vulnerability of these buildings by preventing damage to life and property and ensuring continuous operations capacity for critical facilities.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Public Safety and Municipal Services Objectives 1- 4.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of the vulnerability of critical facilities by preventing damage to life and property and ensuring continuous operations capacity for critical facilities.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 116: Reduction of Nonstructural and Structural Earthquake Hazards

Mitigation Action Information			
Title of action	Reduction of Nonstructural and Structural Earthquake Hazards		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices through public education. Develop informational brochures about individual mitigation opportunities and post on the websites of the cities, include in the water bill, and make available on the front counters at the police, public works, and community development departments. Include recommendations regarding non-structural retrofits in these brochures. Use the following modes of communication or events to educate the public: Quarterly Newsletter, Website, Flyers, National Night Out, and Safety Fair. CERT can also assist in promoting this type of outreach.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Seismic hazards pose a real and serious threat to many communities in Oregon, requiring local governments, planners, and engineers to consider their community's safety. Earthquake damage occurs because we have built structures that cannot withstand severe shaking. Buildings, ports, and lifelines (highways, telephone lines, gas, water, etc.) suffer damage in earthquakes. Damage and loss of life can be very severe if structures are not designed to withstand shaking, are on ground that amplifies shaking, or ground which liquefies due to shaking. Nonstructural retrofits protect building contents with little cost and effort. Examples of retrofits include: • Securing water heaters, large appliances, bookcases, pictures and bulletin boards; • Latching cabinet doors; and • Using safety film on windows.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Fire		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s) (Est. Cost x 6)**	
Educating the public to reduce risk from earthquakes.		To be determined	
Project Timeline			
Expected Timeline for Completion			
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 117: Seismic Assessment of Downtown Forest Grove Businesses

Mitigation Action Information	
Title of action	Seismic Assessment of Downtown Forest Grove Businesses
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☒
Action description	Assess the vulnerability to Forest Grove downtown businesses to an earthquake and encourage businesses to develop business continuity and recovery plans. Determine what resources are available to help assess the risk and what grant and loan opportunities are available to businesses owners to help mitigate. Encourage business owners to have a recovery plan and provide examples of what a plan looks like through the Chamber of Commerce. Bring in a business continuity specialist to speak to Chamber members.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	The City of Forest Grove downtown corridor is a major business and tourist center for the City. Loss of this area would be devastating to the Forest Grove economy. The buildings are at extreme risk due to their age and the potential for an earthquake in the area. Most are unreinforced masonry buildings. Evaluating these buildings would give the City a better understanding of the mitigation necessary.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be determined.
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Historic Preservation Objective 1 to preserve, protect, and enhance historic assets; Economic Development Objectives 1-3. Connection to City of Forest Grove's Comprehensive Plan – Chapter V Economy local goals. Assists in implementing the initiatives and goals of the Forest Grove Economic Development Commission Strategic Plan.

Mitigation Action Implementation Plan		
Priority	Low ☐ Medium ☒ High ☐	
Lead position, office, department, or division responsible for implementation	Chamber of Commerce	
Potential Funding Sources		
Non-Federal Funding Sources	**Federal Funding Sources**	
General Fund	BRIC and FMA grants through FEMA	
Estimated Cost	To be determined	
Estimated Benefit		
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**	
Reduction of risk to people and property from earthquakes.	To be determined	
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		
Implementation Progress Report for Plan Maintenance		
Date		
What progress in implementation has been made to date?		
What challenges in implementation have been experienced?		
What are the next steps in implementation?		

Table 118: Seismic Assessment of Forest Grove Water Treatment Plant

Mitigation Action Information			
Title of action	Seismic Assessment of Forest Grove Water Treatment Plant		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Assess the seismic vulnerability of the Forest Grove water treatment plant as well as the distribution and transmission systems. Conduct a seismic evaluation of the Forest Grove Water Treatment Plant.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Water is critical for public drinking, firefighting, and sanitation. This plant serves both Forest Grove and Cornelius.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Public Safety and Municipal Services Objective 1. Connection to City of Forest Grove's Comprehensive Plan – Chapter XII Public Facilities and Services.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Engineering		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of risk to people and property from earthquakes and lack of water.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 119: Seismically Assess Pacific University Campus Buildings

Mitigation Action Information			
Title of action	Seismically Assess Pacific University Campus Buildings		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Coordinate with Pacific University to seek funding to assess and seismically retrofit campus buildings that are vulnerable to collapse. Work with Oregon Independent College Association (OICA), Department of Education (DOE), Oregon Department of Emergency Management (OEM) and other partners to determine funding sources. Prioritize any actions that need to be taken to address any seismic concerts and coordinate with the university and other partners (OEM, etc.) to develop funding and action plans. Use FEMA's procedures document for developing scopes of work for seismic structural and non-structural retrofit projects.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Pacific University has many buildings on their Forest Grove campus that are of significant age. There has been no formal analysis conducted on any of these buildings to determine their seismic stability. A significant at-risk population exists on campus. An analysis needs to be completed to support planning and funding for future seismic retrofits to reduce the potential for collapse and the risk to population.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development		

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of risk to people and property on campus from earthquakes.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 120: Compliance with the National Flood Insurance Program

Mitigation Action Information			
Title of action	Compliance with the National Flood Insurance Program		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Continue compliance with the National Flood Insurance Program (NFIP) through the enforcement of local floodplain ordinances. 1) Actively participate with DLCD and FEMA during Community Assistance Visits. The Community Assisted Visit (CAV) is a scheduled visit to a community participating in the NFIP for the purpose of: 1) conducting a comprehensive assessment of the community's floodplain management program; 2) assisting the community and its staff in understanding the NFIP and its requirements; and 3) assisting the community in implementing effective flood loss reduction measures when program deficiencies or violations are discovered. • Conduct an assessment of the cities' floodplain ordinances to ensure they reflect current flood hazards. • Coordinate with the county to ensure that floodplain ordinances and NFIP regulations are maintained and enforced. Continue to assess the need for updated ordinances. • Mitigate areas that are prone to flooding and/or have the potential to flood.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	The National Flood Insurance Program provides communities with federally backed flood insurance to homeowners, renters, and business owners, provided that communities develop and enforce adequate floodplain management ordinances. The benefits of adopting NFIP standards for communities are a reduced level of flood damage in the community and stronger buildings that can withstand floods. According to the NFIP, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined.		

Alignment with existing plans and policies	To be determined.

Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Community Development

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA

Estimated Cost	To be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of flood risk to people and property.	To be determined

Project Timeline
Expected Timeline for Completion
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 121: Adoption of Updated Flood Insurance Rate Maps

Mitigation Action Information			
Title of action	Adoption of Updated Flood Insurance Rate Maps		
Type of action	Plans/regulations ☒		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☐
Action description	When updated Flood Insurance Rate Maps for the Tualatin River become available, adopt the updated maps. When the final maps become available, the cities will adopt the new map using their existing protocols for adopting this type of map.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	The City of Forest Grove and Cornelius has Flood Mitigation Rate Maps current as of 1982. Clean Water Services has been working with FEMA to update the maps for the Tualatin River. These maps are currently in draft form and updated versions will more accurately reflect flood risk.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of flood risk to people and property.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 122: Acquire More Detailed Landslide Data and Update Development Codes

Mitigation Action Information			
Title of action	Acquire More Detailed Landslide Data		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Acquire more detailed data on landslide hazards to better understand risk and be able to set more effective thresholds for the requirement of geotechnical reports. Consult with Department of Geology and Mineral Industries on availability of new data. Seek funding for a study if the necessary data is not available. Review existing requirements in the development code based on newly acquired data. Update development code based on new data.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☒	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Current landslide data is not effective in identifying landslide risk. More detailed data would allow for refining geotechnical report requirements in the development code. Having this data will allow the cities to more effectively limit future development in landslide prone areas.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development		

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of landslide risk to people and property.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 123: Mitigate Wildfire Risk Outside of City Limits

Mitigation Action Information			
Title of action	Mitigate Wildfire Risk Outside of City Limits		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Coordinate with Clean Water Services, Washington County, rural fire districts, and the Department of Forestry to mitigate wildfire risk outside of City limits. Coordinate efforts with the Washington County Community Wildfire Protection Plan Steering Committee and Washington County Emergency Management.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	There is a concern that wildfires beginning in Washington County on the urban fringe could easily spread to the cities. Working together with the County may result in the identification of wildfire mitigation efforts that will reduce the chance of fires spreading from the County into one or both of the cities.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Fire		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of wildfire risk to people and property.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 124: Use Existing Park Land as a Wildfire Buffer

Mitigation Action Information			
Title of action	Use Existing Park Land as a Wildfire Buffer		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐		Natural systems protection ☐ Public education/awareness ☐
Action description	Explore opportunities to utilize City park land on the edges of town as wildfire buffers. Review vegetative requirements of CWS and Metro to ensure that wildfire mitigation efforts are not in direct conflict with existing requirements. Evaluate the codes of both cities to determine opportunities for wildfire mitigation. Identify mitigation alternatives for those park lands. Seek funding to implement the optimal mitigation alternative.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☒	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	There is a concern that wildfires beginning in Washington County on the urban fringe could easily spread to the cities. There may be opportunities to use existing park land on the City's fringe as a wildfire buffer.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☒ Goal 6 ☒	Goal 7 ☐
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Fire		

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of wildfire risk to people and property.	To be determined

Project Timeline
Expected Timeline for Completion
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 125: Public Education About Tree Pruning

Mitigation Action Information	
Title of action	Public Education About Tree Pruning
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Coordinate with utility providers to educate the public about the role of proper tree pruning and stability in preventing damage during windstorms. Review regulations and standards for easement and right of way maintenance and provide training to foresters and logging crews. Educate homeowners in pruning of vegetation, tree care safety, and proper tree care for trees bordering utility corridors and public rights of way via Safety Fair, Website, or Quarterly Newsletter. Coordinate with arboricultural groups, public agencies, and utilities to promote proper tree pruning and care practices that can reduce the risk of tree failure and property damage. Common messages refined by state level entities such as the Oregon Department of Forestry (ODF) and Oregon State University Extension can help provide continuity and efficiency across the state.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	High winds can topple trees and break limbs which in turn can result in power outages and disrupt telephone, computer, and TV and radio service, and compromise the functioning of the communities' utilities such as the wastewater and water treatment plants. While the Public Works and utility companies manage trees in public areas, private property owners are responsible for trees on their property. Educating property owners about how to properly prune their trees to prevent power outages and damage to their property can help reduce impacts of windstorm events. Forest Grove and Cornelius have experienced severe windstorm events in the past and is vulnerable to windstorm events.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be determined.
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Public Safety and Municipal Services Objectives 1 and 2.

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Community Development		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s) (Est. Cost x 6)**	
Reduction of risk from windstorms, including tornado, to people and property.		To be determined	
Project Timeline			
Expected Timeline for Completion			
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 126: Assessment of Trees on the Pacific University Campus

Mitigation Action Information	
Title of action	Assessment of Trees on the Pacific University Campus
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Coordinate with Pacific University to conduct an assessment of all on-campus trees to determine their stability to aid in preventing damage during severe weather. Coordinate with university facilities staff and their landscape contractor to conduct the assessment and develop a plan for proper pruning, care and maintenance, especially as it relates to utility service on campus.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	High winds can topple trees and break limbs which in turn can result in power outages and disrupt telephone, computer, and TV and radio service. Personal injury to community members is also a potential. While the Public Works and utility companies manage trees in public areas, private property owners are responsible for trees on their property. Conducting a proper assessment and performing proper pruning/care, can help reduce impacts of windstorm events. The campus has experienced severe windstorm events in the past and is vulnerable to windstorm events.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be determined.
Alignment with existing plans and policies	To be determined.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Community Development

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of risk to people and property from trees downed by windstorms, including tornados.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 127: Public Education About Home Weatherization

Mitigation Action Information	
Title of action	Public Education About Home Weatherization
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Educate residents about ways to weatherize their homes, as well as safe emergency heating equipment. • Use energy audits, cash rebates, and tax credits to help homeowners weatherize their homes. • Coordinate efforts with home improvement businesses to educate citizens about weatherizing homes and providing safe emergency heating equipment. • Coordinate education efforts with Portland General Electric to education citizens about weatherization. • Coordinate with the local Fire Districts to develop a list of emergency heating information. • Advertise weatherization tax credits to serve as an incentive for people to weatherize their homes and reduce their heating bills. • Brochures can be provided at Community Development counters.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Severe winter storms can bring extreme cold, snow, and ice, causing power outages and breaks in un- insulated water lines. Power outages can lead to heat loss, potentially harming citizens. Educating citizens about ways to weatherize their homes, as well as safe emergency heating equipment, can reduce the effects of extreme cold and inform residents of how to properly heat their homes in the event of a power outage. Cornelius has a higher than average percentage of residents with disabilities, many of whom are especially vulnerable to power outages and lack backup sources of heat and water. Educating these citizens about ways to weatherize their homes and safe emergency heating equipment they can use will reduce the vulnerability of these populations.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be determined.
Alignment with existing plans and policies	To be determined.

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Fire and Forest Grove Power and Light		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s) (Est. Cost x 6)**	
Reduction of risk from winter storms to people, especially vulnerable populations.		To be determined	
Project Timeline			
Expected Timeline for Completion			
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 128: Tree Health Assessment

Mitigation Action Information			
Title of action	Tree Health Assessment		
Type of action	Plans/regulations ☐		Natural systems protection ☒
	Structure and infrastructure project ☐		Public education/awareness ☐
Action description	Maintain regular assessments of the health of trees in the cities to prevent damage to buildings and utilities from falling trees. Contact Washington County's certified Arborist to see if they would be willing to perform this service. Develop a list of agencies, organizations, etc., who would be able to provide assistance in assessing tree health on their property.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	There are trees in the cities that could damage businesses and utilities. Regularly assessing the health of trees will prevent damage to buildings and utilities from falling trees.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Connection to the City of Forest Grove's Action Plan – Public Safety and Municipal Services Objectives 1 and 2.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development/Parks		

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Reduction of risk from windstorms, including tornado, to people and property.	To be determined

Project Timeline
Expected Timeline for Completion
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 129: Update Facilities Master Plan

Mitigation Action Information			
Title of action	Update Facilities Master Plan		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐		Natural systems protection ☐ Public education/awareness ☐
Action description	Update existing Facilities Master Plan so that it assesses the need for new or updated facilities and includes natural hazard vulnerabilities and mitigation measures for reducing vulnerability. Coordinate development of the Facilities Master Plan with information found in this mitigation plan annex. In the facilities plan, identify the number of buildings and facilities in specific hazard areas, the potential dollar losses to the facilities, and the methodology used to develop the estimates. This will meet the requirements of the Disaster Mitigation Act of 2000. Seek funding for retrofitting buildings and infrastructure in hazard areas to reduce vulnerability		
Hazard(s) addressed	Dam failure ☒ Drought ☒ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☒ Volcanic ash ☒ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Facility master plans assess current City facilities and City-wide facility needs and provide recommendations for further improvements. Currently the cities of Forest Grove and Cornelius do not have Facilities Master Plans that provide an overall assessment of City-owned facilities. Creating a plan that assesses the need for new or updated facilities and incorporates natural hazard vulnerabilities and mitigation measures for reducing vulnerability, will improve City services and reduce the City's overall vulnerability to natural hazard events. In addition, buildings and facilities in hazard areas may be eligible for Pre-Disaster Mitigation funding.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☒	Goal 4 ☐ Goal 5 ☒ Goal 6 ☐	Goal 7 ☒
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Forest Grove Administrative Services and Cornelius Development Operations		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s) (Est. Cost x 6)**	
Reduction of risk from all hazards to City facilities.		To be determined	
Project Timeline			
Expected Timeline for Completion			
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 130: Public Preparedness Education

Mitigation Action Information			
Title of action	Public Preparedness Education		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	Encourage citizens to prepare for all hazards and maintain 72-hour kits. Provide educational material and examples of how to assemble 72-hour kits to residents of the City and employees. Outreach and awareness campaigns need to be carefully organized and developed to ensure that residents receive critical information. Distribute information through the City's newsletter. Alternatively, post information about 72-hour kits on the City's website. During National Emergency Preparedness Month or National Night Out, use first responders and community members to host educational presentations to groups within the community to encourage individuals to put together their own kit. Materials must be made available in multiple languages. Resources like www.preparedness.gov or www.72hours.org can provide content needs for 72-hour kits.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	The cities of Forest Grove and Cornelius are vulnerable to a number of natural hazards that could disrupt services. In a major disaster, utilities transportation networks, and businesses could be disrupted, and it may take days until vital services are restored. Preparing a 72-hour kit can help community members survive on their own without relying too heavily on emergency services.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Fire		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s) (Est. Cost x 6)**	
Reduction of risk to people and property from all hazards.		To be determined	
Project Timeline			
Expected Timeline for Completion			
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 131: Broadband Redundancy

Mitigation Action Information			
Title of action	Broadband Redundancy		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒	Natural systems protection ☐ Public education/awareness ☐	
Action description	Coordinate with utility providers to address lack of broadband redundancy in the community. Work with utility providers to identify alternatives to add redundancy to the existing broadband system. Identify potential funding sources for the redundancy systems.		
Hazard(s) addressed	Dam failure ☒ Drought ☒ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☒ Volcanic ash ☒ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Currently, there is no redundancy to the broadband network in the cities of Forest Grove and Cornelius. This can create communication and connectivity problems before, during, and after natural hazard events.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☒	Goal 4 ☐ Goal 5 ☒ Goal 6 ☐	Goal 7 ☒
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	To be determined.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Forest Grove IT		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA	
Estimated Cost	To be determined		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Broadband redundancy during natural hazard events.	To be determined
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 132: Review of Comprehensive Plan and Development Codes

Mitigation Action Information			
Title of action	Review of Comprehensive Plan and Development Codes		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Review the City of Forest Grove's comprehensive plan and development codes for opportunities to more effectively reduce risks to new development. Incorporate new hazard information in the Comprehensive Plan's Periodic Review process. Review latest vulnerability assessment information and policies that address hazards. Information can be obtained from the risk assessment portion of the Washington County Natural Hazard Mitigation Action Plan and other state agencies.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	The City's Comprehensive Plans provided the legal framework and long-term vision for implementing plans and land use regulations, this is one of the best places to implement mitigation because risks can be eliminated before development occurs.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	Statewide Planning Goal 2 (Land Use Planning) requires local governments to create comprehensive plans that "shall include identification of issues and problems, inventories, and other factual information for each applicable statewide planning goal…" Furthermore, Goal 7 of Oregon's Land Use Planning Goals requires that local governments "shall adopt comprehensive plans (inventories, policies, and implementing measures) to reduce risk to people and property from natural hazards."		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development		

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC and FMA grants through FEMA
Estimated Cost	To be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Eliminating risk from natural hazards before development occurs.	To be determined

Project Timeline
Expected Timeline for Completion
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Annex D: City of Hillsboro

1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for the City of Hillsboro was the Emergency Program Manager.

1.2. Annex Organization

This annex has six sections that satisfy mitigation requirements in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

The information provided in this annex is for the City of Hillsboro alone. All pertinent information that is not identified in this annex is identified in other sections of this NHMP or within the respective appendices.

1.3. NHMP Adoption Process

Once the Washington County NHMP received the designation “Approvable Pending Local Adoption” from the Federal Emergency Management Agency (FEMA), the City will take the plan to City Council for final public comment and local adoption. A copy of the resolution was inserted into the NHMP and is held on file in the City of Hillsboro and Washington County.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

City officials recognize the benefits of having a long-term, all-hazards approach to mitigating natural hazards. The passage of the Disaster Mitigation Act of 2000 (DMA 2000) enabled City officials to recognize the benefits of having a long-term, all-hazards approach to hazard mitigation and mitigating natural hazards. The City's involvement in the Washington County NHMP represents the collective efforts of the NHMP Steering Committee members, all participating local Technical Committee members, the public, and stakeholders

The City developed this annex in accordance with guidance outlined in 44 CFR §201.6(c)(5) of DMA 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in the geographical area of the City.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP. An open involvement process was established for the public and all stakeholders, which provided an opportunity for everyone to be involved in the planning process and make their views known.

Two teams worked simultaneously on this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of points of contact from each plan participant. The group met to discuss countywide topics, including hazards and mitigation strategies. The points of contact were the leads of their local Technical Committee.
2. **Local Technical Committee:** Each plan participant had a Technical Committee that consisted of the Steering Committee representative for that jurisdiction or special district as well as designated representatives from within the organization. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. City of Hillsboro's Technical Committee

This annex within the NHMP was developed by the City of Hillsboro's local Technical Committee with support from IEM, a consulting firm hired to assist with the planning process. The efforts of the committee were led by the City's Emergency Program Manager throughout 2022.

Table 133: City of Hillsboro Technical Committee Members for the 2023 NHMP

Job Title and Department	Role in Committee and Planning Process
Emergency Program Manager, Fire and Rescue	General oversight, hazard identification, and plan development
Emergency Management Officer, Fire and Rescue	Hazard identification and plan development
Management Analyst, Human Resources/Risk	Hazard identification and plan development
Senior Project Manager, City Manager's Office	Hazard identification and plan development
Senior Program Manager, Water	Hazard identification and plan development
Management Analyst, Water	Hazard identification and plan development
Fire Chief, Fire and Rescue	Hazard identification and plan development
Development Services Manager, Planning/Community Development	Hazard identification and plan development
Building Division Director, Building Division	Hazard identification and plan development
Public Works Director, Public Works	Hazard identification and plan development

IEM also supported or led the following activities associated with the development, approval, and adoption of the plan:

1. Facilitated the NHMP update process.
2. Based on committee direction and stakeholder and community input, prepared the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.
3. Submitted the proposed plan to the State of Oregon Department of Emergency Management (OEM) and FEMA for review and approval, and completed edits or revisions requested by these organizations.
4. Coordinated the plan adoption processes with the City, OEM, and FEMA.

2.3. Public Participation

Public participation is an important component of this NHMP and also a required element as outlined in 44 CFR §201.6(c)(5), FEMA's mitigation planning guidance. Public participation offered community members the opportunity to voice their ideas, interests, and opinions about hazards that affect them and the best way to mitigate hazard impacts. As the City implements the mitigation actions identified in this annex, there will be additional opportunities for public participation.

Plan participants used a survey to collect information about community perceptions of natural hazards and priorities. The Steering and Technical Committees used the results to inform their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP. See Volume III, Appendix B for additional information about the survey and opportunities for public comment.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist the City of Hillsboro in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards.

3.1. Changes in Development Since Adoption of the 2017 NHMP

(In compliance with 44 CFR §201.6(d)(3))

Since the 2017 Washington County NHMP was adopted, the City's population has increased approximately 9%. This has led to an increase in single-family residential development to meet the demand of population growth and the expansion of the City's Urban Growth Boundary (UGB) as needed to accommodate forecasted residential or employment growth needs. While expansion of the UGB can increase vulnerability to natural hazards, the City has focused on minimizing or eliminating vulnerability in the UGB and throughout the City by creating and enforcing policies focused on minimizing impacts of natural hazards on people and property, providing information and services to support disaster preparedness and recovery for people of all ages, abilities, cultures, and incomes; improving coordination

with public and private partners; building capacity for greater urban resilience; and managing and maintaining spatial, demographic, and economic data to support hazard mitigation planning.[382]

The Hillsboro 2035 Community Plan includes the vision statement of "In 2035, Hillsboro is an inclusive, welcoming multicultural community that supports a resilient, world-class economy and dynamic urban tapestry while continuing to honor the City's agricultural heritage and commitment to environmental stewardship."[383] The work and initiatives the City has undertaken since the 2017 NHMP have focused on fulfilling this vision statement.

3.2. Community Profile

This section provides information on City-specific characteristics. Additional discussion of the planning area's community characteristics is outlined in Volume III, Appendix A of the NHMP.

Some community characteristics may suggest how natural hazards may impact communities and how communities choose to plan for natural hazard mitigation. Identifying and considering the City-specific assets during the planning process may assist in identifying appropriate measures for natural hazard mitigation.

The following table reflects the community demographics and vulnerable populations in the City. This information was gathered from the U.S. Census, Portland State University, and the City of Hillsboro.

Table 134: Community Demographics*

Population	Total	Percent Change
2010 population[384]	91,611	
2021 population[385]	108,154	+18.1%
2035 forecasted population	114,323	+5.7%
Race and Ethnicity[386]	**Total**	**Percent of Population**
White alone	61,512	57%
Black or African American alone	3,122	3%
American Indian and Alaska Native alone	1,428	1%
Asian alone	13,411	18%
Native Hawaiian and Other Pacific Islander alone	568	0.5%
Two or more races	12,033	18%
Hispanic/Latino/a/x	26,339	24%

[382] City of Hillsboro. (2017, November 21). Hillsboro Comprehensive Plan. https://www.hillsboro-oregon.gov/home/showpublisheddocument/16832/637995422246570000
[383] City of Hillsboro. (2020, August). Hillsboro 2035 Community Plan. https://www.hillsboro2035.org/wp-content/uploads/2021/07/Plan-Update-2020_English_VER23_web.pdf
[384] United States Census Bureau. (2010, April 1). QuickFacts Hillsboro City, Oregon. Accessed August 15, 2022, from https://www.census.gov/quickfacts/hillsborocityoregon
[385] Portland State University Population Research Center. (2022). Population Estimate Reports. https://www.pdx.edu/population-research/population-estimate-reports
[386] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates Demographic and Housing Estimates, Table DP05. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon&tid=ACSDP5Y2020.DP05

Language Spoken at Home[387]	Percent of Population
English only	69.2%
Spanish	17.8%
Indo-European languages	4.5%
Asian and Pacific Island languages	7.4%
Other languages	1.1%
Vulnerable Age Groups[388]	**Percent of Population**
Less than 15 years of age	13%
65 years and older	11%
Disability Status[389]	**Percent of Population**
Total	10%
Less than 17 years of age	7%
65 years and older	25%

*Due to how respondents identify and answer questions, there may be overlapping responses, and results may equal greater than 100% of the population. Percentages are rounded.

3.2.1. Geography, Topography, and Climate

The City of Hillsboro is in central Washington County, about 10 miles west of Portland. It is the largest city in Washington County and serves as the county seat.

All of Hillsboro is located within the watershed of the Tualatin River. Hillsboro's dominant natural landscape features are the Tualatin River and its tributaries, including Dairy, McKay, Dawson, and Rock Creeks, as well as the Jackson Bottom Wetlands Area along the Tualatin River. Hillsboro is relatively flat, but the Coastal Range is to the west, Tualatin Hills is to the north, Portland's West Hills and Mount Hood are to the east, and Chehalem Mountain is to the south.

The climate for Hillsboro is moderate. Mean daily temperatures range from highs of about 81 °F and lows of about 52 °F in July and August, to highs of about 45 °F and lows of about 33 °F in December and January. The average annual rainfall is about 38 inches. Average monthly precipitation varies from 6 to 7 inches in November through January to about 0.5 inches in July. Average annual snowfall is about 5 inches, although many years have no measurable snow.

The following tables reflect the community demographics, vulnerable facilities in the jurisdiction, and the critical facilities and infrastructure that are exposed to the identified hazards and could be impacted. This information was gathered from the U.S. Census, Portland State University, and from the City of Hillsboro.

[387] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Language Spoken at Home, Table S1601. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon%20language&tid=ACSST5Y2020.S1601
[388] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Age and Sex, Table S0101. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon%20age
[389] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Disability Characteristics, Table S1810. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon%20disability

3.2.2. Transportation, Infrastructure, and Housing

3.2.2.1. Transportation

Critical transportation routes in Hillsboro include Oregon Route 8, known locally as the Tualatin Valley Highway (TV Highway), the primary east–west highway. US Highway 26, also known as the Sunset Highway, bisects the northeast corner of the City. Other major east–west roads are Cornell Road and Main Street (also known as Baseline Road). Major north–south routes are Oregon Route 219/1st Avenue, 10th Avenue, Cornelius Pass Road, and Brookwood Parkway. The easternmost north–south route, 185th Avenue, borders the City of Beaverton and runs between the Tanasbourne Town Center and the rest of Hillsboro. TV Highway connects to the cities of Cornelius and Forest Grove to the west and Beaverton to the east.

The Hillsboro Airport, which is owned, operated, and maintained by the Port of Portland, is located on the north side of the City. With over 200,000 operations annually, it is the second busiest airport in the state (second only to Portland International Airport) and the busiest “general aviation” airport in Oregon. It is a 900-acre executive airport with three runways (6,600 feet, 3,821 feet, and 3,600 feet) and four full-service fixed-base operators, and it provides all the facilities necessary to support jet and propeller-driven aircraft and helicopters. Hillsboro Airport is one of the sites of the Oregon International Airshow.

The Tri-County Metropolitan Transit District (TriMet) provides light rail commuter service from Hillsboro to Beaverton, Portland, and east Multnomah County and bus service throughout the tri-county region. The Southern Pacific Railroad provides limited freight service through Hillsboro.

During the workday, more than 50,000 employees commute to the City by car, bicycle, bus, or light rail train to work.

3.2.2.2. Infrastructure

The City of Hillsboro critical and vulnerable facilities listed below in Table 135 may be vulnerable to one or more natural hazards.

Table 135: Critical Facility and Asset Inventory

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Hillsboro Garbage Disposal Waste Re-Load Facility	Infrastructure or Facility	4945 SW Minter Bridge Road	Owned by Hillsboro Garbage, Hillsboro solid waste franchisee
Hillsboro Landfill	Infrastructure or Facility	3205 SE Minter Bridge Road	Owned by Waste Management, Inc., Hillsboro solid waste franchisee
Hidden Creek Community Center	Infrastructure or Facility	5100 NE Hidden Creek Drive	
Fiber Hut	Infrastructure or Facility	Redacted	
Civic Center	Infrastructure or Facility	150 E. Main Street	
Facilities - Maintenance Shop	Infrastructure or Facility	1890 NE Griffin Oaks Street	
Fire - Parkwood Logistics	Infrastructure or Facility	275 NE 25th Avenue	
Fire - Station 1 Main	Infrastructure or Facility	240 S 1st Avenue	
Fire - Station 2 Brookwood	Infrastructure or Facility	5045 SE Drake Road	
Fire - Station 3 Ronler	Infrastructure or Facility	4455 NE Century Blvd	
Fire - Station 5 Jones	Infrastructure or Facility	2850 NE 25th Avenue	Contains Fire and Police Department Operations Center
Fire - Station 6 Cherry	Infrastructure or Facility	1225 NE Cherry Lane	Contains City Emergency Operations Center
Fire - Wood St. Training Center	Infrastructure or Facility	620 SW Wood Street	
Fleet - Evergreen	Infrastructure or Facility	4437 NE 30th Avenue	

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Intermodal Transit Facility - Bike	Infrastructure or Facility	775 SE Baseline Street	
Intermodal Transit Facility - East Side	Infrastructure or Facility	285 SE 8th Avenue	
Intermodal Transit Facility - Pacific University	Infrastructure or Facility	775 SE Baseline Street	
Intermodal Transit Facility - Parking Structure	Infrastructure or Facility	253 SE 8th Avenue	
Intermodal Transit Facility - Portland Community College	Infrastructure or Facility	775 SE Baseline Street	
Library - Brookwood	Infrastructure or Facility	2850 NE Brookwood Pkwy	
Library - Shute	Infrastructure or Facility	775 SE 10th Avenue	
Parking Lot - 2nd & Lincoln	Infrastructure or Facility	257 NE 2nd Avenue	
Parking Lot - 2nd & Washington	Infrastructure or Facility	202 SE 2nd Avenue	
Parking Lot - 300 West Main	Infrastructure or Facility	300 W. Main Street	
Parks - 53rd Ave Concession	Infrastructure or Facility	250 NE 53rd Avenue	
Parks - Administration	Infrastructure or Facility	4400 NE Century Boulevard	
Parks - Ballpark/Hops/Ron Tonkin	Infrastructure or Facility	4460 NE Century Boulevard	
Parks - Cultural Arts Center	Infrastructure or Facility	527 E. Main Street	
Parks - Hidden Creek Community Center	Infrastructure or Facility	5100 NE Hidden Creek Drive	

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Parks - Jackson Bottom Wetland	Infrastructure or Facility	2600 SW Hillsboro Highway	
Parks - Maintenance	Infrastructure or Facility	450 NE 53rd Avenue	
Parks - Masters House	Infrastructure or Facility	20650 SW Kinnaman Road	
Parks - McDonald House	Infrastructure or Facility	22180 NW Birch Street	
Parks - Patterson House	Infrastructure or Facility	5207 SE Patterson Street	
Parks - River House	Infrastructure or Facility	4000 SE Rood Bridge Road	
Parks - Senior Center	Infrastructure or Facility	750 SE 8th Avenue	
Parks - Shute Aquatic and Recreation Center	Infrastructure or Facility	953 SE Maple Street	
Parks - Shute Aquatic and Recreation Center Annex	Infrastructure or Facility	626 SE 9th Avenue	
Parks - Stadium/Gordon Faber Recreation Complex/Canadians	Infrastructure or Facility	4450 NE Century Boulevard	
Parks - Tyson Rec	Infrastructure or Facility	1880 NE Griffin Oaks Street	
Police - East Precinct	Infrastructure or Facility	8695 NE Cornell Road	
Police - Maple Street Training	Infrastructure or Facility	142 SE Maple Street	
Police - West Precinct	Infrastructure or Facility	250 SE 10th Avenue	
Public Works - Evergreen	Infrastructure or Facility	4415 NE 30th Avenue	Contains Public Works Department Operations Center

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Water - Operations	Infrastructure or Facility	390 W. Main Street	Contains Water Department Operations Center
Crandall Reservoir	Infrastructure or Facility	30575 NW Evergreen Road	
Evergreen Reservoir	Infrastructure or Facility	5540 NW Evergreen Parkway	
24th Ave Reservoir	Infrastructure or Facility	250 NE 24th Avenue	
Clean Water Services Rock Creek Wastewater Treatment Plant	Infrastructure or Facility	3125 SE River Road	
Clean Water Services Quality Lab	Infrastructure or Facility	2550 SW Hillsboro Highway	
Clean Water Services Wastewater Treatment Plant	Infrastructure or Facility	770 S. First Avenue	
Metro West Ambulance	Infrastructure or Facility	5475 NE Dawson Creek Road	
Oregon Health and Science University (OHSU) Hillsboro Medical Center	Infrastructure or Facility	335 SE 8th Avenue	
Kaiser Westside Medical Center	Infrastructure or Facility	19301 NW Venetian Drive	
OHSU West Campus	Infrastructure or Facility	505 NW 185th Avenue	
Orenco Elementary School	Infrastructure or Facility	22550 NW Birch Street	
Quatama Elementary School	Infrastructure or Facility	6905 NE Campus Way	
Tualatin Valley Junior Academy	Infrastructure or Facility	21975 SW Baseline Road	
West Union Elementary School	Infrastructure or Facility	2387 NW West Union Road	

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Farmington View Elementary	Infrastructure or Facility	8300 SW Hillsboro Highway	
Groner Elementary School	Infrastructure or Facility	23405 SW Scholls Ferry Road	
Eastwood Elementary School	Infrastructure or Facility	2100 NE Lincoln Street	
J.W. Poynter Middle School	Infrastructure or Facility	1535 NE Grant Street	
Mooberry Elementary School	Infrastructure or Facility	1230 NE 10th Avenue	
Carden Cascade Academy	Infrastructure or Facility	770 NE Rogahn Street	
Brookwood Elementary School	Infrastructure or Facility	3960 SE Cedar Street	
Century High School	Infrastructure or Facility	2000 SW Century Blvd.	
City View Charter School	Infrastructure or Facility	1771 SE Minter Bridge Road	
Hillsboro High School	Infrastructure or Facility	3285 SE Rood Bridge Road	
Imlay Elementary School	Infrastructure or Facility	5900 SE Lois Street	
Ladd Acres Elementary	Infrastructure or Facility	2425 SW Cornelius Road	
Minter Bridge Elementary School	Infrastructure or Facility	1750 SE Jacquelin Drive	
R.A. Brown Middle School	Infrastructure or Facility	1505 SW Cornelius Pass Road	
Rosedale Elementary School	Infrastructure or Facility	3901 SW 229th Avenue	

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
South Meadows Middle School	Infrastructure or Facility	4690 SE Davis Road	
W. L. Henry Elementary School	Infrastructure or Facility	1060 SE 24th Avenue	
Witch Hazel Elementary School	Infrastructure or Facility	4950 SW Davis Road	
Faith Bible Christian High School	Infrastructure or Facility	2299 SE 45th Avenue	
Evergreen Middle School	Infrastructure or Facility	29850 NW Evergreen Road	
Glencoe High School	Infrastructure or Facility	2700 NW Glencoe Road	
Hillsboro Online Academy	Infrastructure or Facility	452 NE 3rd Avenue	
Jackson Elementary School	Infrastructure or Facility	675 NE Estate Drive	
Lincoln St. Elementary School	Infrastructure or Facility	801 NE Lincoln Street	
Miller Education Center - Options Program	Infrastructure or Facility	215 SE 6th Avenue	
Miller Education Center 6–12 grades	Infrastructure or Facility	440 SE Oak Street	
Liberty High School	Infrastructure or Facility	21945 NW Wagon Way	
Paul L. Patterson Elementary School	Infrastructure or Facility	261 NE Lenox Street	
W. Verne McKinney Elementary School	Infrastructure or Facility	535 NW Darnielle Street	
St. Matthew Elementary School	Infrastructure or Facility	221 SE Walnut Street	
Johnson House	Historical Property	771 NE Third Avenue	

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Faull House	Historical Property	123 NW Garibaldi Street	
Wilfert House	Historical Property	868 SE Washington Street	
Warren Oak Trees	Historical Property	1023–1093 E. Main Street	
Shorey House	Historical Property	905 E Main Street	National Registry Site
Williams Developmental Learning Center Oak Tree	Historical Property	2170 NE Cornell Road	
Shute Estate	Historical Property	210 SE Twelfth Avenue	
Bergen House	Historical Property	2009 E. Main Street	
Shute House I	Historical Property	2140 E. Main Street	
Brogden House	Historical Property	2846 NE Brogden Street	
Tongue Estate	Historical Property	328 W Main Street	
Emmott House	Historical Property	425 SE 26th Avenue	
Douglas Fir Tree	Historical Property	356 SE Sixth Avenue	Tree only
Walker House	Historical Property	711 SE Maple Street	
Hoag House	Historical Property	308 SE Maple Street	
Master House	Historical Property	565 SE Heathcliff Lane	
Freudenthal House	Historical Property	2025 SE Jean Court	
The Manor (Wells House)	Historical Property	725 SE Seventh Avenue	
Burger People	Historical Property	626 SE 9th Avenue; relocated from original site	
Pioneer Cemetery	Historical Property	1601 SE Baseline Street	
Richard D. Malone House	Historical Property	258 NE 2nd Avenue	
Robert Busch House	Historical Property	261 NE 3rd Avenue	
Five Oaks	Cultural Resource	NE Casper Court, South of NE Jacobsen Street and Helvetia Road	
Hillsboro Artists' Regional Theatre (HART)	Cultural Resource	185 SE Washington Street	National Registry Site

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Sewell Clay Works site	Cultural Resource	Southeast corner of Evergreen & Sewell Roads	
McGill/Pitman House	Cultural Resource	6810 NE Cherry Drive	
Orenco Presbyterian Church	Cultural Resource	6815 NE Birch Street	
Orenco Presbyterian Church Manse	Cultural Resource	6851 NE Birch Street	
Methodist Meeting House Site	Cultural Resource	East of NE Starr Boulevard, North of NE Evergreen Road	
McDonald House	Cultural Resource	7248 NE Birch Street	National Registry Site
Mincemoyer House	Cultural Resource	102 NE Century Boulevard	
Orenco Grocery	Cultural Resource	6698 NE Alder Street	
Berry House	Cultural Resource	1255 NE 68th Avenue	
Oelrich House	Cultural Resource	1135 NE 68th Avenue	
Wilson House	Cultural Resource	6694 NE Chestnut Street	
Holmasen House	Cultural Resource	6917 NE Quatama Street	
McFadden House	Cultural Resource	6724 NE Birch Street	
Orenco Drug	Cultural Resource	6750 NE Alder Street	
McGee House	Cultural Resource	6796 NE Birch Street	
Johnson–Belluschi House	Cultural Resource	1513 NE Stile Drive	
Jackson Bottom Wetlands Preserve	Natural Resource	2600 SE Hillsboro Highway	Major wetland area and home to several native sensitive species

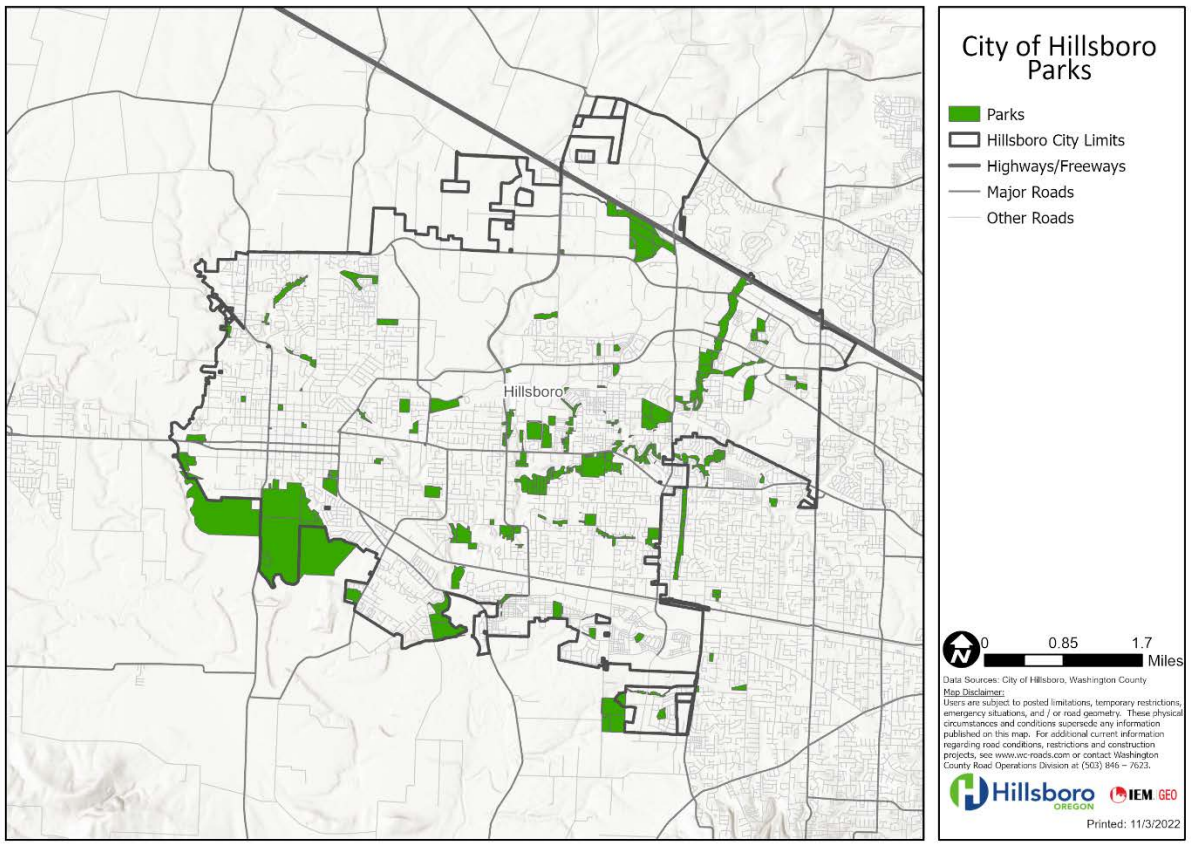


Figure 32: City of Hillsboro Parks and Greenspaces

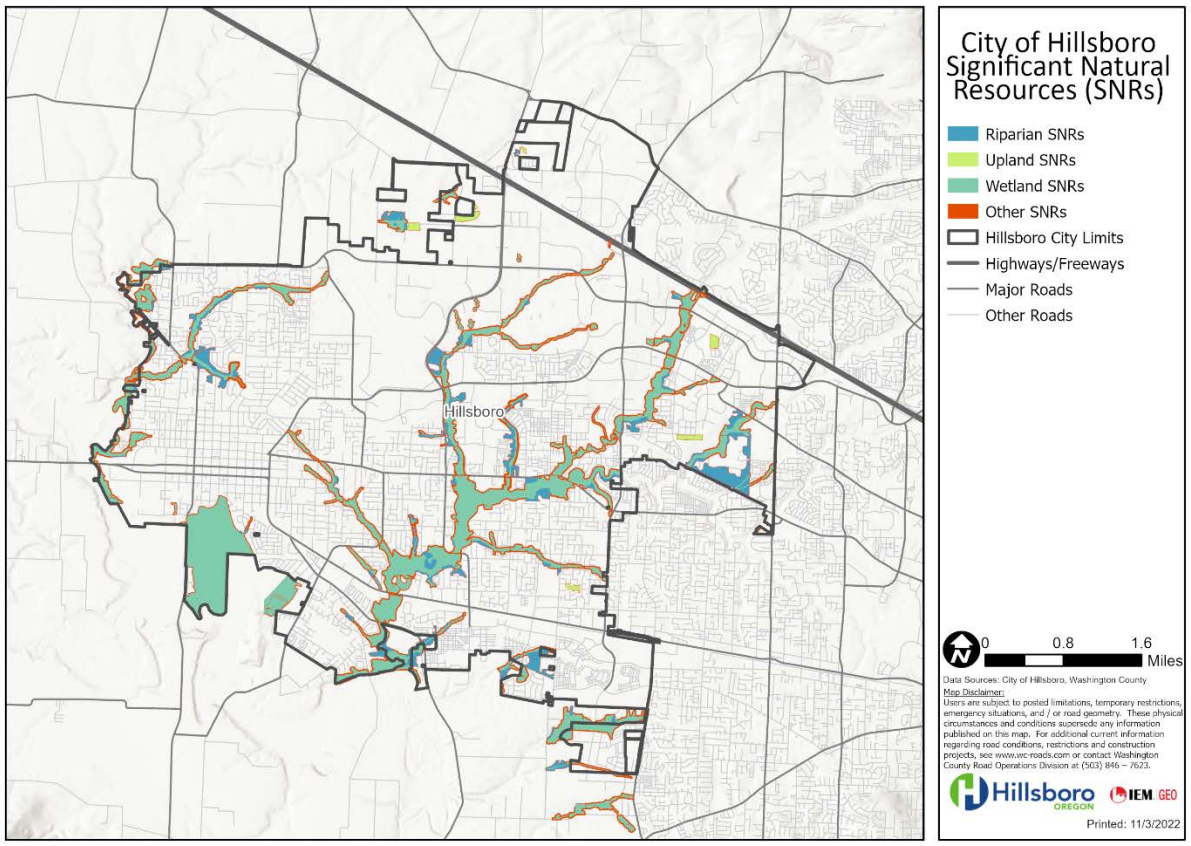


Figure 33: City of Hillsboro Significant Natural Resources

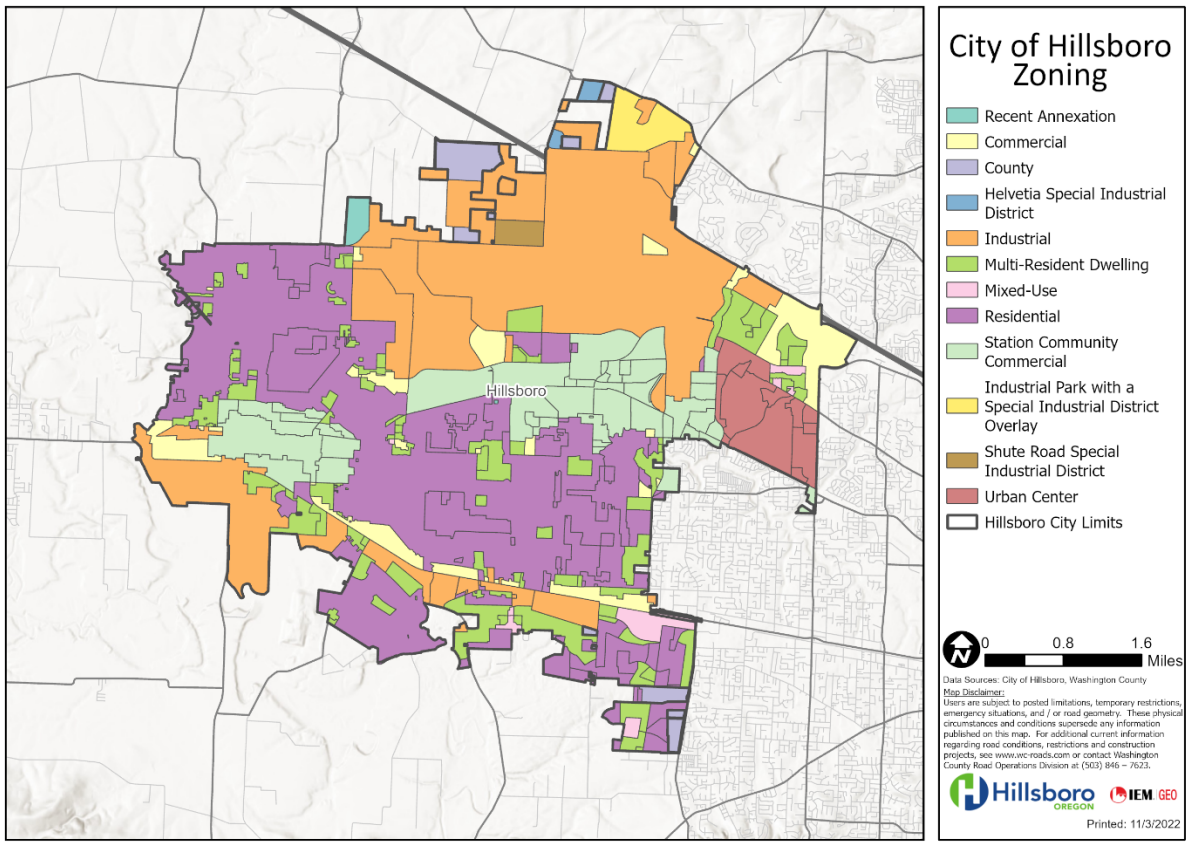


Figure 34: City of Hillsboro Zoning

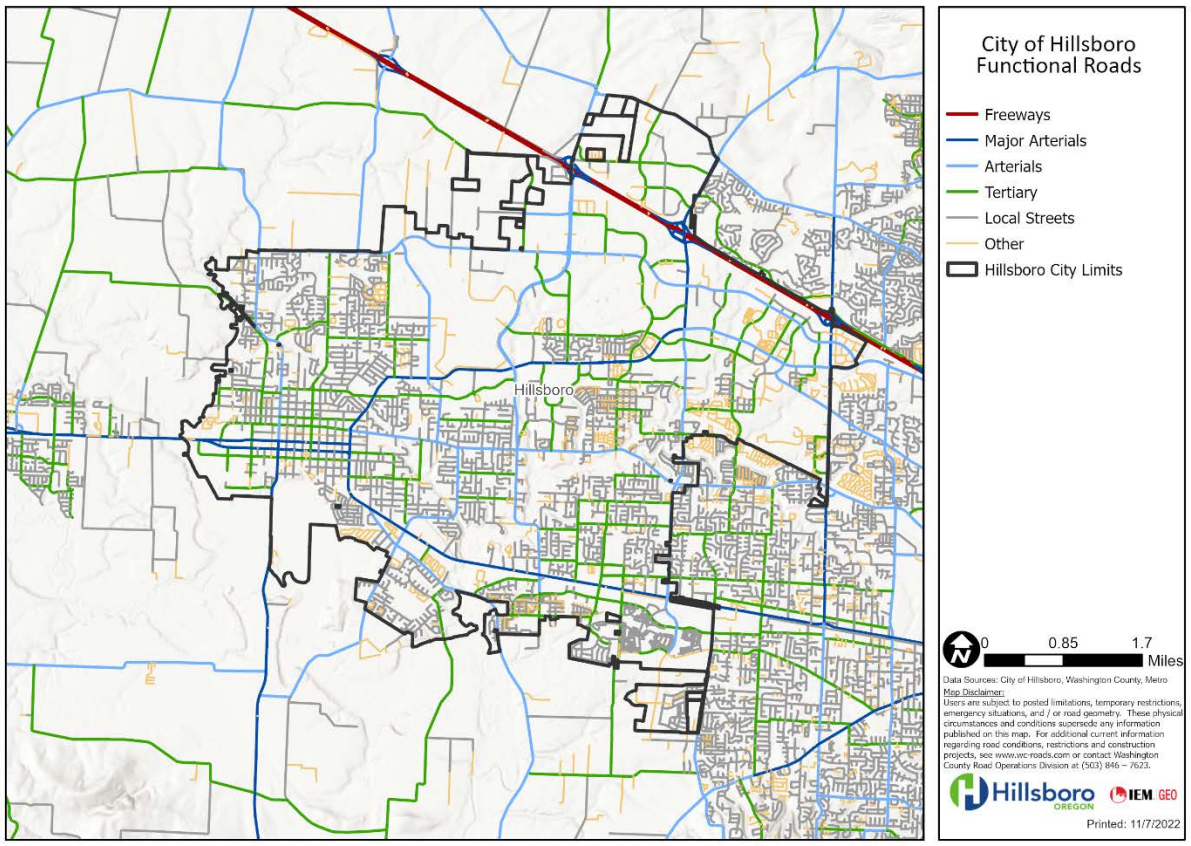


Figure 35: City of Hillsboro Functional Road Classifications

3.2.2.3. Housing

Housing characteristics are an important factor in mitigation planning. The information below shows that most housing units are owner-occupied and consist of one-unit buildings built before 1999. The older the housing, the more at risk it can be to damage from natural hazards such as earthquakes and windstorms, including tornadoes.

Table 136: Housing Characteristics*

Households	Total
Total households[390]	38,903
Units in Housing Structure[391]	**Percent of Housing**
One-unit structures	63%
Structures with two or more units	36%
Manufactured homes and all other types	1%
Year Housing Structure Built[392]	**Percent of Housing**
Pre-1979	26%
1980–1999	37%
2000 to present	37%
Housing Tenure and Vacancy	**Percent of Housing**
Owner-occupied[393]	53%
Renter-occupied[394]	47%
Vacant[395]	5%

* Due to how respondents answer questions there may be overlapping responses and results may equal greater than 100%. Percentages are rounded.

3.2.3. Economy

Hillsboro is in the “silicon forest” and is known as the “high-tech hub of Oregon” or the “tallest tree in the silicon forest.” Companies such as Intel and Genentech are large employers in the City, in addition to

[390] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon%20housing&tid=ACSST5Y2020.S1101
[391] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon%20housing&tid=ACSST5Y2020.S1101
[392] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Physical Housing Characteristics for Occupied Housing Units, Table S2504. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon%20housing&tid=ACSST5Y2020.S2504
[393] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon%20housing&tid=ACSST5Y2020.S1101
[394] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon%20housing&tid=ACSST5Y2020.S1101
[395] United States Census Bureau. (2021, July 1). 2020 Decennial Census, Occupancy Status, Table H1. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon%20housing&tid=DECENNIALPL2020.H1

government agencies and healthcare and education systems. Hillsboro is home to a research facility associated with Oregon Health and Sciences University, which includes the Regional Primate Center and Pacific University's College of Health Professions Campus.

Table 137: Income Characteristics[396]*

Households by Income Category	Percent of Households
Less than $5,000	2%
$5,000 to $9,999	2%
$10,000 to $14,999	2%
$15,000 to $19,999	2%
$20,000 to $24,999	2%
$25,000 to $34,999	6%
$35,000 to $49,999	9%
$50,000 to $74,999	19%
$75,000 to $99,999	14%
$100,000 to $149,999	22%
$150,000 or more	21%
Median Household Income	
$85,586	

* Due to how respondents answer questions, there may be overlapping responses, and results may equal greater than 100%. Percentages are rounded.

[396] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Financial Characteristics, Table S2503. Accessed November 30, 2022, from https://data.census.gov/cedsci/table?q=hillsboro%20oregon%20income&tid=ACSST5Y2020.S2503

3.3. Natural Hazard Profiles

The City of Hillsboro's Technical Committee utilized the OEM's hazard analysis methodology to examine hazard vulnerability and probability by collecting information about history, probability, vulnerability, and maximum threat for each hazard that impacts the City. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants.

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Volume I, Section 2.

All natural hazards included in the NHMP have the potential to impact the City; however, due to geographic location and topography, the City cannot be directly impacted by dam failure and landslide. The City assigned relatively low scores to these hazards and identifies their potential impacts as secondary and not direct.

Table 138: Natural Hazard Risk Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	Low	Medium	Medium	Low	81
Drought	High	High	Medium	High	184
Earthquake	Low	High	High	Medium	201
Extreme heat	High	Medium	High	High	179
Flooding, including channel migration and streambed erosion	High	Medium	Medium	High	159
Landslide	Low	Low	Low	Low	34
Volcanic ash	Low	Medium	High	Low	126
Wildland fire	High	Medium	High	High	177
Windstorm, including tornado	High	Medium	High	High	205
Winter storm	High	Medium	High	High	205

Full descriptions of each hazard are provided in Volume I, Section 2. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description in this annex and in Volume I, Section 2.

The timeframe of data collected during the planning process for the City of Hillsboro was November 1, 2016, to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the City's Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events since the adoption of the 2017 NHMP, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are presented in the same order, as applicable: populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

3.3.1. Dam Failure

Due to geographic location and topography, the City cannot be directly impacted by dam failure. Any impacts in the City due to dam failure are identified as secondary and minimal. Potential impacts of and vulnerabilities to dam failure are identified below.

3.3.1.1. Potential Impacts

The potential impacts of a dam failure event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- If Scoggins Dam were to fail, areas in the south and southwest portions of the City within the established 100-year flood risk area of the Tualatin River could be impacted by flooding. There is not a significant amount of built development and population in the 100-year flood risk area that could be affected by a failure event.

3.3.1.2. Vulnerabilities

The built environment, critical facilities, infrastructure, and natural environment vulnerabilities to a dam failure event are identified below.

- The Jackson Bottom Wetlands Preserve may be vulnerable to dam failure. The preserve is owned and managed by the City; however, the area is not located within City limits. Despite not being located within the City, if the area were to be impacted, the City would be in charge of response and recovery actions.
- The Clean Water Services Hillsboro Treatment Facility is in the potential dam failure impact area. This facility provides wastewater treatment for the cities of North Plains and Banks, the western region of Hillsboro, the southeastern portion of Cornelius, and the northwestern portion of Forest Grove. The facility cleans approximately 4 million gallons of wastewater on an average day.[397]
- The Joint Water Commission (JWC) Water Treatment Plant could be vulnerable to flooding created by a Scoggins Dam failure event. The plant could be vulnerable to higher-than-normal water levels and damage to infrastructure due to debris flows, which could lead to changes in the amount of water available for use.

[397] Clean Water Services. (2022). Locations. https://cleanwaterservices.org/about/locations/

3.3.2. Drought

Drought typically occurs as a regional event and often affects more than one city and county simultaneously. The City is a member of the JWC and has water storage reservoirs. It therefore may be impacted by drought differently than other NHMP participants. Potential impacts of and vulnerabilities to drought are identified below.

3.3.2.1. Potential Impacts

The potential impacts of a drought event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Reduction or loss of water supply, water use restrictions, and lack of potable water supply.
- Health effects, including increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions.
- Reduced economic productivity or business closures in such industries as agriculture, livestock, recreation, energy, tourism, timber, and fisheries.
- Supply chain restrictions, including food shortages.
- Loss of power or reduced availability of electricity due to infrastructure damage and high demand.
- Property and infrastructure damage due to expansive soils, which are clay-based soils that expand and contract based on the amount of moisture in the soil.
- Damage to natural environments, including low water levels in lakes, rivers, and other water bodies, reduced plant growth, local species reduction or extinction, increased water temperature, and deteriorated water quality, which may result in fish kills and increased waterborne pollutants.
- Concurrent hazards, including extreme heat, wildfire, flooding, and landslides.

3.3.2.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to drought. These include:

- People in the City with preexisting health conditions, those without access to clean water, children, pregnant women, and older adults. This may include those living in or spending time in the City's schools and medical care facilities.
- Those who are employed in water-dependent sectors, such as agriculture and recreation, may experience a reduction in income.
- Water supply sources of the upper Tualatin River and its tributaries.
- Critical infrastructure and facilities, including solid waste disposal facilities, city buildings and facilities, fiber huts, fire stations and facilities, intermodal transit facilities, parking lots, parks, a water operations center, wastewater treatment plants, a Clean Water Services Quality Lab, police stations, historical properties, including historical trees and landscaping, cultural resources, Jackson Bottom Wetlands Preserve, Oregon Health and Science University West Campus, schools and administrative facilities, ambulance service, and hospitals.
    - The City has three in-town storage reservoirs totaling 31 million gallons of treated water storage capacity. The City also owns Dilley Reservoir, located in Dilley, which provides an additional 650,000 gallons of storage.

- Other critical infrastructure, including arterial roads, TriMet light rail, communication structures, and emergency generators.

3.3.3. Earthquake

The City could experience earthquakes that originate from the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek Fault Zone. It could also experience liquefaction and landslides as the result of an earthquake. Potential impacts of and vulnerabilities to earthquake are identified below.

3.3.3.1. Potential Impacts

The potential impacts of an earthquake event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Mental health impacts, including post-traumatic stress disorder.
- Public health hazards resulting from disruption of drinking water and wastewater systems.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to ground utilities; residential, public, and private buildings; and transportation systems above and below.
- Disruption of essential infrastructure systems, such as power systems, public utilities, and telecommunications.
- Blocked roads and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction.
- Downed or damaged powerlines that can lead to wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Change in water flows, including paths of rivers and streams.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards initiated by an earthquake, including flood, wildland fire, and landslide.

3.3.3.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to earthquakes. These include:

- Critical infrastructure and facilities, including solid waste disposal facilities, city buildings and facilities, fiber huts, fire stations and facilities, intermodal transit facilities, parking lots, parks, a water operations center, wastewater treatment plants, a Clean Water Services Quality Lab, police stations, historical properties, including historical trees and landscaping, cultural resources, Jackson Bottom Wetlands Preserve, Oregon Health and Science University West Campus, schools and administrative facilities, ambulance service, and hospitals.
- Other critical infrastructure, such as pipelines and utility lines, arterial roads, TriMet light rail, communication structures, and emergency generators can be vulnerable to damage from liquefaction due to the type of soil in the City.
- Buildings in relatively high liquefaction-susceptible areas along Dairy Creek, Gales Creek, and the Tualatin River are at higher risk to damage from coseismic liquefaction-induced ground deformation.
- Unreinforced masonry buildings in the older central business district of the City are more vulnerable to potentially substantial damage during an earthquake compared to other nearby structures built to modern standards.[398]
- Wood frame buildings with sill plates not bolted to foundation, cripple wall perimeter systems, and buildings on steep slopes, partially supported on “stilts,” are generally vulnerable to major seismic damage.
- Buildings with very high or high collapse potential include residential and commercial buildings constructed prior to 1990. Nearly half of all structures in the City were built in or before 1980, with most of these structures being residential buildings.[399]
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.
    - Using 2022 Hazus®-MH information, it is estimated a 6.7 magnitude Gales Creek Fault earthquake event would result in 888 yellow-tagged buildings, 148 red-tagged buildings, and $426,257,000 in total economic losses.[400]
    - A 2018 Oregon Department of Geology and Mineral Industries (DOGAMI) report described the following earthquake scenarios and their potential impacts on Hillsboro[401]:
        - A Cascadia Subduction Zone magnitude 9.0 earthquake in “dry” soil conditions could result in $1,810,000,000 in building repair costs, 946,000 tons of debris, 938 long-term displaced residents, and up to 1,601 deaths.
        - A Cascadia Subduction Zone magnitude 9.0 earthquake in “wet” soil conditions could result in $2,884,000,000 in building repair costs, 1,280,000 tons of debris, 7,124 long-term displaced residents, and up to 2,986 deaths.

[398] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[399] City of Hillsboro. (2017, November 21). Hillsboro Comprehensive Plan. https://www.hillsboro-oregon.gov/home/showpublisheddocument/16832/637995422246570000
[400] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[401] Oregon Department of Geology and Mineral Industries. (2018). Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-18-02/O-18-02_report.pdf

- A Portland Hills Fault magnitude 6.8 earthquake in “dry” soil conditions could results in $3,320,000,000 in building repair costs, 1,476 thousand tons of debris, 2,116 long-term displaced residents, and up to 2,788 deaths.
- A Portland Hills Fault magnitude 6.8 earthquake in “wet” soil conditions could result in $5,269,000,000 in building repair costs, 2,063,000 tons of debris, 12,836 long-term displaced residents, and up to 5,247 deaths.

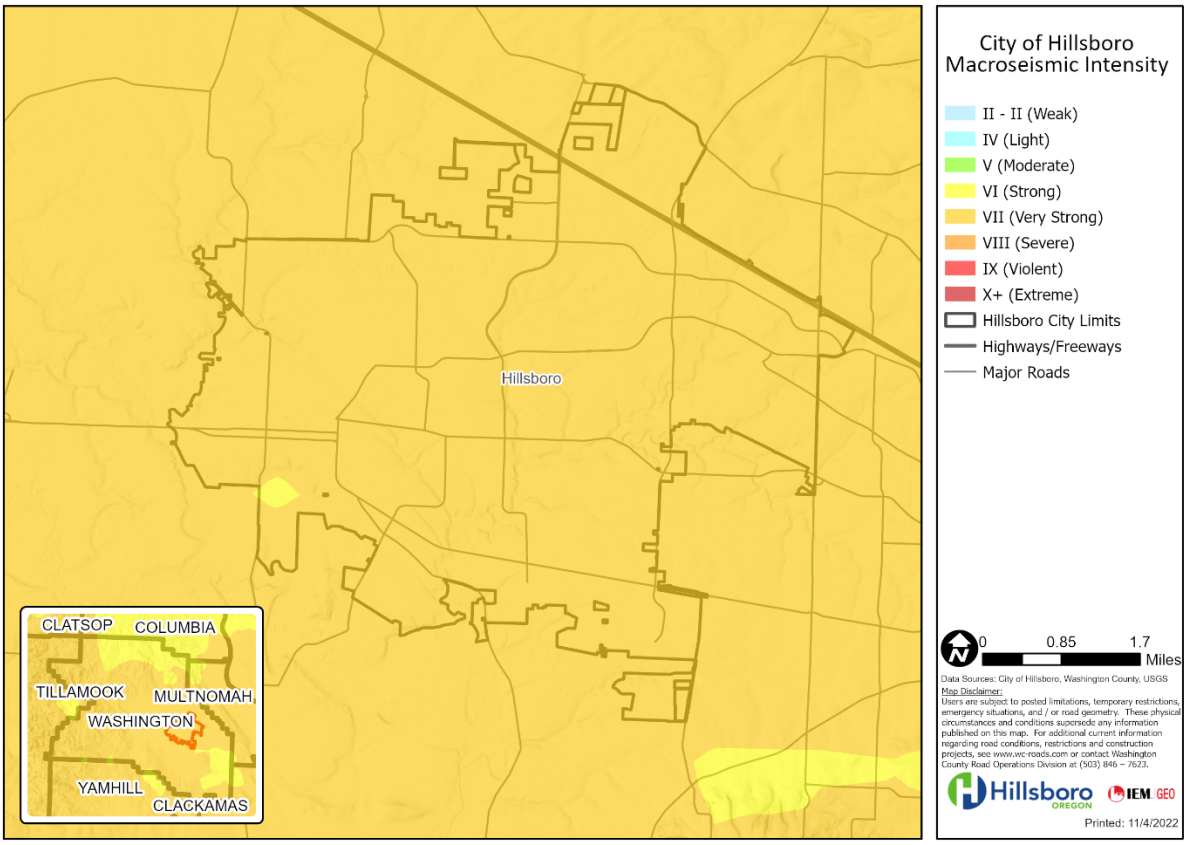


Figure 36: City of Hillsboro Perceived Shaking and Damage Potential of a Magnitude 9.0 Earthquake

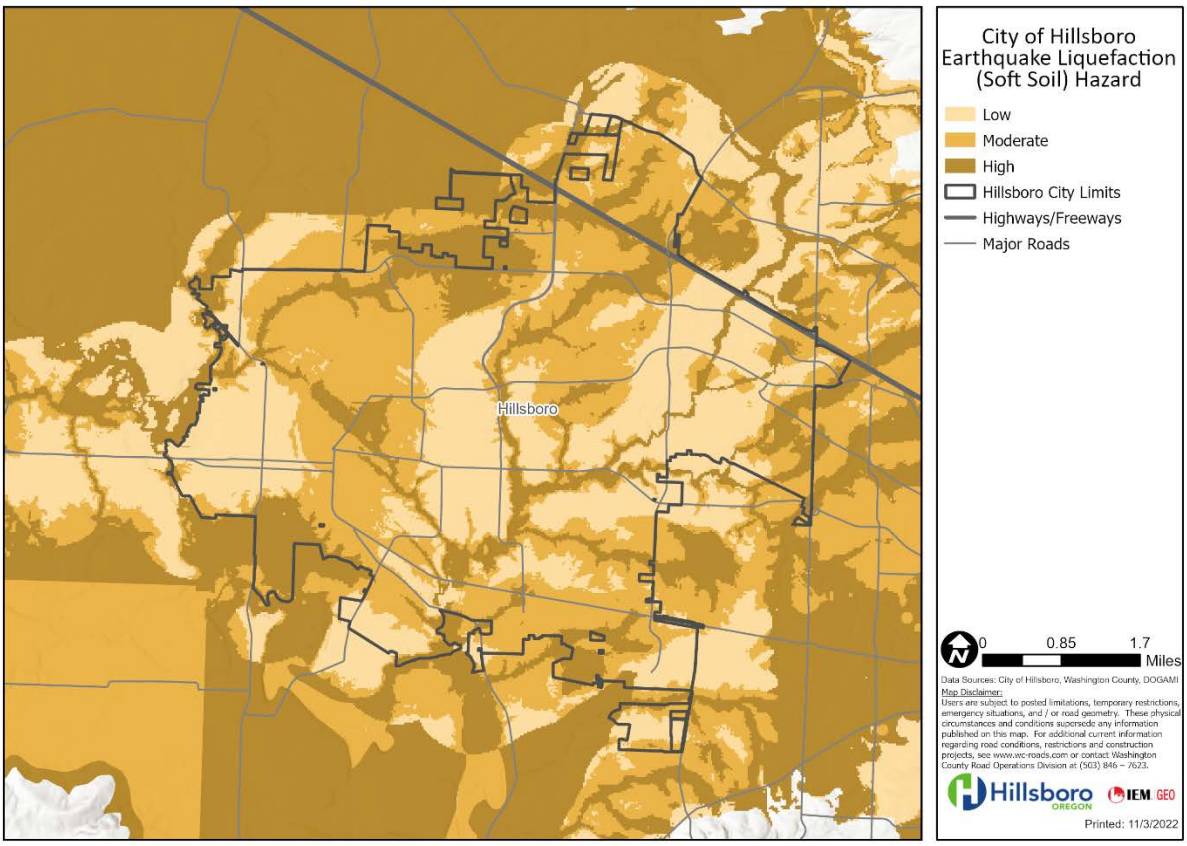


Figure 37: City of Hillsboro Liquefaction

3.3.4. Extreme Heat

Due to a rise in the frequency, severity, and impacts of extreme heat events, the NHMP Steering Committee chose to include this hazard in the Washington County NHMP for the first time. Potential impacts of and vulnerabilities to extreme heat and previous significant events are identified below.

3.3.4.1. Significant Events

Extreme heat was not included in previous NHMPs. The City identified two significant extreme heat events it has experienced.

- **June 26–29, 2021:** The maximum temperature reached 108 °F, with a heat index of 115 °F. Throughout Washington County there were numerous fatalities, closures and postponements of businesses and events, and buckled roads, and cooling shelters were opened.
- **August 11–24, 2021:** The high temperature at Hillsboro Airport was 103 °F, with a heat index of 109 °F on August 11 and 12. Peak afternoon temperatures ranged from 100 °F to 105 °F. Throughout the County there were fatalities, closures and postponements of businesses and events, and cooling shelters were opened.

3.3.4.2. Potential Impacts

The potential impacts of an extreme heat event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts may include:

- Injuries or deaths.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, heat stroke, and death.
- Extended operational hours of County staff and additional resources needed for response to the event, including the operation of daytime cooling centers and overnight cooling shelters.
- Strain on or loss of water supply due to increased demand.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic losses from decreased worker efficiency and effectiveness and time lost on the job when workers take more frequent or longer breaks to avoid overheating.
- Economic impacts of closure of outdoor activities and events, such as farmers markets and concerts.
- Property damage, such as roof expansions, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding.
- Disruption of essential infrastructure systems from overheated and damaged utilities, including power, water, transportation, and communication systems.
- Impacts to roadways as heat expands concrete or causes cracking and buckling. Public transit can also be impacted due to melted cables, sagging wires, and warping tracks.
- Damage to crops, livestock, vegetation, parks, and natural systems.

- Impacts to greenspaces, such as scorch and sunscald of new foliage, branches or tops of trees dying, and significant stress and die-off of native trees, particularly Douglas fir and cedar. These impacts are intensified if drought is also occurring.
- Concurrent hazards include drought and wildland fire.

3.3.4.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to extreme heat.

Populations substantially vulnerable to extreme heat include:

- People who work or spend a significant amount of time outdoors, including those in construction, landscaping, maintenance and repair, roofing, and solid waste collection.[402]
- People who live and/or work in buildings without air conditioning or cooling equipment. A City resident without a cooling source in his home died in June of 2021.[403]
- People living, working, or spending time in heat islands within the City.
- People living outdoors or in the upper floors of multi-family housing units.
- Populations with higher heat sensitivity, including older adults, infants and children, pregnant women, people with preexisting or chronic diseases, and those who take certain medications that affect thermoregulation or block nerve impulses. This may include those living in or spending time in the City's schools and medical care facilities.
- People with limited mobility and no access to cooling systems who may not be able to travel to cooling centers or shelters.
- People who live in social isolation, including linguistic isolation or those living alone with few social relationships.

Additional vulnerabilities to extreme heat include:

- A limited number of cooling centers and shelters are available for the public.
- Critical infrastructure and facilities, including solid waste disposal facilities, city buildings and facilities, fiber huts, fire stations and facilities, intermodal transit facilities, parking lots, parks, a water operations center, wastewater treatment plants, a Clean Water Services Quality Lab, police stations, historical properties, including historical trees and landscaping, cultural resources, Jackson Bottom Wetlands Preserve, Oregon Health and Science University West Campus, schools and administrative facilities, ambulance service, and hospitals.
- Other critical infrastructure, such as pipelines and utility lines, arterial roads, TriMet light rail, communication structures, and emergency generators.
- Bridge infrastructure is vulnerable to thermal expansion of bridge joints and paved surfaces and deterioration of steel, asphalt, protective cladding, coats, and sealants.
- Asphalt pavement is vulnerable to accelerated deterioration through softening, rutting, and migration of liquid asphalt.

[402] Samayoa, Monica. (2021, July 21). *Hillsboro construction worker latest workplace heat death.* OPB. https://www.opb.org/article/2021/07/21/hillsboro-construction-worker-latest-workplace-heat-death/
[403] Forrest, Jack. (2021, July 8). *Daughter, longtime neighbor remember Washington County man who died in heat wave.* Oregon Live. https://www.oregonlive.com/news/2021/07/daughter-longtime-neighbor-remember-washington-county-man-who-died-in-heatwave.html

- Vehicles, including first responder vehicles, are vulnerable to engine overheating and tire deterioration.
- Aboveground utility and power lines can droop or sag and create a heightened fire risk.
- Natural environments located throughout the City.
- Plants, animals, ecosystems, and natural environments are vulnerable to high rates of mortality due to excessive heat.

3.3.5. Flooding, Including Channel Migration and Streambed Erosion

Some degree of flooding is not uncommon in the County, and events typically occur from October through April. The City experiences localized flooding, but historically it has not been significant or severe. Potential impacts of and vulnerabilities to flooding are identified below. It is anticipated that flooding caused by a dam failure event would have similar impacts and create similar vulnerabilities as flood caused by other events.

3.3.5.1. Potential Impacts

The potential impacts of a flooding event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts may include:

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Need for widespread search and rescue operations, including water rescues.
- Displaced residents in need of sheltering.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal economic impacts of loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.5.2. Vulnerabilities

Populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments vulnerable to a flooding event include:

- Populations without access to private transportation.
- Critical infrastructure and facilities, including solid waste disposal facilities, city buildings and facilities, fiber huts, fire stations and facilities, intermodal transit facilities, parking lots, parks, a water operations center, wastewater treatment plants, a Clean Water Services Quality Lab, police stations, historical properties, including historical trees and landscaping, cultural resources, Jackson Bottom Wetlands Preserve, Oregon Health and Science University West Campus, schools and administrative facilities, ambulance service, and hospitals.

- Other critical infrastructure, such as pipelines and utility lines, arterial roads, TriMet light rail, communication structures, and emergency generators.
- Natural environments such as Jackson Bottom Wetlands Preserve and historical landscaping and trees.
- Repetitive loss property within the City.
- Properties without flood insurance.
- Special flood hazard areas within the City.
- Portions of the City outside of the mapped floodplains are subject to flooding from local storm water drainage and overbank flooding from streams too small to be mapped by FEMA. Buildings and infrastructure in these areas may be at flood risk. The identified drainage hazard areas include about two dozen areas within the City.
- The following street intersections in the City have been identified as prone to flooding:
  - Highway 219 at Wood Street
  - Glencoe Road at Harewood Street
  - Brookwood Avenue at curve north of SW Golden Road
  - NW 317th Avenue at Jackson Street
  - Bridge at River Road at Rood Bridge Road
  - NW Paget Road at NW 10th Avenue
  - NW 9th Avenue at Hertie Road
- Flood loss estimates determined by Hazus-MH include[404]:
  - 10-year flood scenario
    - Number of buildings lost: 39
    - Loss estimate: $922,000
  - 50-year flood scenario
    - Number of buildings lost: 66
    - Loss estimate: $1,995,000
  - 100-year flood scenario
    - Number of buildings lost: 74
    - Loss estimate: $2,547,000
  - 500-year flood scenario
    - Number of buildings lost: 141
    - Loss estimate: $6,173,000

[404] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

Table 139: Land Use Type in the 100-Year Floodplain

Land Use Type	Total Parcels in 100-Year Floodplain	Total Value of Exposed Parcels	Total Area in Jurisdiction (Acres)	Total Area in the 100-Year Floodplain (Acres)	Percentage of Area in the 100-year Floodplain
Agriculture	14	$63,516,600	609.14	284.53	46.7%
Commercial	59	$326,050,420	3,234.64	322.98	9.99%
Forest	4	$5,355,460	25.92	23.2	89.5%
Industrial	4	$80,858,220	676.17	166.87	24.68%
Multi-Family Residential	15	$562,701,460	539.94	134.23	24.86%
Public	153	$133,689,890	2,105.88	916.34	43.5%
Rural	1	$415,660	1.24	0.92	74.2%
Single Family Residential	611	$340,338,860	4,213.51	442.96	10.5%
Vacant	67	$9,033,530	293.89	100.79	34.3%
Other	98	$379,228,190	2,276.6	962.16	42.3%
Total	**1,026**	**$1,901,188,290**	**13,976.93**	**3,354.98**	**24%**

Table 140: Buildings in Hillsboro within FEMA-Mapped Floodplains

Buildings	Buildings Within Hillsboro	Buildings Within 100-Year Floodplain
Total Buildings	43,004	228
Percentage of Buildings within Hillsboro	100%	0.53%

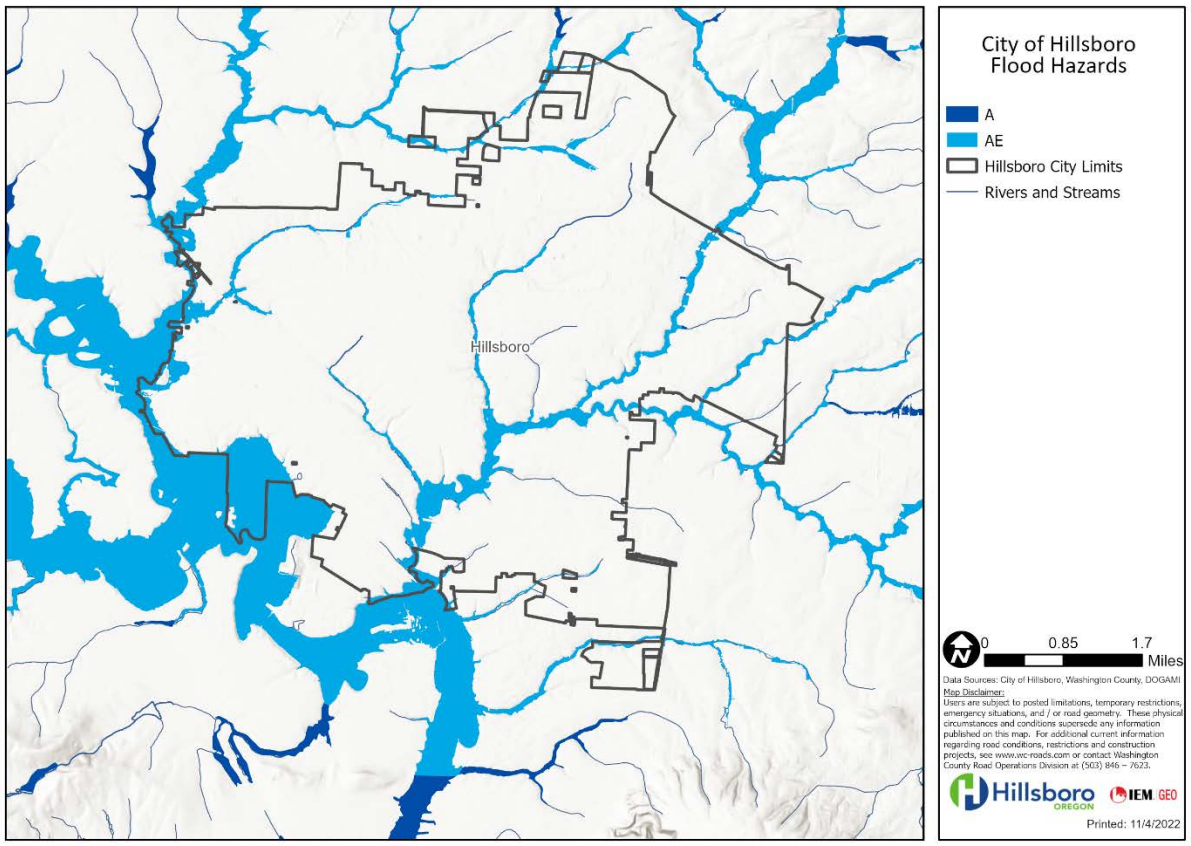


Figure 38: City of Hillsboro Flood Hazards

3.3.6. Landslide

Due to geographic location and topography, the City cannot be directly impacted by landslides. Any impacts in the City due to landslides are identified as secondary. Potential impacts of and vulnerabilities to landslides are identified below.

3.3.6.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a landslide event are identified below. The type, magnitude, and extent of these can vary based on the scale of the event.

- The potential for landslide impacts in the City is minimal with the possible exception of very small areas immediately adjacent to stream channels. Buildings built along Rock Creek in Hillsboro are at higher risk of damage from landslides than other adjacent areas[405]; however, the potential impact is minimal.
- Landslide hazard is ubiquitous in a large percentage of undeveloped land and may present challenges for future planning and mitigation efforts. Awareness of nearby areas of landslide hazard is beneficial for reducing risk for every community in Washington County.

[405] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.3.7. Volcanic Ash

Volcanic activity is possible from the Cascade Volcanoes. It is anticipated that ashfall from a volcanic eruption has the potential to impact the City, although the scale and types of impacts and vulnerabilities may differ depending on which volcano erupts, the level of eruption, and the wind direction during and after eruption. Potential impacts of and vulnerabilities to volcanic ash are identified below.

3.3.7.1. Potential Impacts

Though unlikely, the impacts of a significant ashfall can be substantial, and may include:

- Indirect injuries and deaths, such as those sustained during ash cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation. This includes public water systems that rely on outdoor reservoirs.
- The need to shelter individuals to protect them from poor air quality, including houseless persons and persons displaced from their residences due to poor residential air filtration systems.
- Delayed emergency response times due to decreased visibility and increased traffic hazards.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and cleanup activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Downed or damaged powerlines can lead to wildfires.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.7.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to volcanic ash. These include:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults. This may include those living in or spending time in the City's schools and medical care facilities.
- People without access to effective dust masks, eye protection, and drinking water and food uncontaminated by volcanic ash.

- Critical infrastructure and facilities, including solid waste disposal facilities, city buildings and facilities, fiber huts, fire stations and facilities, intermodal transit facilities, parking lots, parks, a water operations center, wastewater treatment plants, a Clean Water Services Quality Lab, police stations, historical properties, including historical trees and landscaping, cultural resources, Jackson Bottom Wetlands Preserve, Oregon Health and Science University West Campus, schools and administrative facilities, ambulance service, and hospitals.
- Other critical infrastructure, including arterial roads, TriMet light rail, communication structures, and emergency generators.
- Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of volcanic ash, including manufactured homes and buildings, and the people who live or work in them.

3.3.8. Wildland Fire

Although the City could experience a wildland–urban interface event, historically the City is more likely to be affected by smoke and poor air quality due to wildland fires outside its boundaries. Previous events and potential impacts of and vulnerabilities to wildland fire are identified below.

3.3.8.1. Significant Events

The City has not been directly impacted by a wildland fire event since adoption of the 2017 NHMP. However, in September 2020, multiple wildland fires occurred concurrently in the County, outside the County, and outside the state, and the City experienced significant smoke from the fires. The Air Quality Index in the City was between 199 and 317 with particulate matter 2.5 micrometers or smaller ($PM_{2.5}$).

3.3.8.2. Potential Impacts

The potential impacts of a wildfire event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Exposure to wildfire smoke, which can lead to eye, nose, and throat irritation and the worsening of chronic heart and lung diseases.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to blocked transportation routes and debris, congested transportation routes due to evacuations, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Strain on or loss of water supply due to increased demand.
- Economic impacts to governments, including costs for fire suppression, staff, equipment, supplies, transportation and mobilization of first responders, evacuations, sheltering operations, post-fire recovery, and rebuilding costs associated with government-owned buildings, property, and infrastructure.
- Economic impacts, including loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity. Scoggins Valley Park receives one million visitors a year, most during summer, which is when wildland fires tend to occur.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.

- Debris from trees and damaged property, causing blocked roads and rail transportation routes.
- Downed or damaged powerlines. This impact may be compounded since powerline failures can lead to additional wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including air and water quality issues. Landslide and erosion issues are common following a wildland fire.

3.3.8.3. Vulnerabilities

Given the dynamic nature of wildland fires, all populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to this hazard. These include:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults. This may include those living in or spending time in the City's schools and medical care facilities.
- Populations without access to private transportation.
- First responders and other personnel working directly on fire protection, suppression, and patrols or near a wildland fire can experience burns, smoke exposure, heat-related impacts such as heat stroke, heat exhaustion, dehydration, physical fatigue, mental health challenges, injuries, and death.
- Critical infrastructure and facilities, including solid waste disposal facilities, city buildings and facilities, fiber huts, fire stations and facilities, intermodal transit facilities, parking lots, parks, a water operations center, wastewater treatment plants, a Clean Water Services Quality Lab, police stations, historical properties, including historical trees and landscaping, cultural resources, Jackson Bottom Wetlands Preserve, Oregon Health and Science University West Campus, schools and administrative facilities, ambulance service, and hospitals.
- Other critical infrastructure, including arterial roads, TriMet light rail, communication structures, and emergency generators.
- Drinking water sources and water treatment infrastructure, food supplies and availability, and access to medical resources or care may also be impacted by wildland fire and can cause health impacts on a large scale.
- Homes, businesses, and infrastructure adjacent to the wooded areas near the outskirts of the City.
- Per analysis of the Oregon State University–Extension Service Fire Program and Wildland Fire Associates dataset, there are 32 buildings with a total value of $6,772,000 at high risk of wildland fire, 25 buildings with a total value of $6,932,000 at moderate wildland fire risk, and 2,431 buildings with a total value of $733,690,000 at low wildland fire risk.[406] Additionally, a community

[406] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

risk profile completed by DOGAMI shows 166 residents may be potentially displaced due to a wildland fire event.[407]

[407] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.3.9. Windstorm, Including Tornado

The City has an elevation of 194 feet and historically has not experienced the same frequency of windstorms as those parts of the County at higher elevations. Potential impacts of and vulnerabilities to windstorm, including tornado and previous significant events are identified below.

3.3.9.1. Significant Events

The City identified one significant windstorm event since the 2017 NHMP. On September 7, 2020, strong winds caused widespread damage to trees and downed power lines in the City, leading to power outages and road closures.

3.3.9.2. Potential Impacts

The potential impacts of a windstorm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged powerlines can lead to wildfires.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.9.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to windstorms, including tornadoes. These include:

- Critical infrastructure and facilities, including solid waste disposal facilities, city buildings and facilities, fiber huts, fire stations and facilities, intermodal transit facilities, parking lots, parks, a water operations center, wastewater treatment plants, a Clean Water Services Quality Lab, police stations, historical properties, including historical trees and landscaping, cultural resources, Jackson Bottom Wetlands Preserve, Oregon Health and Science University West Campus, schools and administrative facilities, ambulance service, and hospitals.
- Older buildings and infrastructure not built to withstand high winds, including manufactured homes and buildings.
- Other critical infrastructure, including arterial roads, TriMet light rail, communication structures, and emergency generators.
- Aboveground utility and power lines.

3.3.10. Winter Storm

The City has an elevation of 194 feet and historically has not experienced the same frequency and intensity of winter storms as those parts of the County at higher elevations. Potential impacts of and vulnerabilities to winter storm and previous significant events are identified below.

3.3.10.1. Significant Events

The City identified one significant winter storm event since the 2017 NHMP. Between February 11 to February 14, 2021, freezing rain and heavy snow came down and gusty winds up to 50 mph occurred, resulting in a five-day ice storm. The City experienced snowy and icy roads, downed tree limbs, localized power outages, and travel impacts.

3.3.10.2. Potential Impacts

The potential impacts of a winter storm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths, including from carbon monoxide poisoning, falls from slick or icy conditions, frostbite, and hypothermia.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components.
- Stranded travelers due to ice, snow, and transportation impacts.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- An increased number of house fires due to unsafe alternate heating methods.
- Significant property damage and loss of water due to frozen or damaged pipes or the thawing of frozen pipes.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged powerlines can lead to wildfires, and tree debris can create fuel load for wildfire.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.

- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including flooding.

3.3.10.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to winter storms. These include:

- People who do not have access to sufficient heating, insulated clothing, or dry living conditions, including unhoused populations.
- Older adults and infants, people who take certain medications, people who have certain medical conditions, or people who have been drinking alcohol are at increased risk for hypothermia. This may include those living in or spending time in the City's schools and medical care facilities.
- People improperly using generators and heating devices.
- Populations with disabilities may be more affected due to mobility issues.
- Critical infrastructure and facilities, including solid waste disposal facilities, city buildings and facilities, fiber huts, fire stations and facilities, intermodal transit facilities, parking lots, parks, a water operations center, wastewater treatment plants, a Clean Water Services Quality Lab, police stations, historical properties, including historical trees and landscaping, cultural resources, Jackson Bottom Wetlands Preserve, Oregon Health and Science University West Campus, schools and administrative facilities, ambulance service, and hospitals.
- Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of snow and ice.
- Other critical infrastructure, including arterial roads, TriMet light rail, communication structures, and emergency generators.
- Numerous roads, bridges, and overpasses identified within the City's Inclement Weather Response Plan are vulnerable to winter storms and are included in snowplow and anti-icing priority routes.

3.4. Historical Events

The timeframe of data collected during the planning process for the City of Hillsboro was November 1, 2016, to February 22, 2022. Hazard events that impacted the entire planning area during that timeframe are detailed in Volume I, Section 2. Since the adoption of the 2017 NHMP, the City has experienced impacts of widespread extreme heat, windstorm, winter storm, and wildland fire smoke events.

One disaster declaration was issued by the City since the adoption of the 2017 NHMP. A disaster declaration for the COVID-19 pandemic was in effect from March 12, 2020, to April 7, 2021. Although pandemic is not a hazard included in this NHMP, this declaration is noted because FEMA provided support and Hazard Mitigation Grant Program funding during the event.

3.5. Overall Vulnerability

Based on the analysis completed by the Technical Committee, windstorm, including tornado, winter storm, earthquake, drought, and extreme heat present the highest relative risk to the City of Hillsboro. These hazards can create widespread events and all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City can be vulnerable to these hazards.

Areas of greatest vulnerability to these hazards within the City include:

- Populations with higher vulnerability, such as those with preexisting health conditions, older adults, children, and pregnant women.
- Populations that are unhoused, do not have access to private transportation, and/or are without access to air conditioning, cooling equipment, sufficient heating, and clean water.
- People living, working, or spending time in heat islands within the City.
- Populations with limited income and financial resources.
- Populations whose primary language is not English.
- Industries that can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic impacts to the City, including loss of local revenue due to business and property tax losses, reduced future revenues, reduced recreation and tourism activity, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Critical infrastructure and facilities, including solid waste disposal facilities, city buildings and facilities, fiber huts, fire stations and facilities, intermodal transit facilities, parking lots, parks, a water operations center, wastewater treatment plants, a Clean Water Services Quality Lab, police stations, historical properties, including historical trees and landscaping, cultural resources, Jackson Bottom Wetlands Preserve, Oregon Health and Science University West Campus, schools and administrative facilities, ambulance service, and hospitals.
- Other critical infrastructure, including arterial roads, TriMet light rail, communication structures, and electric generating systems.
- Older buildings and infrastructure not built to current building codes or seismic standards may be more vulnerable. This includes historical structures and properties, unreinforced masonry buildings, and buildings in relatively high liquefaction-susceptible areas.
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment and safe growth analysis examine the ability of the City to implement and manage a comprehensive mitigation strategy. Strengths, opportunities, and resources of the jurisdiction are identified to develop an effective hazard mitigation action plan. The capabilities identified in this assessment were evaluated collectively to develop feasible recommendations, which support the implementation of effective mitigation activities.

A capability questionnaire was distributed to the City of Hillsboro Technical Committee to initiate this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities. The Technical Committee also completed a safe growth analysis to identify potential gaps in growth guidance instruments and improvements that could be made to reduce vulnerability to future development.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances within the City that can prevent and reduce the impacts of hazards.

The City's Comprehensive Plan addresses natural hazards, identifies projects that can be included in the mitigation strategy, and can be used to implement mitigation actions. This plan provides adequate space for expected future growth in areas located outside natural hazard areas. Many of the goals and policies in the City's Comprehensive Plan are related to those in this NHMP and safe growth objectives. The monitoring and implementation section of the NHMP covers these and all other hazard mitigation strategies discussed in the plan. Safety is explicitly included in the City's Comprehensive Plan's growth and development policies.

Hillsboro's Capital Improvement Plan addresses natural hazards, identifies projects that can be included in the mitigation strategy, and can be used to implement mitigation actions. Additionally, this plan's corresponding capital improvement program provides funding for hazard mitigation projects identified in this NHMP; however, the program does not limit expenditures on projects that would encourage development in areas vulnerable to natural hazards. The City's infrastructure policies do not limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.

The City's Local Emergency Operations Plan, Stormwater Management Plan, and Community Wildfire Protection Plan (CWPP) also address natural hazards, identify projects that can be included in the mitigation strategy, and can be used to implement mitigation actions.

The continuity of operations plans for some City departments are complete, and the planning effort for the remaining departments is underway and is an action included in Section 6 of this annex. The Hillsboro Transportation System Plan does not specifically address natural hazards or identify projects that can be included in the mitigation strategy and cannot be used to implement mitigation actions. However, the Hillsboro Transportation System Plan limits access to identified hazard areas and is used to guide growth into safe locations and the City's corridor plans recognize the need to avoid or mitigate natural hazards. The City and the plan do not identify movement systems designed to function under disaster conditions, such as during an evacuation. The Regional Disaster Preparedness Organization and Metro are working to create Emergency Transportation Route maps, and the City is a part of this effort.

Land use planning and ordinances are adequately administered and enforced and are an effective measure for reducing hazard impacts through the City's Community Development Code. These include zoning, subdivision, floodplain, and natural hazard-specific ordinances and the utilization of flood insurance rate maps (FIRM)s. The City has a future land use map that clearly identifies natural hazard areas. Additionally, land use policies discourage development or redevelopment within natural hazard areas. Depending on the development activity, the Community Development Code dictates what level the permit is reviewed at, either a Type II staff-level review or a Type III hearing body review. After receiving land use approval, developers can submit required engineering or building permitting. The City's building code also contains provisions to strengthen or elevate construction to withstand hazard forces.

The City has zoning ordinances that conform to the comprehensive plan in terms of discouraging development or redevelopment within natural hazard areas, including prohibiting development within, or filling of, wetlands, floodways, and floodplains. The ordinance also contains natural hazard overlay zones that set conditions for land use within such hazard zones. Rezoning procedures recognize natural hazard areas as off limits to any zoning changes that would allow for increased activity or development in the area. The City does not have subdivision regulations that restrict the division of land within or adjacent to natural hazard areas, provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources, or allow density transfer where hazard areas exist.

The City's Planning Division leads and facilitates review of land use applications and enforces site plan review requirements. The City of Hillsboro utilizes the most current building codes as they are adopted by the State of Oregon.[408] The Hillsboro Fire and Rescue Department has an Insurance Services Office (ISO) rating of 2, and the last Public Protection Classification survey was completed in January 2003.

The City has environmental systems that protect development from hazards identified and mapped and policies that maintain and restore protective ecosystems, including land use policies and an Environmental Sustainability Plan. The City does not have policies that provide incentives to development that is located outside protective ecosystems.

Hillsboro has an adopted shelter plan to deal with emergencies from natural hazards. The economic development or redevelopment strategies in the City do not include provisions for mitigating natural hazards.

4.1.1. National Flood Insurance Program Compliance

Participation in the National Flood Insurance Program (NFIP) is based on a voluntary agreement between a community and FEMA. For communities that adopt a floodplain management ordinance to reduce flood risks to new construction, federally backed flood insurance is made available to property owners in the community. Compliance with the NFIP, however, extends beyond participation in the program. The three basic components of the NFIP include: floodplain identification and mapping risk, responsible floodplain management, and flood insurance.

A repetitive loss (RL) property is a property insured under the NFIP for which the program has paid at least two claims of more than $1,000 in any 10-year period since 1978, regardless of any change(s) of ownership during that period. As of September 30, 2021, there is one FEMA-identified RL property in the City.

[408] City of Hillsboro. (2022). Codes & Standards. https://www.hillsboro-oregon.gov/our-city/departments/community-development/codes-standards

4.1.1.1. National Flood Insurance Program Details

Insurance Summary

There are currently 105 NFIP policies in the City and $33,537,900 coverage in force. There are $79,683 in premiums paid annually.

There have been 15 claims paid for a total amount of $178,860 paid. Two substantial damage claims have been paid.

There are approximately 226 structures exposed to flood risk within the community.

Staff Resources

There are no barriers to running an effective NFIP program in the City. The City's NFIP Coordinator is currently undergoing the certification process, including completing the *FEMA E0273: Managing Floodplain Development through the National Flood Insurance Program* course and exam. The Planner who executes floodplain management functions also handles development applications outside the floodplain. NFIP administration services in the City include permit review for new development in the floodplain and alterations, geographic information system (GIS) management of floodplain data and determining the base flood elevation, education with homeowners and property owners, coordination with the Building Department on structural reviews, and review of capital projects affecting the floodplain.

Compliance History

The City is in good standing with the NFIP and there are no outstanding compliance issues. The most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC) was on September 4, 2003, and a CAC is scheduled with FEMA for summer 2023.

The City will continue NFIP compliance during the next five years of NHMP implementation by enforcing floodplain management requirements, including new construction and substantial improvements within the Special Flood Hazard Area (SFHA), maintaining and using floodplain mapping, and undertaking any code amendments needed to maintain compliance.

Regulation

The City entered into the NFIP on April 12, 1974, and has both digital and paper flood insurance rate maps (FIRMs). Floodplain development regulations meet the minimum FEMA and state requirements. Development within the floodplain requires a Floodplain Activity permit, which is a Land Use Application.

Community Rating System

The City does not participate in the Community Rating System.

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions.

The City's Planning Commission is responsible for reviewing, recommending, and approving Type II and III land use case files as well as making recommendations to the City Council on policy and code amendments. The Mitigation Technical Committee works together effectively to update and maintain the NHMP.

The City administers maintenance programs to reduce risk, including tree trimming, clearing drainage systems, and landscape maintenance of open spaces and rights of way. The City also has multiple effective mutual aid agreements and planning partnerships, including intergovernmental agreements,

Oregon Water/Wastewater Agency Response Network, Washington County Emergency Management Cooperative, the Regional Disaster Preparedness Organization, and the Cooperative Public Agencies of Washington County.
The City of Hillsboro has adequate staffing levels to enforce regulations, staff are trained on hazards and mitigation efforts, and coordination on mitigation initiatives with staff is effective. The Chief Building Official is part of the Community Development Department and is a full-time position. The Development Services Section is within the Planning Division of the Community Development Department and has several full-time positions, including Planning Technicians, Planners, Senior Planners, an Urban Design Planner, and a Manager. This department houses the subject matter expert on the floodplain and natural resources. The Emergency Management Office is located within Hillsboro Fire and Rescue.

Multiple City departments have staff who can support the mitigation strategy, including planners and engineers with an understanding of natural hazards, engineers and professionals trained in construction practices related to buildings and infrastructure, staff with education or expertise to assess vulnerability to hazards, and GIS staff and coordinators.

Additionally, the City has many technical capabilities that have been used to assess or mitigate risk and could be used in future efforts. Warning systems include Everbridge and OR-Alert in partnership with Washington County and the Barney Reservoir earthquake monitoring system. Grant writing is completed by individual departments as needed. The City has a robust GIS program and has created mapping products specific to each department, and hazard data and information can be pulled from a variety of sources, including historical records and DOGAMI.

4.3. Education and Outreach Assessment

Education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information were assessed to determine the City's capabilities.

Hillsboro's Community Emergency Response Team (CERT) Program promotes disaster preparedness for hazards and trains members in basic disaster response skills, such as fire safety, light search and rescue, and disaster medical operations. Safety Town is hosted by the Hillsboro Police Department each year and educates the public on the effects of various emergencies and disasters as well as steps families can take to lessen the affects. The City's Public Works Department trains residents on proper tree trimming and vegetation waste disposal. Additionally, Hillsboro is a Tree City USA and works with contractors to maintain landscaping and properties to reduce natural hazards vulnerabilities and impacts. General preparedness and natural hazard mitigation education is also provided to homeowner's associations and community groups as requested. The Hillsboro Building Department's website includes videos on home preparation and retrofitting. The Hillsboro Water Department provides preparedness and emergency information to residents at public events about being prepared with an action plan, building up a water supply at home, accessing additional water from your water heater, winterization, and shutting off your home's water supply during an emergency.

There are many nonprofit organizations and community groups that can assist with implementing future mitigation actions, including those that provide food security resources and healthcare, sheltering and emergency assistance, extreme heat sheltering, and emergency management-specific groups. These partners include Centro, Adelante Mujeres, Salvation Army, local churches, the Regional Disaster Preparedness Organization, Washington County Emergency Management Cooperative, Local Emergency Managers group, Regional Water Providers Consortium, and the Local Emergency Planning Committee.

4.4. Financial Assessment

The City has access to or is eligible to potentially use the following funding resources for hazard mitigation initiatives:

- Capital improvements project funding
- Fees for water, sewer, gas, and/or electric services
- Impact fees for new development
- Stormwater utility fees
- Incurrence of debt through general obligation bonds and/or special tax bonds
- Incurrence of debt through private activities
- Federal funding sources, including the Community Development Block Grant, Urban Areas Security Initiative, Building Resilient Infrastructure and Communities, and Hazard Mitigation Assistance Grants
- State funding programs, including the State Homeland Security Program

4.5. Capability Expansion and Improvement

Actions that can expand and improve existing authorities, plans, policies, and resources for mitigation include:

- Continuing to update City plans as necessary to ensure they are current and reflect the needs of the community;
- Further developing warning systems and messaging;
- Increasing dedicated grant writing staff;
- Creating and implementing additional public education and outreach offerings and increasing the volume of translated materials; and
- Ensuring grant opportunities are capitalized upon to meet goals.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iii), §201.6(c)(3)(iv), and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) and the above identified sections of 44 CFR require that local mitigation plans describe hazard mitigation actions a community will undertake to lessen the danger from hazards of concern and establish a strategy for implementing those actions. As such, all other requirements for a local hazard mitigation plan lead to and support the mitigation strategy.

5.1. Mitigation Goals

The Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 City of Beaverton NHMP, 2011 Cities of Cornelius and Forest Grove NHMPs, and 2020 Oregon NHMP.

The goals from each plan were grouped by topic and then synthesized to create the seven goals detailed in Volume I, Section 3. These goals are the basis of this NHMP and summarize what the Steering Committee will accomplish by implementing the plan.

5.2. Mitigation Successes

Joint Water Commission Wildfire Protection Plan

The JWC, in partnership with Clean Water Services, hired Geosyntec Consultants Inc. to complete a CWPP. The plan includes a pre-fire prevention and mitigation plan and post-fire response and mitigation plan for the Tualatin Basin and the JWC's Drinking Water Source Area. The plan identifies important resources and assets vulnerable to wildland fire and recognizes actions that can be taken before, during, and after a wildland fire event to mitigate the impacts. Based on plan recommendations, JWC will work to implement the short-term prevention and mitigation measures immediately and plan for some of the longer-term mitigation projects.

City of Hillsboro Water Department Seismic Pipeline Design Standards

The intent of the design standards is to mitigate the impact of a seismic event and resulting seismic hazards for critical pipelines, transmission lines, and those serving critical facilities within the City, thereby increasing the resilience of the water transmission and distribution system. The standards were developed primarily for ductile iron pipelines, ranging in size from 8 to 24 inches in diameter, which represent over 55% of the City's water system. These standards are intended to guide engineers in the application of seismic design requirements for the design of pipeline systems.

Heat-Reduction Initiatives

The Hillsboro Comprehensive Plan, effective January 2, 2018, contains heat-reduction initiatives such as using shade vegetation and paving materials with a high Solar Reflectance Index.

5.3. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on mitigation plan requirement 44 CFR §201.6(c)(4)(ii), the vulnerability and capabilities assessment for the City were carefully reviewed and considered when developing the mitigation actions for this plan. The City's Technical Committee will establish a process in which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into the existing local planning strategies.

Once the plan is adopted, the committee will coordinate implementation with the responsible parties in the City and with external stakeholders as needed. The primary means for integrating mitigation strategies will be through the revision, update, and implementation of plans and regulations such as comprehensive plans, capital improvement plans, and land development regulations, as feasible.

The members of the City's Technical Committee will remain charged with ensuring the goals and strategies of new and updated local planning documents for their jurisdictions and special districts are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.3.1. Comprehensive Plan

The City of Hillsboro's Comprehensive Plan has goals and policies related to hazard mitigation. Through a coordinated resiliency strategy, the City will focus on five goals related to natural hazards: minimizing risk, increasing preparedness, improving coordination, building resilience, and mitigating hazards. The City will enhance ordinances and standards as part of this effort—especially those relating to the siting of essential facilities and other development—minimizing the potential risk of natural hazards to people and property. Hillsboro will also coordinate emergency preparedness, resilience building, and hazard mitigation efforts with local and regional partners in both the public and private sectors.[409]

When the plan goes through a regular update, additional details about hazard mitigation will be added, as applicable.

5.3.2. Building and Zoning Codes

The City's zoning code, known as the Community Development Code (CDC), addresses the mitigation of flooding hazards through the City's Regulatory Floodplain Overlay (RFO) in CDC Section 12.27.100. Updates to this section and additions for other areas of hazard mitigation strategies can be integrated into future CDC amendment efforts.

5.3.3. Public Engagement, Education, and Outreach

The City of Hillsboro Emergency Management Office will continue public engagement campaigns during National Preparedness Month, expanding translation of the information into multiple languages. The City's Public Works Department will continue to distribute information about leaf pickup and proper tree trimming to reduce potential wildland fire fuel load and debris that could clog the stormwater system.

The Hillsboro Water Department will continue to use social media to share public messaging about mitigation actions for hazards, including drought prevention and extreme heat.

5.3.4. Land Development Regulations

The City's land development regulations, known as the CDC, address the mitigation of flooding hazards through the City's RFO in CDC Section 12.27.100. Updates to this section and additions for other areas of hazard mitigation strategies can be integrated into future CDC amendment efforts.

5.3.5. Floodplain Management Program and/or National Flood Insurance Program

The City of Hillsboro Community Development Department and Emergency Management Office will continue to review any RL properties and incorporate any new findings into the City's mitigation strategy, as appropriate.

The City's Floodplain Management Program is implemented through the City's RFO in CDC Section 12.27.100. Updates to this section and additions for other areas of hazard mitigation can be integrated into future CDC amendment efforts.

[409] City of Hillsboro. (2017, November 21). Hillsboro Comprehensive Plan. https://www.hillsboro-oregon.gov/home/showpublisheddocument/16832/636869398552970000

5.3.6. Stormwater Management Plans and Procedures

Findings of the 2021 City of Hillsboro Stormwater Master Plan will be incorporated into the 2023 NHMP and plan action items.

5.3.7. Water Master Plan

Findings of the 2019 Water Master Plan will be incorporated into the 2023 NHMP and plan action items.

5.3.8. Emergency Plans That Address Evacuation and Sheltering

Evacuation and sheltering are addressed in the City's Emergency Operations Plan, and the City works with Washington County on sheltering efforts as needed. The City of Hillsboro's Emergency Management Office will ensure sheltering and evacuation sites are planned with consideration of flooding potential.

5.3.9. Funding Opportunities

The City of Hillsboro's Emergency Management Office will continue to review annual, post-disaster, and stand-alone grant opportunities for potential mitigation project funding opportunities.

6. Action Items

The City of Hillsboro's action items in the 2017 Washington County NHMP were determined by the 2017 planning team. The action items from the previous plan and the status of each action are provided below in Section 6.1.

Action items for the 2023 NHMP were determined by the City's Technical Committee based on the review of its risk assessment, its existing capabilities, and the status of its previous action items. This comprehensive range of actions includes local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.2 and 6.3 below. Additional information about how these actions were developed, evaluated, and prioritized is in Volume I, Section 3.

6.1. Status of City of Hillsboro Action Items from the 2017 Washington County NHMP

Table 141: Status of Action Items from 2017 NHMP

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Short-Term 1	Prepare and pre-script public messages about water conservation.	Drought	2018–2019: The Water Department had a Curtailment Plan addressing water shortage. Also, active messaging on social media and various publications.	Complete.
Long-Term 1	Evaluate current systems and equipment and explore options for backup systems and supplies.	Drought	2018–2019: The Willamette Water Supply System (WWSS) offers redundancy and resilience. 2021: Continued work on WWSS.	Redesigned for 2023 plan.

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Short-Term 1	Complete seismic vulnerability analyses for lifeline utility and transportation systems, including water, wastewater, natural gas, electric power, telecommunications, and bridges. Explore options to enhance these systems.	Earthquake	2018–2019: The Water Master Plan update has a seismic resiliency component. The Hillsboro Public Works Department has a catalog of all sanitary and storm lines, which are rated every eight years. They have also conducted a risk analysis of different locations in the system. The Oregon Department of Transportation inspects the City's bridges and is undertaking a review of priority transportation routes, which the City has been heavily involved in. Once those are established, the City will work with the County to develop plans to make priority roadways more resilient. 2020: The Joint Water Commission (JWC) and Hillsboro Water Department have completed their risk and resilience assessments that heavily focus on earthquakes as the primary natural hazard. 2021: Developed seismic design standards for water mains and will include in the design standards at the next update. Planning to implement ShakeAlert at the Pumps Stations and in-town reservoirs and upgrades to the Supervisory Control and Data Acquisition (SCADA) system.	Redesigned for 2023 plan.
Short-Term 2	Analyze fuel storage capabilities and explore locations for emergency fuel storage.	Earthquake	Office of Innovation completed a preliminary scoping project and presented findings to City Council. Numerous locations in the City have been explored as potential fuel storage sites although none have been found suitable/possible at this time.	Phase 1 completed. Redesigned for 2023 plan.

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Long-Term 1	Expand and complete a seismic safety inventory of public, commercial, and residential buildings (particularly critical and essential facilities) that may be vulnerable to natural hazards (particularly earthquake).	Earthquake	Inventory of facilities exists as created by Washington County Emergency Management.	Completed. Efforts will continue in the future.
Long-Term 2	Educate homeowners about structural and non-structural retrofitting of vulnerable homes.	Earthquake	Information about preparing homes has been uploaded to the Building Department's webpage.	Complete and expanded for 2023.
Short-Term 1	Identify and inventory critical facilities and buildings in floodplains or other high-risk flood areas and identify mitigation options if such facilities are identified.	Flooding	2018–2019: Hillsboro Public Works Department has identified flood prone areas with historical data.	Completed.
Short-Term 2	Survey elevation data for buildings within mapped floodplains, evaluate flood risk quantitatively, and educate homeowners on mitigation options.	Flooding		Redesigned for 2023 plan.
Long-Term 1	Conduct public awareness campaign each fall to remind residents of ways they can be involved in the prevention of street flooding.	Flooding	2018–2019: Hillsboro Public Works Department conducts outreach each fall to educate the public on street flooding prevention due to leaves or other issues.	Complete. Established efforts will continue in the future.

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Long-Term 2	For locations with repetitive flooding and significant damages or road closures, determine and implement mitigation measures such as upsizing culverts or storm water drainage ditches.	Flooding	2018–2019: Culverts: - NE Lori Street/NE Lennox Drive - Secondary route for 49th to increase egress. Worked with business at Cronie to move the pond from private to public ownership. Completed a repair on Evergreen and Rock Creek storm pipe and reviewed recent flood incidents to determine projects for the future. 2021: The 49th Street alternative access was completed. Hidden Creek Drive access was built. The pavement was raised approximately 4 inches at the 47th culvert to help provide a flooding buffer.	Redesigned for 2023 plan.
Long-Term 1	Encourage removal of non-native or invasive plant species.	Wildland Fire	2021: The removal of non-native or invasive plant species is required as part of any permitting associated with the City's Significant Natural Resources Overlay. Working on a wildland fire mitigation plan for critical assets.	Completed and expanded for 2023 plan.
Long-Term 2	Promote tree preservation with consideration of hazard impacts.	Wildland Fire	2021: The City has tree preservation standards in Community Development Code (CDC) Section 12.50.230.	Complete.

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Short-Term 1	Ensure that all new and existing critical facilities in the City of Hillsboro have backup power and plans to deal with power outages.	Winter Storm	2018–2019: All critical facilities have backup power, including the newest Public Works Department facility. 2021: The Fire and Rescue Department has a facility request in the fiscal year 2022–2023 budget process to replace the three oldest backup power generators at fire stations 1, 2, and 3. The generators still have useful life, so two of the three being replaced will be repurposed to Wood Street warehouse buildings.	Completed and expanded for 2023 plan.
Long-Term 1	Conduct public awareness campaign to encourage property owners to trim trees near service drops to individual customers.	Winter Storm	2018–2019: The Public Works Department conducted public outreach on tree health and trimming.	Complete. Established efforts will continue in the future.
Long-Term 2	Evaluate current equipment and explore options to increase response capabilities.	Winter Storm	2018–2019: The Public Works Department developed an inclement weather plan for staffing and equipment preparations. Emergency contracts include both equipment and operators. 2020: The Water Department had an inventory of spare parts for repairs and emergency response plans in the case of 24-hour operations.	Redesigned for 2023 plan.

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Short-Term 1	Evaluate capability of water treatment plants to deal with high turbidity from ashfalls, and review and update emergency response plans (ERPs) as needed.	Volcanic Ash	2018–2019: Completed. The ERP will be updated in 2020, after the All-Hazards Risk Assessment - Risk and Resilience Assessment of the America's Water Infrastructure Act of 2018 (AWIA) will be completed. 2021: ERP addresses contamination threats and identified contamination of finished water.	Complete.
Short-Term 2	Prepare and pre-script public messages about protecting from and disposing of volcanic ash.	Volcanic Ash	2020: The Fire and Rescue Department worked with the Water Department to prepare/pre-script public messages about the health risks and safety measures related to volcanic ash.	Expanded for 2023 plan.
Long-Term 1	Develop strategy and obtain resources needed to reduce the impact of ashfall to stormwater drainage systems.	Volcanic Ash	2018–2019: On-call contracts include both storm pipe flushing and cleaning and storm water maintenance.	Complete.
Short-Term 1	Develop public and private sector partnerships to foster hazard mitigation.	Multi-Hazard	2018–2019: Training and exercises included the private sector, such as hospitals, assisted living facilities, and local businesses. Newly implemented on-call Public Works contracts with private partners for spills, hazardous materials, tree removal, traffic control, snow removal, etc. Also have on-call contracts for pipeline inspection and cleaning and restoration of traffic signals. 2021: The Water Department completed meetings and made connections with local Oregon Department of Forestry offices and the City of Forest Grove Fire Department to discuss mitigation efforts and fostered relationships.	Complete. Efforts will continue in the future.

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Short-Term 2	Establish a liaison with the City of Hillsboro 2035 Vision Implementation Committee to where there might be common interests and activities.	Multi-Hazard	2018–2019: The City's Emergency Program Manager made contact with the committee and will participate where appropriate.	Complete.
Short-Term 3	Identify and pursue funding opportunities to implement mitigation actions.	Multi-Hazard	2018–2019: City of Hillsboro participated in the State Homeland Security Grant Program, State Preparedness and Incident Response Equipment grant program, and Urban Areas Security Initiative Program grant cycles and planning. 2021: Through the 2021 Hazard Mitigation Grant Program–Post Fire notice of funding opportunities, the Fire and Rescue Department submitted a grant application for a Community Wildfire Protection Plan (CWPP) that would guide future mitigation efforts. The Water Department submitted an application for the Building Resilient Infrastructure and Communities Grant Program (BRIC) grant process for a chlorine generation retrofit.	This action item has been implemented and is ongoing. It will be reshaped for the next update to include additional details for the 2023 NHMP cycle.

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Short-Term 4	Develop inventory of at-risk buildings and infrastructure and prioritize mitigation items.	Multi-Hazard	2018–2019: An inventory of facilities was created by Washington County Emergency Management. The City's Water Department created a critical facility map and related infrastructure in the Water Master Plan update. The Public Works Department has a catalog of all sanitary and storm pipes, which are rated every eight years. They also conducted a risk analysis of different locations in the system. 2020: The Water Department completed a Risk and Resiliency Assessment and consequent Vulnerability Assessment under the AWIA requirements. The Water Department updated the critical facility map in fall 2020.	Complete. Efforts will continue in the future.

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Short-Term 5	Review and update public notification and alert/warning procedures.	Multi-Hazard	2018–2019: The Water Department developed notification and communications plans for algal contamination events. The Communications Department has developed alert and warning procedures for various topics. 2020: The Fire and Rescue Department developed notification, communications, and messaging coordination plans with other City departments on common fire and rescue incidents. Primary notification tools include department Twitter, PublicAlerts, and press release news wire. 2021: The switch from the County's CodeRED emergency notification system to a statewide system (Everbridge) was completed at the county level and is in process to be implemented for internal emergency notifications.	Completed and expanded for 2023 plan.

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Long-Term 1	Develop and/or enhance and implement education programs aimed at mitigating natural hazards and reducing the risk to citizens, private property owners, public agencies, businesses, and schools. Programs will focus on actionable items, such as creation of an emergency supply kit or home retrofitting.	Multi-Hazard	2018–2019: CERT classes were hosted each spring and fall. Emergency Management presented at Head Start parent meetings once each year, and revision of Take 5 flyers with Washington County was ongoing. Multiple City departments participated in Celebrate Hillsboro and the library's earthquake preparedness fair. The Public Works Department hosted a Public Works Day at the Saturday Market in May. 2020: The Water Department worked with the Regional Disaster Preparedness Organization (RDPO) and the Regional Water Providers Consortium (RWPC) to address water emergency planning. The Fire and Rescue Department adapted public education and community risk reduction programs such as Hands Only CPR and home fire safety into virtual offerings. Short engaging videos were planned to educate community members with actionable steps to prepare themselves for emergencies. 2021: The Water Department continued to work with the RDPO and RWPC on the Emergency Drinking Water Framework Project.	Complete. Established efforts will continue in the future. Additional public education topics will be added to the 2023 plan.
Long-Term 2	Integrate mitigation plan findings into planning and regulatory documents and programs, including the City of Hillsboro Comprehensive Plan (HCP).	Multi-Hazard	2021: The Planning Division proposed amendments to the municipal code subchapter 11.12 to refine regulations associated with temporary uses from lessons learned through the COVID-19 pandemic.	Complete. Efforts will continue in the future.

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Long-Term 3	Update website and social media to include mitigation activities, opportunities, and success stories.	Multi-Hazard	2018–2019: Developed an emergency side to the City's website that can be turned on in the event of an emergency. Social media posts for fire prevention and emergency preparedness months were posted. 2020: The Fire and Rescue Department developed an editorial calendar to consistently create and share useful emergency preparedness and mitigation tips and activities using social media, with call-to-action links to the relevant topics on their website or other timely, relevant sources. 2021: The Fire and Rescue Department webpage content was updated concurrently with City webpage revisions. The Water Department put emergency response information specific to water customers on the updated website.	Complete. Established efforts will continue in the future.

*Number given to action item in 2017 Washington County NHMP.

6.2. City of Hillsboro Action Items: 2023 Washington County NHMP

Table 142: City of Hillsboro Action Items

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
1	Publish informational materials on City website to provide information on Scoggins Dam and any potential downstream effects that would occur as a result of dam failure. Analyze current preparedness materials and presentations and update as needed.	Dam Failure	Low
2	This project would ensure that all essential buildings in the City would remain safe from potential gas leaks in the event of seismic activity. The City has identified roughly 25 buildings it considers essential in the event of an emergency. Adding seismic gas shutoff valves to these sites would allow the City to use these areas for planning, mobilizing, and implementing its response to whatever is encountered. Adding seismic gas shutoff valves to these sites would also ensure that any staff or public patrons in areas of these buildings would remain safe from potential gas explosions caused by a gas leak.	Earthquake	Low
3	This project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of insufficient water storage for industrial microchip manufacturing cluster after a seismic event. These assets are at risk of catastrophic failure during a major seismic event. These assets are located in Hillsboro, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).	Earthquake	Low
4	This mitigation action proposes a seismic engineering analysis that will assist the City in prioritizing capital projects to upgrade the sanitary sewer system. Planned retrofits will create a sanitary sewer system that is more resilient to earthquakes.	Earthquake	Medium
5	This project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate and seismically retrofit pipelines and related infrastructure in Hillsboro's Water distribution system. These assets are at risk of catastrophic failure during a major seismic event. These assets are located in Hillsboro, Oregon, a western suburb of Portland, which is within the CSZ.	Earthquake	Medium
6	This project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of power loss to Water critical lifeline assets after seismic event. These assets are at risk of being unusable after a major seismic event until power can be restored. These assets are located in Hillsboro, Oregon, a western suburb of Portland, which is within the CSZ.	Earthquake	High

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
7	Seismic retrofit mitigation of the JWC's primary water transmission pipelines, the North Transmission Line (NTL), and the South Transmission Line (STL). The City of Hillsboro, Oregon, is the managing agency for the JWC. These assets are located in/near Hillsboro, Oregon, a western suburb of Portland, which is within the CSZ. Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction projects to mitigate risk of catastrophic failure of these assets. These assets are at risk of catastrophic failure during a major seismic event. A preliminary assessment for insurance purposes identified the older STL as at highest risk of catastrophic failure after an earthquake, while the NTL would sustain major damage but might be viable at reduced pressure in an emergency.	Earthquake	High
8	After a recent staff transition in which a new City staff member attended the FEMA E0273 NFIP Floodplain Development course, staff have identified a need to have a more robust response plan in place when overland flooding has impacted structure(s) within the City. Furthermore, City staff expect to need to refine the Regulatory Floodplain Overlay (RFO) regulations to implement the recommendations/requirements from the BiOp effort and provide any additional needed clarity on FEMA regulations.	Flood	Medium
9	This mitigation action proposes a program to analyze and repair stormwater outfalls to natural waterways to prevent flooding conditions. Stormwater outfalls to natural waterways to prevent flooding conditions in several scenarios. Outfalls that are constructed under the 100-year flow elevation can cause backwatering into the storm system causing flooding. Additionally, stormwater outfalls that are inadequately sized for large storm events or are buried/submerged can cause flooding conditions. This action will include a comprehensive plan for determining which outfalls need attention and prioritize repair order based on the flood risk associated with outfall.	Flood	Medium
10	This mitigation action is to replace and upgrade culverts throughout the City but includes two projects within the City of Hillsboro that propose to upgrade and enlarge existing culverts with known flooding issues. The project sites are at the Glencoe Swale crossing at NW Connell Avenue and the Dawson Creek crossing on NE 47th Avenue. At both sites, the roadways become inundated during large storm events, which causes dangerous conditions for residents and infrastructure.	Flood	High
11	Research and purchase equipment needed for volcanic ash cleanup of roadways and pedestrian facilities.	Volcanic Ash	Low
12	This project would upgrade all of the City's existing heating, ventilation, and air-conditioning (HVAC) systems to better deal with downfall of volcanic ash. Physically installing hoods over air intake would reduce direct ash ingestion into HVAC systems.	Volcanic Ash	Low

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
13	The fuels reduction goals include having nothing burnable within 5 feet of priority buildings and communication sites, maintaining vegetation to heights less than 6" within 30 feet, spacing plants widely (every 100 feet) around buildings, making burn lines, and pruning trees to 8 to 10 feet above ground. This would be accomplished by mowing, thinning, piling, and pile burning as needed. The JWC, BRJOC, and COH plan to create and maintain defensible space and reduce fuel loadings around the following facilities and assets: Cherry Grove Slow Sand Filter Plant (SSFP), Soda Ash Facility, Tualatin Flume, Patton Valley Control Valve, JWC Water Treatment Plant (WTP), and JWC Fernhill Reservoirs.	Wildland Fire	High
14	This project would ensure all of the City's HVAC systems are equipped with means to provide MERV 13 filtration for all the City's HVAC systems. While most of the City's sites do have the ability to use MERV 13 filters, not every system is capable of this. This would give the City the funds to upgrade existing infrastructure to provide MERV 13 filtration for these systems.	Wildland Fire	High
15	Develop a CWPP for the City of Hillsboro. The CWPP will also include actionable tasks that can be taken to prevent or reduce the impact of wildland fires within the City and address the following: determining fuel hazards, assess risk of wildland fire occurrence, identify homes, businesses, and essential infrastructure at risk, and fuel treatment prioritization. The planning project includes a Story Map that will create a highly functional, easy-to-use interface to tell the story of place and people's values in a way that illustrates data-rich science-based information. The Story Map will incorporate important baseline information and will be a place where residents can assess project recommendations, interact with baseline mapping and risk assessment information, and seek real mitigation measures they can take in and around their properties. The Story Map will be designed to be accessible and easily navigable by the public and be available in English and Spanish.	Wildland Fire	High
16	Hillsboro's CWPP will include actionable tasks that can be taken to prevent or reduce the impact of wildland fires within the City and address the following: determining fuel hazards, assess risk of wildland fire occurrence, identify homes, businesses, and essential infrastructure at risk, and fuel treatment prioritization. Using the CWPP as a guide, the City will analyze and implement fuel reduction strategies to reduce the risk and/or spread of wildland fires within the City of Hillsboro.	Wildland Fire	High
17	Evaluate needs for snow/ice response to clear cycle tracks and to purchase equipment if needed.	Winter Storm	Low
18	Install Econolite ZincBlue2 battery backup systems to 11 City of Hillsboro signalized intersections.	Multi-Hazard	Low
19	Construct a new Public Works shop/carport to shelter Public Works equipment and supplies to protect from extreme heat, volcanic ash, inclement weather, and other natural hazards.	Multi-Hazard	Low

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
20	This mitigation action proposes the installation of weather stations at strategic traffic intersections and other areas throughout the City of Hillsboro. Weather stations will collect and transmit live data to Public Works operation and maintenance staff. Data transmitted will include pavement temperatures as well as rainfall data related to microburst storms. By collecting this data, operation and maintenance staff will be able to prioritize their response to specific weather events. Hazards mitigated by the implementation and management of these weather stations involve slippery road conditions due to severe winter weather and potential flooding due to microburst storms. Live data will allow Public Works staff to prioritize response to the most impacted intersections, therefore minimizing harm to City of Hillsboro residents and infrastructure.	Multi-Hazard	Low
21	The City/Clean Water Services Design and Construction Standards need to be revised to expand plant options when new vegetative stormwater management facilities (SMF) are initially constructed or repaired. More heat- and drought-tolerant plants need to be added, such as native succulents or kinnikinnick, for ground cover that require little amounts of maintenance or water to survive, cover soils to better retain soil moisture, and flower during the year to provide pollinator friendly plants throughout the City. Water quality will still be accomplished using plugs and other deep-rooted and drought-tolerant plants. Surrounding heat- and drought-tolerant native vegetation types, such as madrone, western juniper, crape myrtle, western redbud, yarrow, sage, thyme, and yucca variations, should be added to the approved plant list. 50% of all plants selected to be installed in new SMFs should be required to be heat- and drought-tolerant plants. All existing SMFs within the City will eventually need to have the existing vegetation augmented with more drought-tolerant plant types.	Multi-Hazard	Low
22	Research and analyze alternate energy sources and alternate fuel sources to provide backup power in addition to current diesel generators at City-owned facilities. Develop a plan for implementation based on findings and feasibility. Implement plan based on funding availability.	Multi-Hazard	Low
23	This project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of catastrophic failure of the Operations Building and rapid mix system. These assets have not been seismically retrofitted to current standards. Therefore, the facilities are at risk of collapse during a major seismic event. These assets are located in unincorporated Washington County near the City of Forest Grove, Oregon, a western suburb of Portland, which is within the CSZ.	Multi-Hazard	Low

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
24	Seismic retrofit mitigation of the JWC's 2.5-million-gallon Clearwell, including foundation stabilizations, at the WTP. The City of Hillsboro, Oregon, is the managing agency for the JWC. Additional work completed might include seismically resilient finished water pumps and backwash pumps. Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of catastrophic failure of the assets and related infrastructure. These assets have not been seismically retrofitted to current standards. Therefore, the facilities are at risk of collapse during a major seismic event. These assets are located in unincorporated Washington County near the City of Forest Grove, Oregon, a western suburb of Portland, which is within the CSZ.	Multi-Hazard	Low
25	Seismic retrofit mitigation of the JWC's finished water pumps at the water treatment plan. The City of Hillsboro, Oregon, is the managing agency for the JWC. Additional work completed might include seismically resilient finished water pumps and backwash pumps. Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of catastrophic failure of the assets and related infrastructure. These assets have not been seismically retrofitted to current standards. Therefore, the facilities are at risk of collapse during a major seismic event. These assets are located in unincorporated Washington County near the City of Forest Grove, Oregon, a western suburb of Portland, which is within the CSZ.	Multi-Hazard	Medium
26	Create plan to expedite translation of emergency messaging and emergency public information for languages spoken by approximately 1,000 or more limited English proficiency (LEP) individuals in the City of Hillsboro, based on the current census. This plan may include but is not limited to the following: evaluation of current capabilities, identification of in-house resources, pre-scripting of messages, template creation, analysis of processes, and creation of a streamlined process for translation with checklists and/or flowcharts.	Multi-Hazard	Medium
27	Evaluate existing state of fueling capacity for the City (reference Emergency Fuel Reserves, Analyze and Business Case 2/7/2019) and identify gaps and potential solutions. Create a plan to identify a funding and development strategy. Implement plan based on need and funding availability.	Multi-Hazard	Medium
28	Project includes completing an engineering feasibility planning study to evaluate options for small water systems to interconnect to Hillsboro's upper system pipeline or other more reliable water service options. This will improve the resilience of these water systems to drought natural hazards. This area of Oregon has experienced recent drought and wildland fire disaster declarations. These assets are located in/near Hillsboro, Oregon, a western suburb of Portland, which is within the CSZ.	Multi-Hazard	Medium

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
29	Hometown Taps (HTTs) provide easy access to safe, cool water in public locations. Misting tents are used to provide community members a place to cool down during high temperatures. Both are popular and used at organized events, but additional units are needed due to the increased frequency of extreme heat events. The City has an imperative to respond with access to water and cooling for the public in neighborhoods and near community gathering locations, particularly in low-income areas or areas of the City with limited means of transportation. These HTTs can also be deployed and used during other events where there is a water distribution need.	Multi-Hazard	Medium
30	Purchase and deploy software that allows customers to view their water usage and can be used to deliver targeted and systemwide messages to the public, such as boil water notices, curtailment and water supply advisories, locations for emergency water, etc.	Multi-Hazard	Medium
31	This project will mitigate the risk of the JWC having insufficient aluminum sulfate (alum) on-site for the WTP to operate after a major seismic event. After an engineering feasibility planning study, it was determined the amount of alum supply that will be needed on-site to allow continuous WTP operation until the alum delivery service would resume. All alum tanks would be seismically reinforced as part of this project.	Multi-Hazard	Medium
32	This project would add high wind door stop systems to entrances at high-risk locations in the City. These systems would prevent catastrophic damage to entryways and emergency exits. The project would also help determine design language for future city buildings.	Multi-Hazard	Medium
33	Update Department Continuity of Operations Plans.	Multi-Hazard	Medium
34	Update current Human Resources policies that relate to natural hazards. Analyze policies for any gaps in coverage or type, and create policies as needed based on that analysis. Conduct training on updated and new policies.	Multi-Hazard	Medium
35	The City Council adopted a major update to the HCP that took effect in January 2018. Since then, Planning Division staff have been working through the implementation measures of this major update through amendments to the City's CDC. One section within the HCP that still needs to be implemented is Section 9, Natural Hazards. This section addresses policies and goals related to (1) minimizing the impacts of natural hazards on people and property, (2) providing information and services to support hazard preparation and recovery for people of all ages, abilities, cultures, and incomes, (3) improving coordination with public and private partners, (4) building capacity for greater urban resilience, and (5) managing and maintaining spatial, demographic, and economic data to support hazard mitigation planning.	Multi-Hazard	Medium

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
36	The CDC that was adopted by the City Council and took effect in September 2014 included the City's Significant Natural Resource Overlay (SNRO) as well as tree preservation standards. Since that adoption, only minor amendments have been made to the SNRO regulations for consistency with Section 12 of the HCP, for ease of implementation and understanding, and to codify off-site mitigation opportunities. In addition, staff have identified a need to analyze current landscaping recommendations to ensure that species susceptible to drought, pests, and wildland fires are possibly removed from the recommendations.	Multi-Hazard	Medium
37	The CWPP recommends that the City set up the JWC WTP for remote operation in the event of an evacuation. In addition to evacuations, monitoring and operating the treatment plant remotely would ensure worker safety and reliable service in the event of other natural disasters, in addition to wildland fire, that could limit operator accessibility to the WTP (i.e., winter storms, flooding, earthquakes, volcanic ash, etc.). The actions needed to set up the WTP for remote operations would entail upgrading cyber security and training operators on new protocols to access the SCADA system.	Multi-Hazard	Medium
38	This project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate the risk of catastrophic failure of the assets and related infrastructure. These assets have not been seismically retrofitted to current standards. Therefore, the facilities are at risk of collapse during a major seismic event. These assets are located in unincorporated Washington County near the City of Forest Grove, Oregon, a western suburb of Portland, which is within the CSZ.	Multi-Hazard	High
39	Small customers along the pipeline alignment are experiencing unreliable water availability due to drought-induced dry wells. This leads to hardship requests for water service from this pipeline. Two wholesale customers rely on this pipeline for water service: City of Gaston and LA Water Co-Op. This area of Oregon has experienced recent drought and wildland fire disaster declarations. Seismic retrofit of the pipeline will improve the resilience of these water systems and retail customers to earthquake and drought natural hazards.	Multi-Hazard	High
40	This project includes completing an engineering feasibility planning study and then Phase 1 Design and Phase 2 Construction to complete seismic retrofitting to mitigate risk of WTP catastrophic failure after a seismic event. This project would also include additional resilient backup power such as generators or solar panels and power storage. WTP has some power, so need would be assessed during the engineering feasibility study. These assets are at risk of being unusable after a major seismic event. These assets are located in/near Hillsboro, Oregon, a western suburb of Portland, which is within the CSZ.	Multi-Hazard	High

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
41	Develop and have ready to deploy community engagement regarding preparation for and actions during an emergency that has caused a disruption in water service to Hillsboro Water customers. This will also involve outreach to key community groups (i.e., schools, childcare facilities, elder care facilities, medical facilities, etc.) to educate about emergency water supplies and preparation as well as coordinating with community groups to be partners in emergency water supply delivery and information centers.	Multi-Hazard	High
42	One of the pre-fire prevention and mitigation strategies recommended from the CWPP is creating a preventative maintenance and fuels reduction plan with an accompanying facility inventory database. The preventative maintenance and fuels reduction plan will be developed and reevaluated annually and include location-specific maintenance, completion dates, and a fuels treatment plan for assets and resources outlined in the accompanying facility inventory database. This facility inventory database will focus on key assets, vulnerabilities, preventative maintenance schedule, tracking log, and actions that should be taken immediately if a wildland fire or other natural disaster occurs.	Multi-Hazard	High
43	This project will mitigate the risk of the JWC having insufficient fuel for emergency backup generators on-site to operate the WTP after a major seismic event. An engineering feasibility planning study will determine the amount of fuel supply that will be needed on-site to allow continuous WTP operation until it is estimated that fuel delivery service would resume. All fuel tanks would be seismically reinforced as part of this project. Phase 1 Design and Phase 2 Construction project would implement the solution selected from the planning study.	Multi-Hazard	High
44	Analyze current disaster preparedness videos for gaps in content and cultural appropriateness for the City. Expand the video library for specific seismic, wind, snow, and/or flood safety tips and seismic retrofitting for single-family homes. Make all videos in English as well as in at least one other language.	Multi-Hazard	High
45	Purchase revised code books and associated standards. Analyze Oregon residential code revisions based on current model International Residential Code. Analyze outward customer handouts, forms, and web information accordingly. Revise permit system software as needed. Provide appropriate training for all plan review and inspection staff for implementation of these revisions. Implement revised code review and inspection accordingly on all new projects.	Multi-Hazard	High

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
46	The City of Hillsboro serves water to 91,000 customers in Washington County, and in the event of an emergency there is no Emergency Drinking Water Plan that specifies water sources, treatment options, drinking water distribution plans, etc. The intent of this plan would be to determine gaps and enhance the City's recovery plan to provide clean, safe drinking water to the public, including identifying underserved communities. The Water Department would use a consultant to identify where water would be delivered, planning for the recovery of existing sources, conveyance, and methods for setting up emergency treatments and distribution centers for City of Hillsboro customers. The plan would include assessment of groundwater sources that could be used as emergency water supplies. The Water Department has a lot of this information or has had these discussions as the City has worked through its Emergency Response Plans; however, the City does not have all of this information in one location/plan to use more effectively to serve the public following a disaster.	Multi-Hazard	High
47	Seismic retrofit mitigation of the JWC Chemical Building for alum, polymer, and power-activated carbon chemical tanks at the WTP. The City of Hillsboro, Oregon, is the managing agency for the JWC. The project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of catastrophic failure of the building and related infrastructure. These assets have not been seismically retrofitted to current standards. Therefore, the facilities are at risk of collapse during a major seismic event. These assets are located in unincorporated Washington County near the City of Forest Grove, Oregon, a western suburb of Portland, which is within the CSZ.	Multi-Hazard	Low

6.3. Mitigation Action Information Worksheets

Table 143: JWC Water Treatment Plant Remote Operations

Mitigation Action Information			
Title of action	JWC Water Treatment Plant Remote Operations		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	**JWC Water Treatment Plant – Remote Operations** High-value assets owned by the City of Hillsboro, Joint Water Commission, and Barney Reservoir Joint Ownership Commission at risk of being impacted by wildfire have been identified in two documents – the Tualatin Basin Quantitative Wildfire Risk Assessment and Recommendations (2021) by OSU-Extension Service Fire Program and Wildland Fire Associates, and the Tualatin Wildfire Protection Plan (2022) by JWC and Clean Water Services. The Wildfire Protection Plan recommends that we set up the JWC Water Treatment Plant for remote operation in the event of an evacuation. In addition to evacuations, monitoring and operating the treatment plant remotely would ensure worker safety and reliable service in the event of other natural disasters in addition to wildfire that could limit operator accessibility to the WTP, such as winter storms, flooding, earthquakes, volcanic ash, etc. The actions needed to set up the WTP for remote operations would entail upgrading cyber security and training operators on new protocols to access the SCADA system.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☐	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	Remote operation of critical infrastructure like the treatment plant would allow for reliable service during emergency situations when operators could not access the plant.		
Area of action impact			
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? JWC Water Treatment Plant, JWC Fernhill Reservoirs		

Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☒	Goal 7 ☐
Integration into other initiatives	State of Oregon NHMP		
Alignment with existing plans and policies	Wildfire Protection Plan (2022)		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Information Services & JWC WTP		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Information Services, JWC WTP			
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
JWC funds, City budget		HMGP	
Estimated Cost	$100,000		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Uninterrupted water service during emergencies	Employee safety, public health	$600,000	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	1/1/2023	12/31/2026	
Implementation Benchmarks: How Will Success Be Measured?			
Potential Challenges to Implementation			
• Acquiring adequate cybersecurity to allow for remote operations is a challenge			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 144: JWC Alum Storage Mitigation Project

Mitigation Action Information	
Title of action	JWC Alum Storage Mitigation Project
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Project will mitigate the risk of the JWC having insufficient alum on-site for the water treatment plant (WTP) to operate after a major seismic event. After an engineering feasibility planning study, it was determined the amount of alum supply that will be needed on-site to allow continuous WTP operation until the alum delivery service would resume. All alum tanks would be seismically reinforced as part of this project. Phase 1 Design and Phase 2 Construction project would implement the solution selected from the planning study.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☐ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	The JWC WTP currently has 3 alum storage tanks and requires approximately 2 large deliveries per week to maintain adequate supplies. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. After a major earthquake, heavy truck delivery service will be interrupted. Since alum is a critical chemical necessary to treat the raw water entering the WTP, the WTP would need to stop producing drinking water within a few days after a seismic event due to insufficient on-site inventory of alum. It appears that securing additional on-site alum storage may be the least costly mitigation strategy. Also, all alum tanks would be evaluated for needed seismic retrofits. The Phase 1 Design and Phase 2 Construction project would implement the selected solution from the planning study. The secondary natural hazards arise because roads could be damaged or unpassable from various natural hazard events, which could also disrupt drinking water production if on-site alum supplies were depleted. In 2020 a wildland fire extended to across the street from the WTP, which interrupted deliveries for several days. Wildland Fire and Drought natural disaster emergencies have been declared in Oregon in recent years. Without mitigation, the WTP could be crippled within a few days of a major earthquake. It will take at least several days for crews to clear critical transportation routes so that alum deliveries could be restored which would leave the JWC partners without their primary source for drinking water. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event.
Area of action impact	Over 400,000 customers located within Washington County receive their drinking water from the JWC WTP, including some large industrial users. JWC partners include the City of Beaverton, City of Forest Grove, City of Hillsboro, Tualatin Valley Water District, and a wholesale customer, City of North Plains.

Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? These assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.
Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion.*
Alignment with existing plans and policies	This capital project will be included in the Hillsboro Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Senior Program Manager, WTP City of Hillsboro Water Department
Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	JWC Partners, including City of Hillsboro, City of Beaverton, City of Forest Grove, and the Tualatin Valley Water District.

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Joint Water Commission	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant
Estimated Cost	Preliminary planning cost estimate: • $100,000 Engineering feasibility planning study • $500,000 Phase 1 Design and Phase 2 Construction

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Additional alum storage will prolong water production and allow additional time for alum deliveries to be arranged. This could keep water at the tap of 400,000 customers within Washington County.	• Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services.	Study: $600,000 Phases 1 and 2: $3,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet cash flow constraints.	Project could be completed within 1 to 2 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for approximately 6 to 10 years.

Implementation Benchmarks: How Will Success Be Measured?

- Success will be measured by the substantial completion date JWC Alum Storage Mitigation Project.

Potential Challenges to Implementation

- The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Ordering and delivery time of such a tank could be delayed due to the national goods and services pipeline issues.

Resources and References, if Applicable

- JWC/Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event.
- If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Add 12,000-gallon alum storage tank	$277,000	JWC Master Plan, JWC Strategic Plan
Alternative #2	Add 20,000-gallon alum storage tank	$350,000	Would allow for 3 truck load deliveries to fill. Oversized at this time and complicates delivery timing.
Alternative #3	No action – not yet available	$0	Status quo.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 145: Hillsboro Crandall Reservoir to High Pressure Zone Pipeline Mitigation Project

Mitigation Action Information			
Title of action	Hillsboro Crandall Reservoir to High Pressure Zone Pipeline Mitigation Project		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☒	Natural systems protection ☐ Public education/awareness ☐	
Action description	Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of insufficient water storage for industrial microchip manufacturing cluster after a seismic event. These assets are at risk of catastrophic failure during a major seismic event. These assets are located in Hillsboro, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. A planning study will identify alternatives to mitigate the risk that existing water reservoir capacity may be insufficient. Industrial microchip manufacturing requires uninterrupted water service. After a seismic event, Hillsboro Water must provide emergency water service to industrial microchip manufacturers for a period of time to allow these firms to gracefully shut down their operations. A follow-up construction project would implement the best value solution to increase reservoir capacity and install isolation valves, pumps, backup power systems, and necessary telemetry and control systems, and to complete seismic retrofit mitigation on any identified at-risk assets. Early indications are that a lower cost solution might be to provide access to additional existing reservoir capacity. Implementing the selected stored water capacity solution and seismic retrofits will allow emergency water service to continue uninterrupted for a limited period after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Without mitigation, industrial microchip manufacturing identified as in the U.S. national interest would experience very costly forced shutdowns. It could take chip plants months to recover from a forced shutdown due to abrupt loss of water service. With pre-disaster mitigation, chip plants will be able to recover more quickly after a major seismic event.		
Area of action impact	The project will benefit Hillsboro Water's High Pressure Zone (HPZ), which is where several industrial microchip manufacturing plants are located.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? This infrastructure provides water service to industrial microchip manufacturing plants (fabs, chip plants) identified as in the U.S. national interest.		

Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion.*
Alignment with existing plans and policies	This capital project will be included in the Hillsboro Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department
Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	Key industrial microchip manufacturing customers of the Hillsboro Water
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City of Hillsboro, PGE Renewable Development Fund, Energy trust of Oregon, Oregon Department of Energy	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant
Estimated Cost	Preliminary planning cost estimate: • $500,000 Engineering feasibility study • $20,000,000 Phase 1 Design and Phase 2 Construction

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Emergency water service can continue nonstop after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.	After a major earthquake: • Will reduce business interruption and allow businesses to stand back up quicker. • Access to adequate levels of stored water and seismically retrofitted infrastructure will allow industrial microchip manufacturing firms to gracefully shutdown after an earthquake.	Study: $3,000,000 Phases 1 and 2: $120,000,000
Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet cash flow constraints.	Project could be completed within 3 to 5 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for approximately 6 to 10 years.
Implementation Benchmarks: How Will Success Be Measured?		
• Success will be measured by the substantial completion date for the Pipeline Retrofit Mitigation Project.		
Potential Challenges to Implementation		
• The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Otherwise, insufficient emergency stored water will be available to industrial microchip manufacturing plants after a major seismic event. This will lead to unexpected fab plant shutdown, and fab plants could take months to recover.		
Resources and References, if Applicable		
• Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.		

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action – not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 146: Joint Water Commission (JWC) Diesel Fuel Storage Mitigation Project

Mitigation Action Information			
Title of action	Joint Water Commission (JWC) Diesel Fuel Storage Mitigation Project		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Project will mitigate the risk of the Joint Water Commission (JWC) having insufficient fuel for emergency backup generators on-site to operate the water treatment plant (WTP) after a major seismic event. An engineering feasibility planning study will determine the amount of fuel supply that will be needed on-site to allow continuous WTP operation until it is estimated that fuel delivery service would resume. All fuel tanks would be seismically reinforced as part of this project. Phase 1 Design and Phase 2 Construction project would implement the solution selected from the planning study.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	The JWC WTP currently has standby power generators that can provide power to both the water treatment plant and back into the PGE power grid if needed. The generators have been utilized in several emergencies already. The generators have been used in both extreme hot and cold weather, in a local wildland fire, and during regular power outages. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. After a major earthquake, heavy truck delivery service will be interrupted. Since power is necessary for pumps and infrastructure to operate and treat the raw water entering the WTP, the WTP would need to stop producing drinking water within a few days after a seismic event due to a power outage. The current 15,000 gallon fuel tank provides enough fuel for about 48 hours of operation. The engineering planning study will evaluate options to mitigate this natural hazard risk. It appears that securing additional on-site fuel storage may be the least costly mitigation strategy. Also, all fuel tanks would be evaluated for needed seismic retrofits. The Phase 1 Design and Phase 2 Construction project would implement the selected solution from the planning study. The secondary natural hazards arise because roads could be damaged or unpassable from various natural hazard events, which could also disrupt drinking water production if backup power is lost. In 2020 a wildland fire extended to across the street from the WTP, which interrupted deliveries for several days. Wildland fire and drought natural disaster emergencies have been declared in Oregon in recent years. Without mitigation, the WTP could be crippled within a few days of a major earthquake. It will take at least several days for crews to clear critical transportation routes so that fuel deliveries could be restored, which would leave the JWC partners without their primary source for drinking water. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event.		

Area of action impact	Over 400,000 customers located within Washington County receive their drinking water from the JWC WTP, including some large industrial microchip manufacturing users.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? These assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.
Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion.*
Alignment with existing plans and policies	This capital project will be included in the Hillsboro Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Senior Program Manager, WTP City of Hillsboro Water Department
Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	JWC Partners, including City of Hillsboro, City of Beaverton, City of Forest Grove and the Tualatin Valley Water District.

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Joint Water Commission	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant
Estimated Cost	Preliminary planning cost estimate: • $100,000 Engineering feasibility planning study • $500,000 Phase 1 Design and Phase 2 Construction

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Additional fuel storage will prolong water production and allow additional time for fuel deliveries to be arranged. This could keep water at the tap of 400,000 customers within Washington County.	• Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services. • Will reduce power demands on the PGE system during an emergency.	Study: $600,000 Phases 1 and 2: $3,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet cash flow constraints.	Project could be completed within 1 to 2 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for approximately 6 to 10 years.

Implementation Benchmarks: How Will Success Be Measured?
• Success will be measured by the substantial completion date for the JWC Diesel Fuel Storage Mitigation Project.

Potential Challenges to Implementation
• The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Ordering and delivery time of such a tank could be delayed due to the national goods and services pipeline issues.

Resources and References, if Applicable
• JWC/Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Add 15,000-gallon diesel fuel tank	$174,000	This is preferred option so that both tanks are the same size.
Alternative #2	Add 20,000-gallon diesel fuel tank	$225,000	Larger tank would create hydraulic differences between the two tanks resulting in poor fuel turnover.
Alternative #3	No action – not yet available	$0	Status quo.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 147: City of Hillsboro Emergency Drinking Water Plan

Mitigation Action Information			
Title of action	City of Hillsboro Emergency Drinking Water Plan		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐		Natural systems protection ☐ Public education/awareness ☐
Action description	The City of Hillsboro serves water to 91,000 customers in Washington County, and in the event of an emergency, there is no Emergency Drinking Water Plan that specifies water sources, treatment options, drinking water distribution plans, etc. The intent of this plan would be to determine gaps and enhance our recovery plan to provide clean, safe drinking water to the public, including identifying underserved communities. The Water Department would use a consultant to identify where water sources could be accessible post-event, determine how and where that water would be delivered, plan for the recovery of existing sources, conveyance, and devise methods for setting up emergency treatment and distribution centers for COH customers. The Plan would include assessment of groundwater sources that could be used as emergency water supplies. The Water Department has a lot of this information or has had these discussions as we've worked through our Emergency Response Plans; however, we do not have all of this information in one location/plan to use to more effectively to serve the public following a disaster.		
Hazard(s) addressed	Dam failure ☐ Drought ☒ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☐ Volcanic ash ☐ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	The vulnerability addressed is minimizing the loss of life and minimizing additional public health issues by being able to deliver clean, high-quality water to the public following an emergency event. Post-hazard we need to identify how we can serve our population, including some of our underserved communities.		
Area of action impact	Citywide		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☒	Goal 7 ☒
Integration into other initiatives	Regional Water Providers Drinking Water Framework Plan		
Alignment with existing plans and policies	Regional Water Providers Drinking Water Framework Plan, City of Hillsboro Water Department Emergency Response Plan, State NHMP		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☐ High ☒		
Lead position, office, department, or division responsible for implementation	City of Hillsboro Water Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Emergency Management, Police, Fire and Planning			
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
City Budget, RDPO UASI Grant		EPA – WIIN Act Grant, HMGP	
Estimated Cost	$300,000		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Efficiently providing safe drinking water to the public	Identifying new and additional drinking water sources	$1,800,000	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	July 2023	June 2024	
Implementation Benchmarks: How Will Success Be Measured?			
• The completion of the plan			
Potential Challenges to Implementation			
• Coordination with other departments and compiling internal documents			
Resources and References, if Applicable			
• Emergency Response Plan			
Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
	Do nothing	$0	
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 148: JWC Chemical Building Seismic Retrofit Mitigation Project

Mitigation Action Information	
Title of action	JWC Chemical Building Seismic Retrofit Mitigation Project
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Seismic retrofit mitigation of the Joint Water Commission (JWC) Chemical Building for alum, polymer, and power-activated carbon chemical tanks at the water treatment plant. The City of Hillsboro, Oregon, is the managing agency for the JWC. Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of catastrophic failure of the building and related infrastructure. These assets have not been seismically retrofitted to current standards. Therefore, the facilities are at risk of collapse during a major seismic event. These assets are located in unincorporated Washington County near the City of Forest Grove, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☒ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. An engineering feasibility planning study will identify alternatives to mitigate the earthquake natural hazard risk. Then, a follow-up Phase 1 Design and Phase 2 Construction project to implement seismic retrofit of the building and related infrastructure will allow water service to resume shortly after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Secondary risk is drought. Climate change–induced drought is leading to private wells drying up, which leads to hardship requests for water service. The Chemical Building is occupied by JWC staff and is an integral component for operating the water treatment plant. Without a seismic retrofit, life safety risk of casualties is increased and time to stand back up the water treatment plant will be greatly increased. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event.
Area of action impact	The JWC water treatment plant is a regional service provider for customers in the Oregon cities of Beaverton, Hillsboro, and Forest Grove and the Tualatin Valley Water District. The city of North Plains is a JWC wholesale customer.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? JWC assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.

Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion*.
Alignment with existing plans and policies	This capital project will be included in the Hillsboro and JWC Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department
Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	City of Beaverton, City of Forest Grove, Tualatin Valley Water District, City of North Plains
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
JWC partners, including City of Beaverton, City of Forest Grove, City of Hillsboro, and Tualatin Valley Water District	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant
Estimated Cost	Preliminary planning cost estimate: • $150,000 Engineering feasibility study • $12,100,000 Phase 1 Design and Phase 2 Construction

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Seismic retrofit will allow water service to resume shortly after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.	After a major earthquake: • Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services.	Study: $900,000 Construction: $72,600,000
Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro/JWC's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet partner cash flow constraints.	Project could be completed within 6 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for approximately 10 years.
Implementation Benchmarks: How Will Success Be Measured?		
• Success will be measured by the substantial completion date for the JWC Chemical Building Seismic Retrofit Mitigation Project.		
Potential Challenges to Implementation		
• The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Otherwise, assets will remain seismically deficient and at greater risk of catastrophic failure for many months after a major seismic event.		
Resources and References, if Applicable		
• JWC/Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.		

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action – not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 149: JWC Clearwell Seismic Retrofit Mitigation Project

Mitigation Action Information			
Title of action	JWC Clearwell Seismic Retrofit Mitigation Project		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Seismic retrofit mitigation of the Joint Water Commission's (JWC) 2.5 million gallon Clearwell, including foundation stabilization, at the water treatment plant. The City of Hillsboro, Oregon, is the managing agency for the JWC. Additional work completed might include seismically resilient finished water pumps and backwash pumps. Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of catastrophic failure of the assets and related infrastructure. These assets have not been seismically retrofitted to current standards. Therefore, the facilities are at risk of collapse during a major seismic event. These assets are located in unincorporated Washington County near the City of Forest Grove, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☒	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. An engineering feasibility planning study will identify alternatives to mitigate the earthquake natural hazard risk. Then, a follow-up Phase 1 Design and Phase 2 Construction project to implement seismic retrofit of the Clearwell and related infrastructure will allow water service to resume shortly after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Secondary risk is drought. Climate change–induced drought is leading to private wells drying up, which leads to hardship requests for water service. Without a seismic retrofit, life safety risk of casualties is increased and time to stand back up the water treatment plant will be greatly increased. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event.		
Area of action impact	The JWC water treatment plant is a regional service provider for customers in the Oregon cities of Beaverton, Hillsboro, and Forest Grove and the Tualatin Valley Water District. The city of North Plains is a JWC wholesale customer.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? JWC assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.		

Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion.*
Alignment with existing plans and policies	This capital project will be included in the Hillsboro and JWC Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department
Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	City of Beaverton, City of Forest Grove, Tualatin Valley Water District, City of North Plains.

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
JWC partners, including City of Beaverton, City of Forest Grove, City of Hillsboro, and Tualatin Valley Water District	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant
Estimated Cost	Preliminary planning cost estimate: • $500,000 Engineering feasibility study • $52,700,000 Phase 1 Design and Phase 2 Construction

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Seismic retrofit will allow water service to resume shortly after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.	After a major earthquake: • Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services.	Study: $3,000,000 Phases 1 and 2: $316,200,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro/JWC's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet partner cash flow constraints.	Project could be completed within 6 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for over 10 years.

Implementation Benchmarks: How Will Success Be Measured?
• Success will be measured by the substantial completion date for the JWC Chemical Building Seismic Retrofit Mitigation Project.

Potential Challenges to Implementation
• The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Otherwise, assets will remain seismically deficient and at greater risk of catastrophic failure for many months after a major seismic event.

Resources and References, if Applicable
• JWC/Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action – not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 150: JWC Finished Water Pumps Seismic Retrofit Mitigation Project

Mitigation Action Information			
Title of action	JWC Finished Water Pumps Seismic Retrofit Mitigation Project		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Seismic retrofit mitigation of the Joint Water Commission's (JWC) Finished Water Pumps at the water treatment plant. The City of Hillsboro, Oregon, is the managing agency for the JWC. Additional work completed might include seismically resilient finished water pumps and backwash pumps. Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of catastrophic failure of the assets and related infrastructure. These assets have not been seismically retrofitted to current standards. Therefore, the facilities are at risk of collapse during a major seismic event. These assets are located in unincorporated Washington County near the City of Forest Grove, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).		
Hazard(s) addressed	Dam failure ☐ Drought ☒ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. An engineering feasibility planning study will identify alternatives to mitigate the earthquake natural hazard risk. Then, a follow-up Phase 1 Design and Phase 2 Construction project to implement seismic retrofit of the Finished Water Pumps and related infrastructure will allow water service to resume shortly after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Secondary risk is drought. Climate change–induced drought is leading to private wells drying up, which leads to hardship requests for water service. Without a seismic retrofit, life safety risk of casualties is increased and time to stand back up the water treatment plant will be greatly increased. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event.		
Area of action impact	The JWC water treatment plant is a regional service provider for customers in the Oregon cities of Beaverton, Hillsboro, and Forest Grove and the Tualatin Valley Water District. The city of North Plains is a JWC wholesale customer.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? JWC assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.		

Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion.*
Alignment with existing plans and policies	This capital project will be included in the Hillsboro and JWC Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	City of Beaverton, City of Forest Grove, Tualatin Valley Water District, City of North Plains.

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
JWC partners, including City of Beaverton, City of Forest Grove, City of Hillsboro, and Tualatin Valley Water District	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant

Estimated Cost	Preliminary planning cost estimate: • $200,000 Engineering feasibility study • $11,100,000 Phase 1 Design and Phase 2 Construction

<table>
<tr><th colspan="3">Estimated Benefit</th></tr>
<tr><th>Primary Benefit(s)</th><th>Secondary Benefit(s)</th><th>Financial Benefit(s)</th></tr>
<tr><td>Seismic retrofit will allow water service to resume shortly after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.</td><td>After a major earthquake:
Will reduce business interruption and allow businesses to stand back up quicker.
Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate.
Will maintain fire protection services.</td><td>Study: $1,200,000
Phases 1 and 2: $66,600,000</td></tr>
<tr><th colspan="3">Project Timeline</th></tr>
<tr><th>Expected Timeline for Completion</th><th>Potential Start Date</th><th>Potential Completion Date</th></tr>
<tr><td>Short-term (1–2 yrs.) ☐
Mid-term (3–5 yrs.) ☐
Long-term (6+ yrs.) ☒
Ongoing ☐</td><td>Start date depends greatly on Hillsboro/JWC’s ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet partner cash flow constraints.</td><td>Project could be completed within 8 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for over 10 years.</td></tr>
<tr><th colspan="3">Implementation Benchmarks: How Will Success Be Measured?</th></tr>
<tr><td colspan="3">Success will be measured by the substantial completion date for the JWC Finished Water Pumps Seismic Retrofit Mitigation Project.</td></tr>
<tr><th colspan="3">Potential Challenges to Implementation</th></tr>
<tr><td colspan="3">The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Otherwise, assets will remain seismically deficient and at greater risk of catastrophic failure for many months after a major seismic event.</td></tr>
<tr><th colspan="3">Resources and References, if Applicable</th></tr>
<tr><td colspan="3">JWC/Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA’s BCA spreadsheet with details for an earthquake natural hazard event.
If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.</td></tr>
</table>

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action – not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 151: JWC North and South Transmission Pipelines Seismic Retrofit Mitigation Project

Mitigation Action Information	
Title of action	JWC North and South Transmission Pipelines Seismic Retrofit Mitigation Project
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Seismic retrofit mitigation of the Joint Water Commission's (JWC) primary water transmission pipelines, the North Transmission Line (NTL) and the South Transmission Line (STL). The City of Hillsboro, Oregon, is the managing agency for the JWC. These assets are located in/near Hillsboro, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ). Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of catastrophic failure of these assets. These assets are at risk of catastrophic failure during a major seismic event. A preliminary assessment for insurance purposes identified the older STL as at highest risk of catastrophic failure after an earthquake, while the NTL would sustain major damage but might be viable at reduced pressure in an emergency.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. An engineering feasibility planning study will identify alternatives to mitigate the seismic natural hazard risk for the NTL and STL. Then, a follow-up Phase 1 Design and Phase 2 Construction project would implement the best value solution to seismically strengthen these large diameter water transmission pipelines. Implementing the seismic retrofits will allow emergency water service to be delivered sooner after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Without mitigation, the NTL and STL could experience catastrophic failure, which would cripple the JWC's ability to deliver water to partners even if the water treatment plant can be returned to service quickly after a seismic event. It could take several months to search for damage as the pipelines are located underground and under roads, etc., and then to effect emergency repairs. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event.
Area of action impact	The JWC is a regional service provider for customers in the Oregon cities of Beaverton, Hillsboro, and Forest Grove and the Tualatin Valley Water District. The city of North Plains is a JWC wholesale customer.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? JWC assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.

<table>
<tr><th colspan="3">Mitigation Action Integration</th></tr>
<tr><td>Alignment with NHMP goals</td><td colspan="2">Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events.
Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure
Goal 2 ☒ Effective mitigation strategies and funding
Goal 3 ☐ Natural hazard education and outreach programs
Goal 4 ☐ Adopt policies and standards
Goal 5 ☐ Enhance communication, collaboration
Goal 6 ☒ Align mitigation strategies with local comprehensive plans
Goal 7 ☒ Enhance economies to rebound quickly</td></tr>
<tr><td>Integration into other initiatives</td><td colspan="2">Aligns with Hillsboro Water's Strategic Plan Goal 2: Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.
A Hillsboro Water Guiding Principle is: Protection of public health is the Hillsboro Water Department's number one priority.
Aligns with City Council Guiding Principles:
• We are prepared and resilient.
• We are exceptional public stewards.
• We are a safe community.
• We exemplify diversity, equity, and inclusion.</td></tr>
<tr><td>Alignment with existing plans and policies</td><td colspan="2">This capital project will be included in the Hillsboro and JWC Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.</td></tr>
<tr><th colspan="3">Mitigation Action Implementation Plan</th></tr>
<tr><td>Priority</td><td colspan="2">Low ☐ Medium ☐ High ☒</td></tr>
<tr><td>Lead position, office, department, or division responsible for implementation</td><td colspan="2">Senior Program Manager
City of Hillsboro Water Department</td></tr>
<tr><th colspan="3">Supporting Partners</th></tr>
<tr><th colspan="2">Internal Partners</th><th>External Partners, Including Community Partners</th></tr>
<tr><td colspan="2">Finance Department Grant Administration</td><td>City of Beaverton, City of Forest Grove, Tualatin Valley Water District, City of North Plains.</td></tr>
<tr><th colspan="3">Potential Funding Sources</th></tr>
<tr><th colspan="2">Non-Federal Funding Sources</th><th>Federal Funding Sources</th></tr>
<tr><td colspan="2">City of Hillsboro</td><td>FEMA BRIC, HMGP
USDA Rural Development
Congressionally directed grant</td></tr>
<tr><td>Estimated Cost</td><td colspan="2">Preliminary planning cost estimate:
• $3,578,000 Transmission line condition engineering assessment
• $32,000,000 Phase 1 Design and Phase 2 Construction</td></tr>
</table>

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Seismic retrofit will allow water service to resume shortly after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.	After a major earthquake: • Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services.	Study: $21,468,000 Phases 1 and 2: $192,000,000
Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet cash flow constraints.	Project could be completed within 3 to 5 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for approximately 6 to 10 years.
Implementation Benchmarks: How Will Success Be Measured?		
• Success will be measured by the substantial completion date for the JWC North and South Transmission Pipelines Seismic Retrofit Mitigation Project.		
Potential Challenges to Implementation		
• The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Otherwise, assets will remain seismically deficient and at greater risk of catastrophic failure for many months after a major seismic event. • Other challenges will include permitting and scheduling of work as pipeline work will impact roads, businesses, residences, etc.		
Resources and References, if Applicable		
• JWC/Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.		

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action – not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 152: JWC Operations Building and Rapid Mix Retrofit Mitigation Project

Mitigation Action Information			
Title of action	JWC Operations Building and Rapid Mix Retrofit Mitigation Project		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Seismic retrofit mitigation of the Joint Water Commission (JWC) Operations Building and rapid mix system at the water treatment plant. The City of Hillsboro, Oregon is the managing agency for the JWC. Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of catastrophic failure of the Operations Building and rapid mix system. These assets have not been seismically retrofitted to current standards. Therefore, the facilities are at risk of collapse during a major seismic event. These assets are located in unincorporated Washington County near the City of Forest Grove, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☒	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. An engineering feasibility planning study will identify alternatives to mitigate the earthquake natural hazard risk. Then, a follow-up Phase 1 Design and Phase 2 Construction project to implement seismic retrofit of the building and rapid mix asset will allow water service to resume shortly after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Secondary risk is drought. Climate change–induced drought is leading to private wells drying up, which leads to hardship requests for water service. The Operations Building is occupied by JWC staff and is an integral component for operating the water treatment plant. Without a seismic retrofit, life safety risk of casualties is increased and time to stand back up the water treatment plant will be greatly increased. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event.		
Area of action impact	The JWC water treatment plant is a regional service provider for customers in the Oregon cities of Beaverton, Hillsboro, and Forest Grove and the Tualatin Valley Water District. The city of North Plains is a JWC wholesale customer.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? JWC assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.		

Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion.*
Alignment with existing plans and policies	This capital project will be included in the Hillsboro and JWC Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department
Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	City of Beaverton, City of Forest Grove, Tualatin Valley Water District, City of North Plains
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
JWC partners, including City of Beaverton, City of Forest Grove, City of Hillsboro, and Tualatin Valley Water District	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant
Estimated Cost	Preliminary planning cost estimate. • $250,000 Engineering feasibility study • $14,500,000 Phase 1 Design and Phase 2 Construction

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Seismic retrofit will allow water service to resume shortly after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.	After a major earthquake: • Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services.	Study: $1,500,000 Phases 1 and 2: $87,000,000
Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro/JWC's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet partner cash flow constraints.	Project could be completed within 3 to 5 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for approximately 6 to 10 years.
Implementation Benchmarks: How Will Success Be Measured?		
• Success will be measured by the substantial completion date for the JWC Operations Building and Rapid Mix Retrofit Mitigation Project.		
Potential Challenges to Implementation		
• The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Otherwise, assets will remain seismically deficient and at greater risk of catastrophic failure for many months after a major seismic event.		
Resources and References, if Applicable		
• JWC/Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.		

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action — not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 153: JWC Raw Water Intake Facility Seismic Retrofit Mitigation Project

Mitigation Action Information			
Title of action	JWC Raw Water Intake Facility Seismic Retrofit Mitigation Project		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Seismic retrofit mitigation of the Joint Water Commission's (JWC) Raw Water Intake Facility. The City of Hillsboro, Oregon, is the managing agency for the JWC. Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of catastrophic failure of the assets and related infrastructure. These assets have not been seismically retrofitted to current standards. Therefore, the facilities are at risk of collapse during a major seismic event. These assets are located in unincorporated Washington County near the City of Forest Grove, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☒	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. An engineering feasibility planning study will identify alternatives to mitigate the earthquake natural hazard risk. Then, a follow-up Phase 1 Design and Phase 2 Construction project to implement seismic retrofit of the Raw Water Intake Facility and related infrastructure will allow water service to resume shortly after a major seismic event. Land purchase may be required for siting Raw Water Intake Facility if engineering feasibility determines that it would be more costly to retrofit the existing facility. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Secondary risk is drought. Climate change–induced drought is leading to private wells drying up, which leads to hardship requests for water service. Without a seismic retrofit, life safety risk of casualties is increased and time to stand back up the water treatment plant will be greatly increased. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event.		
Area of action impact	The JWC water treatment plant is a regional service provider for customers in the Oregon cities of Beaverton, Hillsboro, and Forest Grove and the Tualatin Valley Water District. The city of North Plains is a JWC wholesale customer.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? JWC assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.		

Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and* inclusion.
Alignment with existing plans and policies	This capital project will be included in the Hillsboro and JWC Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	City of Beaverton, City of Forest Grove, Tualatin Valley Water District, City of North Plains.

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
JWC partners, including City of Beaverton, City of Forest Grove, City of Hillsboro, and Tualatin Valley Water District	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant
Estimated Cost	Preliminary planning cost estimate: • $500,000 Engineering feasibility study • $50,000,000 Phase 1 Design and Phase 2 Construction

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Seismic retrofit will allow water service to resume shortly after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.	After a major earthquake: • Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services.	Study: $3,000,000 Phases 1 and 2: $300,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro/JWC's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet partner cash flow constraints.	Project could be completed within 8 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for over 10 years.

Implementation Benchmarks: How Will Success Be Measured?

- Success will be measured by the substantial completion date for the JWC Raw Water Intake Facility Seismic Retrofit Mitigation Project.

Potential Challenges to Implementation

- The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Otherwise, assets will remain seismically deficient and at greater risk of catastrophic failure for many months after a major seismic event.
- A unique obstacle is that the federal government owns the Raw Water Intake Facility which has not been seismically retrofitted. Therefore, obtaining permits, approvals, rights of way, etc., will be more complicated.

Resources and References, if Applicable
• JWC/Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action – not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 154: Hillsboro Pipeline Retrofit Mitigation Project

Mitigation Action Information	
Title of action	Hillsboro Pipeline Retrofit Mitigation Project
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate and seismically retrofit pipelines and related infrastructure in Hillsboro's Water distribution system. These assets are at risk of catastrophic failure during a major seismic event. These assets are located in Hillsboro, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. Planning study will identify at-risk pipelines and related infrastructure. Follow-up construction project will seismically retrofit and mitigate identified natural hazard risks. Seismic retrofit of these assets will allow water service to resume shortly after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Without mitigation, life safety risk of interrupted water service could impact critical services such as hydrants, lifeline facilities, and industrial microchip manufacturing identified as in the U.S. national interest. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event.
Area of action impact	The project will impact the Hillsboro Water service area, which includes census tracts identified as medium to high vulnerability on the CDC's Social Vulnerability index scale.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? This infrastructure provides water service, which is a *Food, Water, Shelter Critical Lifeline*.

Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion.*
Alignment with existing plans and policies	This capital project will be included in the Hillsboro Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department
Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	Businesses, residences, and industrial microchip manufacturing customers of Hillsboro Water
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City of Hillsboro	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant
Estimated Cost	Preliminary planning cost estimate: • $300,000 Engineering feasibility study • $3,500,000 Phase 1 Design and Phase 2 Construction

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Seismic retrofit will allow water service to resume shortly after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.	After a major earthquake: • Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services.	Study: $1,800,000 Phases 1 and 2: $21,000,000
Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet cash flow constraints.	Project could be completed within 3 to 5 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for approximately 6 to 10 years.
Implementation Benchmarks: How Will Success Be Measured?		
• Success will be measured by the substantial completion date for the Pipeline Retrofit Mitigation Project.		
Potential Challenges to Implementation		
• The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Otherwise, assets will remain seismically deficient and at greater risk of catastrophic failure for many months after a major seismic event.		
Resources and References, if Applicable		
• Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.		

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action – not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 155: Hillsboro Water System Power Resilience Mitigation Project

Mitigation Action Information			
Title of action	Hillsboro Water System Power Resilience Mitigation Project		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	Project includes completing an engineering feasibility planning study and then a Phase 1 Design and Phase 2 Construction project to mitigate risk of power loss to Water critical lifeline assets after a seismic event. These assets are at risk of being unusable after a major seismic event until power can be restored. These assets are located in Hillsboro, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. A planning study will identify alternatives to mitigate the risk that power could be lost for critical water system assets. This would render these assets unusable until power could be restored. Implementing the selected power resilience solution and seismic retrofits will allow emergency water service to continue or to be restarted more quickly after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Resilience solutions might include alternative power generation systems, such as generators, solar, and hydroelectric generators, located at reservoir, pump, and pressure-reducing valve sites with backup storage systems. Microsystems with backup storage might be used to provide resilient power for SCADA and other telemetry systems located across the water distribution system. Without mitigation, certain water assets would be unusable until power could be restored. These assets include certain pumps, pressure reducing valves, and SCADA telemetry systems. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event.		
Area of action impact	The project will benefit Hillsboro Water's business and residential customers and the City of Cornelius, City of Gaston, and LA Water Co-Op, which are wholesale partners.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? These assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.		

Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion.*
Alignment with existing plans and policies	This capital project will be included in the Hillsboro Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department
Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	Business and residential customers. City of Cornelius, City of Gaston, LA Water Co-Op

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City of Hillsboro Potential grants: PGE Renewable Development Fund, Energy Trust of Oregon, Oregon Department of Energy	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant

Estimated Cost	Preliminary planning cost estimate: • $150,000 Engineering feasibility study of Hillsboro's water system • $15,000,000 Phase 1 Design and Phase 2 Construction of alternative power generation with on-site power storage systems at major water infrastructure sites and microgeneration systems with local power storage for identified SCADA and other water infrastructure locations needing resilient power

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Resilient power will allow water service to resume shortly after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.	After a major earthquake: • Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection service.	Study: $900,000 Phases 1 and 2: $90,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet cash flow constraints.	Project could be completed within 3 to 5 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for approximately 6 to 10 years.

Implementation Benchmarks: How Will Success Be Measured?
• Success will be measured by the substantial completion date for the Water System Power Resilience Mitigation Project.

Potential Challenges to Implementation
• The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Other challenges might include securing permits and right of ways.

Resources and References, if Applicable
• Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action – not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 156: Hillsboro Small Water Provider Resilience Planning Project

Mitigation Action Information	
Title of action	Hillsboro Small Water Provider Resilience Planning Project
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Project includes completing an engineering feasibility planning study to evaluate options for small water systems to interconnect to Hillsboro's upper system pipeline or other more reliable water service options. This will improve the resilience of these water systems to drought natural hazards. This area of Oregon has experienced recent drought and wildfire disaster declarations. These assets are located in/near Hillsboro, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☒ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Drought is the primary natural hazard. A planning study will identify alternatives to mitigate the risk of small water systems with unreliable water sources from being without water. Certain small water providers in the region have identified that their water sources are becoming unreliable due to more severe drought natural hazard impacts. The engineering feasibility study would evaluate options for more reliable water supply, including potentially installing pipelines and interconnection infrastructure for emergency water service or wholesale water service from the upper system pipeline. Secondary risk is earthquake. Engineering study would also recommend seismic retrofits to critical pipelines and related assets to reduce the time needed to restore water service after a major seismic event. Seismic retrofit of these assets will allow water service to resume shortly after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Without mitigation, life safety risk of interrupted water service could impact critical services such as hydrants, lifeline facilities, and business and residential customers for these small water systems. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event. These small water systems serve rural census tracts, some with high CDC social vulnerability index scores. These populations have already endured distress from COVID pandemic impacts. Water service failure would leave vulnerable residents for an extended period, possibly months, without water service. Temporary relocation could have disparate impacts on vulnerable populations. As has been evidenced with hurricanes in the New Orleans area, distressed communities are often more place-bound due to lack of personal transportation, insufficient ready cash, and other limitations. These populations are more often left behind. ABC News reported, "That was one of the real failings with Katrina. People who don't have money to pay for a hotel room or don't have a car of their own stayed behind." Therefore, this mitigation project will greatly benefit distressed communities. Washington County is identified with about 32% of population as medium-to-high social vulnerability.
Area of action impact	Water customers located in rural Washington County served by these small water providers.

Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? These assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.
Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☒ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion.*
Alignment with existing plans and policies	This capital project will be included in the Hillsboro Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department
Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	Small, at-risk water systems in Washington County

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City of Hillsboro and small water systems	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant
Estimated Cost	Preliminary planning cost estimate: • $500,000 Engineering feasibility study • Phase 1 Design and Phase 2 Construction would be based on which small providers elect to move forward.

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Small water systems at risk due to unreliable water sources would be able to explore emergency backup water service options.	Drought and earthquake risks would be mitigated: • Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services.	$3,000,000 for study. Phase 1 and 2 benefit is dependent on direction.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro's and small partners' ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet cash flow constraints.	Project could be completed within 3 to 5 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for approximately 6 to 10 years.

Implementation Benchmarks: How Will Success Be Measured?
• Success will be measured by the substantial completion date for the Small Water Provider Resilience Planning Project.

Potential Challenges to Implementation
• The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible. Other obstacles could include permitting, right of ways, etc.

Resources and References, if Applicable
• Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to small system approval and securing funding.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action – Not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 157: Hillsboro Upper System Pipeline Retrofit Mitigation Project

Mitigation Action Information			
Title of action	Hillsboro Upper System Pipeline Retrofit Mitigation Project		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Phase 1 Design and Phase 2 Construction project to complete seismic retrofit mitigation of water pipeline serving rural Washington County, Oregon. An engineering feasibility study has been completed. These assets are located in/near Hillsboro, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ). The pipeline serves customers in rural Washington county. Small well customers along the pipeline alignment are experiencing unreliable water availability due to drought climate induced dry wells. This leads to hardship requests for water service from this pipeline. Two wholesale customers rely on this pipeline for water service: City of Gaston and LA Water Co-Op. This area of Oregon has experienced recent drought and wildfire disaster declarations. Seismic retrofit of the pipeline will improve the resilience of these water systems and retail customers to earthquake and drought natural hazards.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☒	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. Seismic retrofit of the water pipeline and related infrastructure will allow water service to resume shortly after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Secondary risks are drought and wildland fires. Climate change–induced drought is leading to private wells drying up, which leads to hardship requests for water service. Also, this water system will provide bulk water to crews fighting wildland fires in the area. These assets have not been seismically retrofitted to current seismic standards. Seismic retrofit of these assets will allow water service to resume shortly after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Mitigation would comprise seismic retrofitting of assets and additional resilient backup power system, such as generators or solar panels with power storage, to ensure backup power will be available if primary power is unavailable after an earthquake. Without mitigation, life safety risk of interrupted water service could impact critical services such as hydrants, lifeline facilities, and business and residential customers. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event. This WTP serves rural census tracts with high CDC social vulnerability index scores. These populations have already endured distress from COVID pandemic impacts. Therefore, WTP could experience catastrophic failure due to climate change and natural hazards. WTP failure would leave vulnerable		

	residents for an extended period, possibly months, without water service. Temporary relocation could have disparate impact on vulnerable populations. As has been evidenced with hurricanes in the New Orleans area, distressed communities are often more place-bound due to lack of personal transportation, insufficient ready cash, and other limitations. These populations are more often left behind. ABC News reported, "That was one of the real failings with Katrina. People who don't have money to pay for a hotel room or don't have a car of their own stayed behind." Therefore, this mitigation project will greatly benefit distressed communities. Washington County is identified with about 32% of population as medium-to-high social vulnerability.
Area of action impact	Water customers located in rural Washington County are served by this water pipeline. This includes residential and commercial customers and the City of Gaston and the LA Water Co-Op.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? The upper system pipeline and related infrastructure provides water service, which is a *Food, Water, Shelter Critical Lifeline*.
Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify* diversity, equity, and inclusion.
Alignment with existing plans and policies	This capital project is included in the Hillsboro Water Capital Improvement Program (CIP) budget which has been published and reviewed at budget-related public meetings.

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☐ High ☒		
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Finance Department Grant Administration		City of Gaston, LA Water Co-Op, Commercial and residential customers served by upper system pipeline, Washington County	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
Hillsboro Water		FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant	
Estimated Cost	Phase 1 Design and Phase 2 Construction preliminary estimates: • AACE class 5 estimates totaling $77.4M: o Segment 1: $6.5M o Segment 2: $6.5M o Segment 3: $4.3M o Segment 4: $7.0M o Segment 5: $8.5M o Segment 6: $7.5M o Segment 7: $8.0M o Segment 8 – High SVI: $11.6M o Segment 9 – High SVI: $10.0M o Segment 10: $7.5M • Staff costs, soft costs, escalation: $5,500,000 Total Cost: $83,000,000		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Seismic retrofit will allow water service to resume shortly after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.	After a major earthquake: • Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services.	Total benefit: $498,000,000	

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to avoid an unsustainable rate increase shock.	Each project segment could be completed within 3 to 5 years of securing 75% or greater grant funding. Without grant funding, perhaps one segment every 3 to 5 years would proceed.

Implementation Benchmarks: How Will Success Be Measured?

- Success will be measured by the substantial completion date for each pipeline segment.

Potential Challenges to Implementation

- The greatest obstacle or challenge will be securing about $60 million in federal grant funds to complete all pipeline segment projects as quickly as possible. Otherwise, pipeline segments will remain seismically deficient and at greater risk of catastrophic failure for many months after a major seismic event.

Resources and References, if Applicable

- Hillsboro Water has completed a preliminary engineering feasibility study that identified pipeline segments, evaluated alternatives for remediation, and provided cost estimates. The engineering report also provided alternative costs to complete work in a manner that reduces disruptive impacts on vulnerable populations during construction—for example, trenchless work at critical transportation arteries.
- For this project, Phase 1 Design and Phase 2 Construction can move forward as soon as funding is secured.

Three Alternatives Considered, Including No Action

	Action Description	Estimated Cost	Evaluation
Alternative #1	No action, keep existing pipe	N/A	Because this alternative would result in a major service disruption, a cost estimate was not calculated at the preliminary design stage. When Hillsboro prepares a FEMA grant application, a detailed analysis of cost impacts will be prepared using FEMA's BCA spreadsheet.

Alternative #2	Segment 1: Sliplining/CIPP Segment 2: Sliplining/CIPP Segment 3: Cut and Cover, Reroute ROW Segment 4: Cut and Cover, Reroute ROW Segment 5: CIPP Segment 6: CIPP Segment 7: Cut and Cover w/ HDPE, Parallel Installation (opposite side of road) Segment 8: High SVI – Cut and Cover, Parallel Installation, Reroute Segment 9: High SVI – CIPP Segment 10: Cut and Cover w/ HDPE, Parallel Installation	Segment 1: $6.5M Segment 2: $6.5M Segment 3: $4.3M Segment 4: $6.7M Segment 5: $7.4M Segment 6: $6.6M Segment 7: $5.4M Segment 8: High SVI – $10.2M Segment 9: High SVI – $8.7M Segment 10: $4.7M	Preliminary cost estimates from preliminary engineering feasibility study.
Alternative #3	Segment 1: Cut and Cover with RJ DIP, Parallel Installation Segment 2: Cut and Cover, Parallel Installation Segment 3: Cut and Cover, Parallel Installation Segment 4: Cut and Cover, Parallel Installation Segment 5: Cut and Cover, Parallel Installation Segment 6: Cut and Cover, Parallel Installation Segment 7: Cut and Cover, Parallel Installation Segment 8: High SVI – Cut and Cover, Parallel Installation Segment 9: High SVI – Cut and Cover, Parallel Installation Segment 10: Cut and Cover, Parallel Installation, Reroute	Segment 1: $5.5M Segment 2: $5.5M Segment 3: $3.5M Segment 4: $6.2M Segment 5: $6.2M Segment 6: $5.5M Segment 7: $7.5M Segment 8: High SVI – $9.8M Segment 9: High SVI – $7.3M Segment 10: $7.5M	Preliminary cost estimates from preliminary engineering feasibility study.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 158: Hillsboro Upper System Water Treatment Plant Seismic Retrofit Mitigation Project

Mitigation Action Information			
Title of action	Hillsboro Upper System Water Treatment Plant Seismic Retrofit Mitigation Project		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	Project includes completing an engineering feasibility planning study and then Phase 1 Design and Phase 2 Construction to complete seismic retrofitting to mitigate risk of water treatment plant (WTP) catastrophic failure after a seismic event. Project would also include additional resilient backup power such as generators or solar panels and power storage. WTP has some power, so need would be assessed during engineering feasibility. These assets are at risk of being unusable after a major seismic event. These assets are located in/near Hillsboro, Oregon, a western suburb of Portland, which is within the Cascadia Subduction Zone (CSZ).		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☒	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	Earthquake is the primary natural hazard. A planning study will identify alternatives to mitigate the risk of catastrophic failure of the upper system WTP. Secondary risks are drought and wildland fires. Climate change induced drought is leading to private wells drying up, which leads to hardship requests for water service. Also, this water system is providing bulk water to crews fighting wildland fires in the area. These assets have not been seismically retrofitted to current seismic standards. Seismic retrofit of these assets will allow water service to resume shortly after a major seismic event. These assets are located in the Cascadia Subduction Zone (CSZ), which is at high risk for a major earthquake. Mitigation would comprise seismic retrofitting of assets and additional resilient backup power system, such as generators or solar panels with power storage, to ensure backup power will be available if primary power is unavailable after an earthquake. Without mitigation, life safety risk of interrupted water service could impact critical services such as hydrants, lifeline facilities, and business and residential customers. With pre-disaster mitigation, the assets will stand up more quickly after a major seismic event. This WTP serves rural census tracts with high CDC social vulnerability index scores. These populations have already endured distress from COVID pandemic impacts. Therefore, WTP could experience catastrophic failure due to climate change and natural hazards. WTP failure would leave vulnerable residents for an extended period, possibly months, without water service. Temporary relocation could have disparate impact on vulnerable populations. As has been evidenced with hurricanes in the New Orleans area, distressed communities are often more place-bound due to lack of personal transportation, insufficient ready cash, and other limitations. These populations are more often left behind. ABC News reported, “That was one of the real failings with Katrina. People who don’t have money to pay for a hotel room or don’t have a car of		

	their own stayed behind." Therefore, this mitigation project will greatly benefit distressed communities. Washington County is identified with about 32% of population as medium-to-high social vulnerability.
Area of action impact	Water customers located in rural Washington County are served by this water facility and pipeline. This includes residential, commercial, and wholesale customers, as well as the City of Gaston and the LA Water Co-Op.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? These assets provide water service, which is a *Food, Water, Shelter Critical Lifeline*.
Mitigation Action Integration	
Alignment with NHMP goals	Final Mitigation Mission Statement: Promote a disaster-resilient Washington County by taking actions to reduce risk, minimize loss, and protect life, property, and the environment from natural hazard events. Goal 1 ☒ Minimize loss of life, disruption of essential infrastructure Goal 2 ☒ Effective mitigation strategies and funding Goal 3 ☐ Natural hazard education and outreach programs Goal 4 ☐ Adopt policies and standards Goal 5 ☐ Enhance communication, collaboration Goal 6 ☒ Align mitigation strategies with local comprehensive plans Goal 7 ☒ Enhance economies to rebound quickly
Integration into other initiatives	Aligns with Hillsboro Water's Strategic Plan Goal 2: *Hillsboro Water continues to plan for the future, moving forward long-term investments while maintaining affordability.* A Hillsboro Water Guiding Principle is: *Protection of public health is the Hillsboro Water Department's number one priority.* Aligns with the Hillsboro's Water Master Plan. Aligns with City Council Guiding Principles: • *We are prepared and resilient.* • *We are exceptional public stewards.* • *We are a safe community.* • *We exemplify diversity, equity, and inclusion.*
Alignment with existing plans and policies	This capital project will be included in the Hillsboro Water Capital Improvement Program (CIP) budget, which is published and reviewed at budget-related public meetings.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Senior Program Manager City of Hillsboro Water Department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Finance Department Grant Administration	City of Gaston, LA Water Co-Op, commercial and residential customers served by upper system pipeline, Washington County
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City of Hillsboro	FEMA BRIC, HMGP USDA Rural Development Congressionally directed grant
Estimated Cost	Preliminary planning cost estimate: • $500,000 Engineering Feasibility Study • $35,000,000 Phase 1 Design and Phase 2 Construction costs to retrofit and remediate seismic deficiencies identified in the engineering study

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Seismic retrofit will allow water service to resume shortly after a major seismic event. Assets located in Cascadia Subduction Zone (CSZ) are at high risk for a major earthquake.	After a major earthquake or wildland fire: • Will reduce business interruption and allow businesses to stand back up quicker. • Will allow residences to remain in the area or return more quickly – equity issue because vulnerable residents have less ability to relocate. • Will maintain fire protection services.	Study: $3,000,000 Phases 1 and 2: $210,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term (1–2 yrs.) ☐ Mid-term (3–5 yrs.) ☐ Long-term (6+ yrs.) ☒ Ongoing ☐	Start date depends greatly on Hillsboro's ability to secure federal grant funds. Without grant funding, project will need to proceed slowly to meet cash flow constraints.	Project could be completed within 3 to 5 years of securing 75% or greater grant funding. Without grant funding, project would be delayed for approximately 6 to 10 years.

Implementation Benchmarks: How Will Success Be Measured?
• Success will be measured by the substantial completion date for the Upper System Water Treatment Plant Seismic Retrofit Mitigation Project.
Potential Challenges to Implementation
• The greatest obstacle or challenge will be securing federal grant funds to complete the project as quickly as possible.

Resources and References, if Applicable
• Hillsboro Water has prepared a preliminary draft cost estimate for this project. The next step would be to publish an RFP for an engineering consultant to prepare a preliminary engineering feasibility report. This report would include an evaluation of at least three alternative remediation solutions, including a No Action option as alternative #3. The engineering report would provide high-level preliminary cost estimates to facilitate determining the best value alternative. The engineer would also be tasked with preparing a preliminary Benefit-Cost Analysis (BCA) using FEMA's BCA spreadsheet with details for an earthquake natural hazard event. • If preliminary engineering feasibility is approved, Phase 1 Design and Phase 2 Construction could move forward subject to securing funding.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #2	Not yet available		Preliminary engineering feasibility report to be prepared.
Alternative #3	No action – not yet available		Preliminary engineering feasibility report to be prepared.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 159: Emergency Water Supply Community Engagement and Response Plan

Mitigation Action Information	
Title of action	Emergency Water Supply Community Engagement and Response Plan
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Develop and have ready to deploy community engagement regarding preparation for and actions during an emergency that has caused a disruption in water service to Hillsboro Water customers. This will also involve outreach to key community groups (schools, childcare facilities, elder care facilities, medical facilities, etc.) to educate about emergency water supplies and preparation, as well as coordinating with community groups to be partners in emergency water supply delivery and information centers.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☐ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	The City will have worked with the public to encourage homeowners to do some emergency preparations at home so they are not as reliant on the City to deliver drinking water and have some of their own source of water saved in case of an emergency. The City will also have an established network of partners to ensure that vulnerable communities are prioritized when there is a water emergency due to wildfire, algal blooms, storms, extreme heat, or infrastructure failure.
Area of action impact	Water service area (in-town and upper system)
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)? JWC WTP, SSFP WTP, JWC Transmission System, COH Distribution System, Emergency Water Distribution Facility (TBD?)
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	City of Hillsboro Emergency Drinking Water Plan
Alignment with existing plans and policies	Water Management and Curtailment Plan, Algal Response Communications Plan, Wildfire Protection Plan, etc.

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☐ High ☒		
Lead position, office, department, or division responsible for implementation	Water – Business Admin (Communications), Resources, Operations (Emergency Management)		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
City Communications/Public Information, City Emergency Planning		County Emergency Planning, Schools, Childcare Facilities, Elder Care Facilities, Community Centers, Medical Centers, etc., communities with limited English proficiency	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
City Budget, RDPO Grants			
Estimated Cost	$30,000		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Community is prepared for an interruption in water service during an emergency. Less loss of life and/or sickness.	Building relationships and partnerships with community partners.	$180,000	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	July 1, 2023	Unknown, TBD	
Implementation Benchmarks: How Will Success Be Measured?			
• Outreach to community at large about emergency water preparation, establishment of community partners, and specific outreach to vulnerable communities			
Potential Challenges to Implementation			
• Unwilling community partners, unreceptive public engagement, staff time, funding			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
	No Action	$0	
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 160: Increase Number of Home Town Tap Water Boards and Misting Tents

Mitigation Action Information	
Title of action	Increase Number of Home Town Tap Water Boards and Misting Tents
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Home Town Taps (HTTs) provide easy access to safe, cool water in public locations. Misting tents are used to provide community members a place to cool down during high temperatures. Both are popular and used at organized events, but additional units are needed due the increased frequency of extreme heat events. The City has an imperative to respond with access to water and cooling for the public in neighborhoods and near community gathering locations, particularly in low-income areas or areas of the City with limited means of transportation. These HTTs can also be deployed and used during other events where there is a water distribution need.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☐ Drought ☒ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Extreme heat events are increasing in frequency and are a greater risk to public health and safety.
Area of action impact	Locations throughout City will be identified based on community access and need with a focus on low-income areas or limited mobility.
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	City of Hillsboro – EOP – Extreme Temperatures Annex (Heat)
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Water – Resources, Operations, Communications

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Parks and Recreation Department, Fire Dept.	Houseless services organizations
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City Budget	
Estimated Cost	$25,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Providing drinking water to underserved populations during extreme heat events.	Additional HHTs at stationary locations, would reduce staffing to setup and tear down of temporary HHT locations.	$150,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	January 1, 2023	July 1, 2023

Implementation Benchmarks: How Will Success Be Measured?
• The City has sufficient units to support planned events and quickly deploy to areas of the community in extreme heat events.

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action	$0	
Alternative #2	Two HHTs rather than four	$10,000	
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 161: Deploy Customer Water Usage and Messaging Software Program

Mitigation Action Information	
Title of action	Deploy Customer Water Usage and Messaging Software Program
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Purchase and deploy software that allows customers to view their water usage and can be used to deliver targeted and system-wide messages to the public such as boil water notices, curtailment and water supply advisories, locations for emergency water, etc.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☐ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Allows customers to monitor their water usage to be more water efficient during times of drought and to better comply with curtailment orders, if issued during a supply emergency or drought. The software also allows the City to communicate vital information to customers quickly when there is a water quality emergency due to wildfire, algal blooms, storms, extreme heat, and infrastructure failure.
Area of action impact	Water service area (in-town and upper system)
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? WTPs, water distribution system
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☐ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	WMCP – Water Curtailment Plan and COH Water Emergency Response Plan, City of Hillsboro Emergency Operations Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Water – Resources, Communications

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Information Services, Finance	
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City Budget	HMGP
Estimated Cost	$100,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Customer will be educated on water usage and receive emergency notices.	Customers can easily see their usage and adjust to meet curtailment goals in a drought or service limitation event.	$600,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	July 2023	June 2024

Implementation Benchmarks: How Will Success Be Measured?
• Software is deployed, integrated with City's billing and meter data, and customers are enrolled.

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
	No Action	$0	
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 162: Initial Wildfire Fuel Reduction and Defensible Space

Mitigation Action Information	
Title of action	Initial Wildfire Fuel Reduction and Defensible Space
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	**Wildfire Protection** **Fuels Reduction and Defensible Space** High-value assets owned by the City of Hillsboro, Joint Water Commission, and Barney Reservoir Joint Ownership Commission at risk of being impacted by wildfire have been identified in two documents – the Tualatin Basin Quantitative Wildfire Risk Assessment and Recommendations (2021) by OSU-Extension Service Fire Program and Wildland Fire Associates, and the Tualatin Wildfire Protection Plan (2022) by JWC and Clean Water Services. Recommendations from these planning documents focused on creating, increasing, and maintaining defensible space and reducing fire fuels near critical assets. The fuels reduction goals include having nothing burnable within 5 feet of priority buildings and communication sites, maintaining vegetation to heights less than 6 inches within 30 feet, spacing plants widely (every 100 feet) around buildings, making burn lines, and pruning trees to 8–10 feet above ground. This would be accomplished by mowing, thinning, piling, and pile burning as needed. The following list includes facilities and assets the JWC, BRJOC, and COH plan to create and maintain defensible space and reduce fuel loadings around: • Cherry Grove Slow Sand Filter Plant (SSFP) • Soda Ash Facility • Tualatin Flume • Patton Valley Control Valve • JWC Water Treatment Plant • JWC Fernhill Reservoirs
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Reducing fuels and increasing defensible space protects worker and public safety in the event of a wildfire, minimizes property loss and damages, and provides resiliency to our water distribution infrastructure to ensure public health and safety.
Area of action impact	City of Hillsboro Water Infrastructure and JWC Water Infrastructure

Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Cherry Grove Slow Sand Filter Plant (SSFP), Soda Ash Facility, Tualatin Flume, Patton Valley Control Valve, JWC Water Treatment Plant, JWC Fernhill Reservoirs
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☒ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	Wildfire Protection Plan (2022) Tualatin Basin Quantitative Wildfire Risk Assessment and Recommendations (2021)
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Water Department; Resources, Operations, WTP

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Fire Department	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City of Hillsboro Budget, Office of State Fire Marshal grants (Defensible Space Local Government Grant)	FEMA BRIC Funding, HMGP
Estimated Cost	$200,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Risk reduction		$1,200,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	1/1/2023	12/31/2026

Implementation Benchmarks: How Will Success Be Measured?
• Success will be measured with the accompanying inventory database and dependent on ability to complete action items in the time intervals set.

Potential Challenges to Implementation

Resources and References, if Applicable
• Wildfire Protection Plan

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No Action	$0	
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 163: Water Maintenance and Fuels Reduction Plan with Facility Inventory Database

Mitigation Action Information			
Title of action	Water Maintenance and Fuels Reduction Plan with Facility Inventory Database		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☒		Natural systems protection ☒ Public education/awareness ☐
Action description	**Wildfire Protection** **Maintenance and Fuels Reduction Plan with Facility Inventory Database** High-valued assets owned by the City of Hillsboro, Joint Water Commission, and Barney Reservoir Joint Ownership Commission at risk of being impacted by wildfire have been identified in two documents – the Tualatin Basin Quantitative Wildfire Risk Assessment and Recommendations (2021) by OSU-Extension Service Fire Program and Wildland Fire Associates, and the Tualatin Wildfire Protection Plan (2022) by JWC and Clean Water Services. One of the pre-fire prevention and mitigation strategies recommended from the Wildfire Protection Plan is creating a preventative maintenance and fuels reduction plan with an accompanying facility inventory database. The preventative maintenance and fuels reduction plan will be developed and reevaluated annually and include location specific maintenance activities to be performed, criteria for initiating maintenance, status of maintenance, completion dates, and a fuels treatment plan for assets and resources outlined in the accompanying facility inventory database. This facility inventory database will focus on key assets, vulnerabilities, preventative maintenance schedule, tracking log, and actions that should be taken immediately if a wildfire or other natural disaster occurs.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☒	Windstorm, incl. tornado ☐ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	The facilities inventory database and maintenance and fuels reduction plan will reduce risk to public safety by making our water distribution infrastructure more resilient to help ensure delivery of drinking water in the event of wildfire or other natural disasters.		
Area of action impact			
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Cherry Grove Slow Sand Filter Plant (SSFP),Soda Ash Facility, Tualatin Flume, Patton Valley Control Valve, JWC Water Treatment Plant, JWC Fernhill Reservoirs		

Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☒	Goal 7 ☐
Integration into other initiatives	State of Oregon NHMP		
Alignment with existing plans and policies	Wildfire Protection Plan (2022) Tualatin Basin Quantitative Wildfire Risk Assessment and Recommendations (2021)		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Water Department; Operations, WTP, Resources		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Fire Department			
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
City Budget, Oregon State Fire Marshal's Office		HMGP	
Estimated Cost	$50,000		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Development of an inventory and maintenance plan for mitigation efforts	Supporting long-term fuel reductions plan	$300,000	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	1/1/2023	12/31/2026	
Implementation Benchmarks: How Will Success Be Measured?			
• Developing an inventory and maintenance plan			
Potential Challenges to Implementation			
• Getting agreements in place for properties that involve other landowners.			
Resources and References, if Applicable			
• Oregon State Fire Marshal's Office. OSU Extension Office.			

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Only create a database with no plan	$25,000	
Alternative #2	Only create a plan with no database of properties	$25,000	
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 164: Battery Backup Systems for Traffic Signals

Mitigation Action Information			
Title of action	Battery Backup Systems for Traffic Signals		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Install Econolite ZincBlue2 battery backup systems to 11 City of Hillsboro signalized intersections		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☒ Extreme heat ☒	Flood ☐ Landslide ☐ Volcanic ash ☒ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	In the event of a power outage, battery backup systems will keep the signals running properly until power is restored. This will aid in response time of emergency responders and the safety of commuting public in the event of a power outage.		
Area of action impact	Emergency response services, commuting public, and citizens of Hillsboro		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☒ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	State of Oregon NHMP		
Alignment with existing plans and policies	City of Hillsboro Comprehensive Plan Policy NH 1.9, NH 4.3, NH 4.4		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Public Works		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Public Works		PGE, State and County DOTs	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Transportation Budget, State DOT grant programs	Hazard Mitigation Grant program, Building Resilient Infrastructure and Communities
Estimated Cost	$110,000.00

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Emergency response services response time and safety	Safety of commuting public and City of Hillsboro citizens	$660,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	July 2024	June 2025

Implementation Benchmarks: How Will Success Be Measured?
• Acquiring funding for project • Purchasing battery backup systems • Installation of systems

Potential Challenges to Implementation
• Software updates as need, acquiring funding for replacement of batteries at end of life.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 165: New Shop/Carport for Emergency Response Equipment and Supplies

Mitigation Action Information	
Title of action	New Shop/Carport for Emergency Response Equipment and Supplies
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Construct a new Public Works shop/carport to shelter public works equipment and supplies to protect from extreme heat, volcanic ash, inclement weather, and other natural hazards
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	To ensure safety to the commuting public and citizens of Hillsboro and to maintain proper response to inclement weather and other natural hazards. Maintain emergency vehicle response times.
Area of action impact	Emergency response services, Commuting public, City of Hillsboro residents and City of Hillsboro Public Works
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	Emergency response plan and policy, City of Hillsboro Emergency Operations Plan, City of Hillsboro Comprehensive Plan
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	City of Hillsboro Facilities and Fleet Division

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Facilities, water, fleet, IS, planning and building departments	State and County department of transportation
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City capital improvement budget and Transportation fund budget	Hazard Mitigation Grant program
Estimated Cost	$4,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Safety of commuting public and residents of the City of Hillsboro		$24,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	July 2025	June 2027

Implementation Benchmarks: How Will Success Be Measured?

- Receiving approval for development and building
- Securing funding and project buy-in
- Permits and building structure
- Relocating equipment and supplies to new building

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 166: Gas Flow Shutoff Valves

Mitigation Action Information	
Title of action	Gas Flow Shutoff Valves
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	This project would ensure that all our essential buildings would remain safe from potential gas leaks in the event of seismic activity. We have identified roughly 25 buildings we consider essential in the event of an emergency. Adding seismic gas shutoff valves to these sites would allow us to use these areas for planning, mobilizing, and implementing our response to whatever is encountered. Adding seismic gas shutoff valves to these sites would also ensure that any staff or public patrons in areas of these buildings would remain safe from potential gas explosions caused by a gas leak.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	The roughly 25 facilities identified for this program do not have seismic shut-off valve devices. These sites are essential to ensuring the City of Hillsboro can respond to whatever emergency or natural disaster there may be for the citizens of Hillsboro. It's our responsibility to be able to be there for the community.
Area of action impact	Facility Departments: Police, Fire, Public Works, Water, Parks, Civic Center.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Civic Center, Facilities, Davis/Shute Fiber Hut, Fire Stations 1, 2, 3, 5, 6, Fire Training, Brookwood Library, Shute Library, Aquatic Center, Hidden Creek, Park Maintenance, Tyson Rec, Police Training, Evidence, Water Operations.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☒ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	Hillsboro Comprehensive Plan Policy NH 2.3 Policy NH 4.2
Alignment with existing plans and policies	City's ability to mobilize and response to emergencies.

Mitigation Action Implementation Plan			
Priority	Low ☒ Medium ☐ High ☐		
Lead position, office, department, or division responsible for implementation	Public Works Director, Superintendent of Operations and Maintenance.		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Office of Emergency Management, Office of the City Manager		Washington County	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
City capital improvement budget, general fund		Hazard Mitigation Grant Program, BRIC	
Estimated Cost	Year 1 – $54,000 ($30,000 equip, $24,000 install); no ongoing cost once complete		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Protection of life and essential buildings and the ability to utilize these properties during seismic activity.		Year 1 – $324,000	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	July 2023	March 2024	
Implementation Benchmarks: How Will Success Be Measured?			
• Securing funding and project buy-in. • Completing audit of gas meters to determine size of equipment needed. • Purchase equipment/supplies. • Obtain bids from contractors to install equipment. • Install equipment.			
Potential Challenges to Implementation			
• Securing ongoing funding for maintenance to gauges and software updates. Needing to replace flood gases due to damage caused by vehicles.			
Resources and References, if Applicable			
• Potential vendor: https://onerain.com/applications/flood-warning/			

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action	$0	Facilities would remain at risk for potential gas leaks during seismic activity.
Alternative #2	Scale project to fire/life/safety facilities only	Year 1 – $27,000	Police/Fire/Communication properties only
Alternative #3	Scale project over multiple years	$10,800 per year	5-Year plan

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 167: Traffic Intersection Weather Station Installation and Monitoring

Mitigation Action Information			
Title of action	Traffic Intersection Weather Station Installation and Monitoring		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	This mitigation action proposes the installation of weather stations at strategic traffic intersections and other areas throughout the City of Hillsboro. Weather stations will collect and transmit live data to Public Works operation and maintenance staff. Data transmitted will include pavement temperatures as well as rainfall data related to microburst storms. By collecting this data, operation and maintenance staff will be able to prioritize their response to specific weather events. Hazards mitigated by the implementation and management of these weather stations involve slippery road conditions due to severe winter weather and potential flooding due to microburst storms. Live data will allow Public Works staff to prioritize response to the most impacted intersections, therefore minimizing harm to City of Hillsboro residents and infrastructure.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☒
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Intersections can become hazardous in the event of severe winter storms as they are the site of most weather-related automobile accidents. The City of Hillsboro responds to frozen road conditions with the use of deicer to create safer road conditions. This action item allows Public Works operation and maintenance teams to mobilize where they are needed most first. Depending on the cause of flooding, crews can then remove blockages in storm system or block off dangerous flooding roads and intersections from use.		
Area of action impact	Traffic intersections and other areas will be chosen strategically and will be located throughout the City. Parameters for selecting intersections will include average daily traffic data as well as historical data suggesting these weather station locations are prone to weather-related accidents or flooding. Locations that are known to be most at risk will be chosen for this mitigation action.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	This action item can be integrated with the City of Hillsboro action item to identify locations with routine significant flooding and install swing gates to block flooded roads. Weather station data can be collected and analyzed to help determine locations for proposed swing gates. Additionally, this action item can be integrated with the mitigation plan related to removing snow and ice from bike lanes within the City of Hillsboro.		

Alignment with existing plans and policies	The City of Hillsboro has an existing response crew that addresses dangerous intersections during severe winter storms and rainstorms. This mitigation plan will assist with the efficiency and cost of responding to such storms. Crews will be able to respond to the highest risk areas first. This mitigation plan will also provide City of Hillsboro Public Works with data that will assist with the local initiative to prioritize and implement capital projects that improve hazardous intersections and insufficient stormwater systems.

Mitigation Action Implementation Plan

Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	Maintenance & Operation Superintendent and Public Works Director

Supporting Partners

Internal Partners	External Partners, Including Community Partners
Traffic Planning, Public Works, City of Hillsboro First Responders	N/A

Potential Funding Sources

Non-Federal Funding Sources	Federal Funding Sources
Transportation Fund	FEMA Hazard Mitigation Grant Program FEMA Hazard Mitigation Assistance Grants (BRIC) – Building Resilient Infrastructure and Communities

Estimated Cost	$2,000 to $5,000 per weather station

Estimated Benefit

Primary Benefit(s)	Secondary Benefit(s)	Financial Benefit(s)
Protection of human life and safety	Weather response procedural efficiency	$12,000 to $30,000 per weather station

Project Timeline

Expected Timeline for Completion	Potential Start Date	Potential Completion Date
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	Start of Fiscal Year 2024	TBD

Implementation Benchmarks: How Will Success Be Measured?

- Create prioritization matrix for prioritizing intersections/areas where weather stations will be installed
- Select weather station manufacturer and purchase weather stations
- Install weather stations
- Train staff on use of weather station, monitoring software, and data utilization
- Create and implement response protocol

Potential Challenges to Implementation
• Potential challenges to implementation include technological malfunctions, cost of weather stations and associated data tracking software, and tampering and/or safe maintenance access of weather stations depending on installation location.
Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 168: High-Risk Outfall Repair Program

Mitigation Action Information			
Title of action	High-Risk Outfall Repair Program		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☒	Natural systems protection ☐ Public education/awareness ☐	
Action description	This mitigation action proposes a program to analyze and repair stormwater outfalls to natural waterways to prevent flooding conditions. Stormwater outfalls that need repair can cause flooding conditions in several scenarios. Outfalls that are constructed under the 100-year flow elevation can cause backwatering into the storm system, causing flooding. Additionally, stormwater outfalls that are inadequately sized for large storm events or are buried/submerged can cause flooding conditions. This action will include a comprehensive plan for determining which outfalls need attention and prioritize repair order based on the flood risk associated with the outfall.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☒ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	This mitigation action plan identifies current and future risks by addressing infrastructure that could affect human safety and damage infrastructure. Outfalls exist throughout the city and high-risk outfalls within low income and vulnerable areas will be prioritized.		
Area of action impact	High-risk outfalls will be chosen strategically and will be located throughout the City. Outfalls that are known to be most at risk, as well as outfalls within low-income and vulnerable areas, will be prioritized for this mitigation action.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☒	Goal 7 ☐
Integration into other initiatives	Other NHMP mitigation actions within City of Hillsboro related to flooding and other weather events. State of Oregon NHMP.		
Alignment with existing plans and policies	The City of Hillsboro has existing planning efforts to repair outfalls to maintain functionality of the storm system as well as protecting natural waterways and riparian areas from the effects of hydromodification (e.g., erosion).		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Storm and Sanitary Sewer Division Manager and Public Works Director		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Planning Department		Clean Water Services, Washington County	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
Storm system local service fee funds, system development charge funds		FEMA Hazard Mitigation Grant Program FEMA Hazard Mitigation Assistance Grants (BRIC) – Building Resilient Infrastructure and Communities	
Estimated Cost	Between $160k and $500k for approximately 500 outfalls		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Protection of human life and safety	Protection of existing infrastructure and private property	$960,000–$3 million	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	Start of Fiscal Year 2024	Unknown	
Implementation Benchmarks: How Will Success Be Measured?			
• Creating a prioritization matrix to identify high-risk outfalls • Creating an implementation plan for repairing identified outfalls • Procuring on-call contractors to implement long-term program • Implementing outfall repair program			
Potential Challenges to Implementation			
• Potential challenges to implementation include access to project sites and environmental permitting due to temporary impacts to riparian areas where outfalls are often located.			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 169: Upsizing Culvert Capacity for Waterways to Reduce Flooding Risks

Mitigation Action Information	
Title of action	Upsizing Culvert Capacity for Waterways to Reduce Flooding Risks
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	This mitigation action is to replace and upgrade culverts throughout the City but includes two projects within the City of Hillsboro that propose to upgrade and enlarge existing culverts with known flooding issues. The project sites are at the Glencoe Swale crossing at NW Connell Avenue and the Dawson Creek crossing on NE 47th Avenue. At both sites, the roadways become inundated during large storm events and cause dangerous conditions for residents and infrastructure.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	These two example project sites are known to create dangerous flooded conditions and are identified as high-ranking projects in planning documents. These sites are located within residential areas, and the roads have been blocked off for significant periods of time due to flooding.
Area of action impact	Culverts located throughout the City, including Glencoe Swale Crossing and NW Connell Avenue and the Dawson Creek Crossing on NE 47th Avenue.
Is the action related to a critical facility or facilities?	Yes ☐ No ☐ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Other NHMP mitigation actions within City of Hillsboro related to flooding and other weather events. State of Oregon NHMP.
Alignment with existing plans and policies	The City of Hillsboro Stormwater Master Plan adopted in 2021 identified projects that should be addressed in a 10-year stormwater capital improvement program. Both example project sites associated with this mitigation action plan were ranked in the top 10 most important projects in the program.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Storm and Sanitary Sewer Division Manager and Public Works Director

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Traffic Planning, Transportation, Storm and Sanitary Division, Water Department	Clean Water Services
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Storm system local service fee funds, system development charge funds, and transportation fund.	FEMA Hazard Mitigation Grant Program FEMA Hazard Mitigation Assistance Grants (BRIC) – Building Resilient Infrastructure and Communities.
Estimated Cost	Individual culvert replacements between $1 million and $5 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Protection of human life and safety	Decreased need for emergency response.	Between $6 million and $30 million
Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	Start of Fiscal Year 2024	Unknown

Implementation Benchmarks: How Will Success Be Measured?

- Complete engineering analysis/feasibility study for identified culverts
- Secure engineering contractors to complete design of culvert upgrades
- Secure construction contractors to construct culvert upgrades

Potential Challenges to Implementation

- Potential challenges to implementation include environmental impacts to waterways during construction, working around existing infrastructure (e.g., railroad and water lines), and traffic control (providing residents access during construction).

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 170: Vegetative Stormwater Management Facility (SMF) Drought Mitigation Plan

Mitigation Action Information			
Title of action	Vegetative Stormwater Management Facility (SMF) Drought Mitigation Plan		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐	Natural systems protection ☒ Public education/awareness ☐	
Action description	The City/CWS Design and Construction Standards need to be revised to expand plant options when new vegetative stormwater management facilities are initially constructed or repaired. More heat- and drought-tolerant plants need to be added, such as native succulents or kinnikinnick, for ground cover that require little amounts of maintenance or water to survive, cover soils to better retain soil moisture, and flower during the year to provide pollinator-friendly plants throughout the City. Water quality will still be accomplished using plugs and other deep-rooted and drought-tolerant plants. Surrounding heat- and drought-tolerant native vegetation types such as Madrone, Western Juniper, Crape Myrtle, Western Redbud, Yarrow, Sage, Thyme, and Yucca variations should be added to the approved plant list. Fifty percent of all plants selected to be installed in new SMFs should be required to be heat- and drought-tolerant plants. All existing SMFs within the City will eventually need to have their existing vegetation augmented with more drought-tolerant plant types.		
Hazard(s) addressed	Dam failure ☐ Drought ☒ Earthquake ☐ Extreme heat ☒	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Vegetation survivability within vegetative stormwater management facilities is critical for the pollutant removal function that each facility performs and maintains compliance with local, state, and federal regulations. Cost savings: maintaining existing vegetation prevents invasive plant establishment/removal and extends the life of the facility before more expensive rehabilitation and restoration are necessary to re-establish the facility.		
Area of action impact	Vegetative stormwater management facilities within the City of Hillsboro.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☒	Goal 4 ☐ Goal 5 ☒ Goal 6 ☒	Goal 7 ☐
Integration into other initiatives	Extreme Heat, Flood (Climate Resiliency). State of Oregon NHMP.		
Alignment with existing plans and policies	City Environmental Stewardship, Pollinator/Bee City, City/CWS Division of Responsibilities IGA, City Storm and Sanitary Performance, and Maintenance Standards.		

Mitigation Action Implementation Plan			
Priority	Low ☒ Medium ☐ High ☒		
Lead position, office, department, or division responsible for implementation	Public Works Department, Storm and Sanitary Division, Environmental Services Section.		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
PW Storm and Sanitary Division, Parks Department, Sustainability		Clean Water Services, Tualatin Soil Water Conservation District, Washington County, METRO	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
COH SWM LSF, COH General Fund, Oregon Clean Water State Revolving Fund		FEMA Hazard Mitigation Grant Program FEMA Hazard Mitigation Assistance Grants (BRIC) – Building Resilient Infrastructure and Communities	
Estimated Cost	Each phase of this action plan has an estimated cost of $100,000 to $500,000		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Resource protection	Maintenance repair costs	$600,000 to $3 million	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	Start of Fiscal Year 2025	End of Fiscal Year 2044	
Implementation Benchmarks: How Will Success Be Measured?			
• When a new SMF drought mitigation policy/procedure is implemented. • Design standards are changed to expand plant selection types. • When implementation of heat- and drought-tolerant/resistant native plants are planted and established within all stormwater management facilities.			
Potential Challenges to Implementation			
• Ability to change design and construction standards, funding availability, available personnel, and the number of facilities to augment with additional plants			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 171: Cycle Track and Bike Lane Snow/Ice Removal

Mitigation Action Information			
Title of action	Cycle Track and Bike Lane Snow/Ice Removal		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	Evaluate needs for snow/ice response to clear cycle tracks and to purchase equipment if needed.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☒
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Clearing cycle tracks and bike lanes during/after a snow/ice event so bicyclists can safely commute		
Area of action impact	Commuting public		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	State of Oregon NHMP		
Alignment with existing plans and policies	City of Hillsboro Comprehensive Plan Policy NH 1.9, NH 4.3, NH 4.4		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Transportation Division		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Transportation and Stormwater divisions		State/County DOT	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Transportation Budget Stormwater Budget	Hazard Mitigation Grant program, Building Resilient Infrastructure and Communities
Estimated Cost	$500,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Safety and reliability of commuting public.		$3,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	July 2026	June 2028

Implementation Benchmarks: How Will Success Be Measured?

- Evaluate need.
- Determine gaps.
- Analyze possible solutions.
- Secure funding.
- Purchase solutions based on findings.

Potential Challenges to Implementation

- Opposing roadway improvements needed to obtain approval of new structure

Resources and References, if Applicable

- Potential vendor: https://onerain.com/applications/flood-warning/

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 172: Volcanic Ash Equipment

Mitigation Action Information			
Title of action	Volcanic Ash Equipment		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Research and purchase equipment needed for volcanic ash cleanup of roadways and pedestrian facilities		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☒	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	In the event of a volcanic eruption, this research and equipment would be needed to streamline the cleanup of ash on roadways and pedestrian facilities to ensure safety of the commuting public. This will also assist with emergency responders' response times.		
Area of action impact	Commuting public, emergency response, storm and sanitary infrastructure		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	State of Oregon NHMP		
Alignment with existing plans and policies	City of Hillsboro Comprehensive Plan Policy NH 1.9, NH 4.3, NH 4.4		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Public Works Operations Division		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Transportation, Sanitary and Stormwater divisions		County and State DOT	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Transportation budget, Sanitary and Stormwater budget	Hazard Mitigation Grant program, building resilient infrastructure and communities
Estimated Cost	$2,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Clear, safe roadways for emergency responders and commuting public		$12,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	July 2026	June 2028

Implementation Benchmarks: How Will Success Be Measured?

- Determine types of equipment needed
- Purchase equipment

Potential Challenges to Implementation

- Securing funding and storage for equipment

Resources and References, if Applicable

- Potential vendor: https://onerain.com/applications/flood-warning/

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 173: Volcanic Ash

Mitigation Action Information	
Title of action	Volcanic Ash
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	This project would upgrade all our existing HVAC systems to better deal with downfall of volcanic ash. Physically installing hoods over air intake would reduce direct ash ingestion into HVAC systems.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☒ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	This would help reduce the damage caused by volcanic ash downfall.
Area of action impact	City of Hillsboro – Citywide Facilities
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Police Stations – West/East, Training Centers, Fire Stations 1–3, 5, 6.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	Hillsboro Comprehensive Plan Policy NH 2.3 Policy NH 4.2 City of Hillsboro Emergency Operations Plan
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	Public Works Director, Superintendent of Operations and Maintenance.

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City capital improvement budget, general fund, ODHS grant for clean air spaces	Hazard Mitigation Grant Program
Estimated Cost	Year 1 – $100,000; no ongoing cost once complete

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Protection of HVAC systems and infrastructure.		Year 1 – $600,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	July 2023	March 2025

Implementation Benchmarks: How Will Success Be Measured?

- Securing funding and project buy-in.
- Completing audit of HVAC systems to determine size of equipment needed.
- Purchase equipment/supplies.
- Install equipment.

Potential Challenges to Implementation

- Securing ongoing funding for maintenance to gauges and software updates.
- Needing to replace floodgates due to damage caused by vehicles.

Resources and References, if Applicable

- Potential vendor: https://onerain.com/applications/flood-warning/

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action	$0	HVAC systems would remain at risk for volcanic ash inhalation from downfall.
Alternative #2	Scale project to fire/life/safety facilities only	$35,000	Police/Fire/Communication properties only
Alternative #3	Scale project over multiple years	$10,000 per year	5 Year plan

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 174: Wildfire – Upgrade HVAC Air Filtration

Mitigation Action Information	
Title of action	Wildfire – Upgrade HVAC Air Filtration
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	This project would ensure all our HVAC system are equipped with means to provide MERV 13 filtration for all our HVAC Systems. While most of our sites do have the ability to use MERV 13 filters, not every system is capable of this. This would give us the funds to upgrade existing infrastructure to provide MERV 13 Filtration for these systems.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Allowing fresh air into a building is important not only for the health of its inhabitants but also for a buildings ability to function properly. When wildfire smoke is in the air, HVAC systems without MERV 13 filtration systems are forced to close off outside air. Not bringing in outside air can cause people in buildings to get sick and can also cause negative building pressure.
Area of action impact	City of Hillsboro – Citywide facilities
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? All City facilities
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☐ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	Hillsboro Comprehensive Plan Policy NH 2.3 Policy NH 2.4 Policy NH 4.2
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Public Works Director, Superintendent of Operations and Maintenance.

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City capital improvement budget, general fund	Hazard Mitigation Grant Program
Estimated Cost	Year 1 – $250,000 (equipment) $250,000 (installation)

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Protection of building occupants' heath during wildfire smoke, continue normal function of building operation.	Improved filtration of outside air	Year 1: $3,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	July 2023	March 2026

Implementation Benchmarks: How Will Success Be Measured?

- Securing funding and project buy-in.
- Completing audit of existing HVAC systems and equipment needs.
- Purchase equipment/supplies.
- Obtain bids from contractors to install equipment.
- Install equipment.

Potential Challenges to Implementation

- Securing ongoing funding for maintenance to gauges and software updates.
- Needing to replace floodgates due to damage caused by vehicles.

Resources and References, if Applicable

- Potential vendor: https://onerain.com/applications/flood-warning/

Three Alternatives Considered, Including No Action

	Action Description	Estimated Cost	Evaluation
Alternative #1	No action	$0	Existing systems would remain same
Alternative #2	Scale project to fire/life/safety facilities only	$125,000	Police/Fire properties only
Alternative #3	Scale project over multiple years	$50,000 per year	5-Year plan

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 175: Windstorm Damage Prevention Hardware

Mitigation Action Information	
Title of action	Windstorm Damage Prevention Hardware
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	This project would add high wind door stop systems to entrances at high-risk locations in the city. These systems would prevent catastrophic damage to entryways and emergency exits. The project would also help determine design language for future city buildings.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Engineering windbreak vestibules or adding hurricane-rated doorstop hardware are options that could prevent damage to public and private property and keep locations secure during windstorm events. Resources to temporarily secure locations are in high demand during such events and could leave the city vulnerable to increased damage.
Area of action impact	City of Hillsboro Civic Center, Police Precincts, Fire Department, Public Works, and Water Department could all be impacted.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Our Civic Center, two Police Precincts, five Fire Stations, Public Works campus, and Water Department could all be impacted.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	City's ability to mobilize and respond to emergencies. City of Hillsboro EOP.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Department of Public Works Public Works Director Superintendent of Operations and Maintenance

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City capital improvement budget, general fund	Hazard Mitigation Grant Program
Estimated Cost	Year 1 – $15,000–$60,000.

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Protection of life safety.	Decreased need for emergency response/securing facilities during windstorm events. Prevent damage to public and private property and infrastructure.	Year 1 – $360,000 Ongoing – $90,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	April 2023	May 2024

Implementation Benchmarks: How Will Success Be Measured?

- Identify high-risk entry systems
- Research solutions
- Procuring equipment and contractors
- Installing equipment

Potential Challenges to Implementation

- Securing ongoing funding for maintenance to gauges and software updates.
- Needing to replace flood gates due to damage caused by vehicles.

Resources and References, if Applicable

- Potential vendor: https://onerain.com/applications/flood-warning/

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action	$0	Continued life safety risk, and risk of damage to city facilities.
Alternative #2	Scale project to Civic Center only	Year 1 – $15,000	Taking on our highest risk site with minimal improvements would help but leave other sites at risk.

Alternative #3	Adjust project dates to multi-year steps.	$15,000 per year for 5 to 7 years.	Take on an additional facility each year until completion.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 176: Expand and Update Continuity of Operations Plans (COOPs)

Mitigation Action Information	
Title of action	Expand and Update Continuity of Operations Plans (COOPs)
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Update Department COOP Plans
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	During and after a natural hazard event, the City relies on its Continuity of Operations Plans (COOPs) to guide each department in their response and recovery. Keeping each department's COOP up-to-date ensures that critical functions and services are maintained as seamlessly as possible. COOPs also provide information on how employees may be deployed into different work areas. COOPs help departments mitigate the length and severity of disruptions that are caused by natural hazards.
Area of action impact	All departments and their staff
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Multiple facilities all across the City (ones that are deemed "primary" and "alternate" facilities).
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☒ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	Updates will be made to existing department COOPs. Updating a COOP provides us with an opportunity to review the existing plan from a wide range of aspects, which may have implications to other existing plans and policies. City of Hillsboro Comprehensive Plan City of Hillsboro Emergency Operations Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Management Analyst (HR/Risk), Department COOP Coordinators, department leadership

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
All City Departments (City Manager's Office, Community Development, Economic Development, Finance, Fire & Rescue, Human Resources, Library, Parks & Recreation, Police, Public Works, Water)	N/A

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	HMGP
Estimated Cost	$150,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Continuity plans for the City's essential functions		$900,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☒	March 2023	December 2025, then updated as needed

Implementation Benchmarks: How Will Success Be Measured?

- Secure funding, project buy-in
- 1/3 of departments have a COOP
- 2/3 of departments have a COOP
- All City departments have a COOP
- COOPs have been tested and evaluated
- Gaps or failures in plans have been identified and addressed
- Plans have been modified accordingly

Potential Challenges to Implementation

- Time, department buy-in

Resources and References, if Applicable

Three Alternatives Considered, Including No Action

	Action Description	Estimated Cost	Evaluation
Alternative #1	Focus on a few departments	$75,000	
Alternative #2	Focus on a few areas of COOP plan	$75,000	

Alternative #3	Create high-level (less detailed), comprehensive COOP plan	$50,000	

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 177: Analyze and Update Human Resources Policies

Mitigation Action Information			
Title of action	Analyze and Update Human Resources Policies		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐		Natural systems protection ☐ Public education/awareness ☐
Action description	Update current Human Resources policies that relate to natural hazards. Analyze policies for any gaps in coverage or type, and create policies as needed based on that analysis. Conduct training on updated and new policies.		
Hazard(s) addressed	Dam failure ☐ Drought ☒ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☐ Volcanic ash ☒ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Human Resources plays a key role in planning for any emergency staffing and workforce planning, training, reorganization, or revising policies to accommodate changing needs and priorities. Performing this function successfully during emergency requires existing HR policies to be up-to-date.		
Area of action impact	City staff		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☒ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	State of Oregon NHMP		
Alignment with existing plans and policies	City of Hillsboro Comprehensive Plan, City of Hillsboro Emergency Operations Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Management Analyst (HR/Risk), policy stakeholder (depends on policy)		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
All City Departments		N/A	

Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General fund		HMGP	
Estimated Cost	$150,000		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Enhancement of City policies to serve and protect staffing during critical times	N/A	$900,000	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☒ Long-term ☒ Ongoing ☐	Spring 2023	Fall 2024	
Implementation Benchmarks: How Will Success Be Measured?			
• Development of policy and review of policies after they are implemented.			
Potential Challenges to Implementation			
• As the project unfolds, its scope of application may expand.			
Resources and References, if Applicable			
• Varies			
Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	**Review policy and create an inventory (no update)**	**$50,000**	
Alternative #2	**Partial review and update**	**$100,000**	
Alternative #3	**No action**	No cost	
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 178: City of Hillsboro Community Wildfire Protection Plan

Mitigation Action Information			
Title of action	City of Hillsboro Community Wildfire Protection Plan		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Develop a Community Wildfire Protection Plan for the City of Hillsboro. The CWPP will also include actionable tasks that can be taken to reduce the impact of wildfires within the City and address the following: determining fuel hazards, assess risk of wildfire occurrence, identify homes, businesses, and essential infrastructure at risk, and fuel treatment prioritization. The planning project includes a Story Map that will create a highly functional, easy-to-use interface to tell the story of place and people's values in a way that illustrates data-rich science-based information. The Story Map will incorporate important baseline information and will be a place where residents can access project recommendations, interact with baseline mapping and risk assessment information, and seek real mitigation measures they can take in and around their properties. The Story Map will be designed to be accessible and easily navigable by the public and be available in English and Spanish.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	This plan will identify and quantify current and future risk, and it will provide actionable tasks that will aid in reducing or preventing wildfires or the spread of wildfires within the City's greenspaces and adjacent areas.		
Area of action impact	Entire City		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	The CWS (National Cohesive Wildland Fire Management Strategy) aligns well with the goals of Healthy Forest Restoration Act and the origins of community fire planning: collaboration. By aligning the CWPP with the CWS, the city will benefit from seamless integration with fire policy at the state, regional, and federal levels. Also aligns with the following OEM NHMP goals: (1) Protect life and reduce injuries resulting from natural hazards. (2) Minimize property damage from natural hazards. (3) Minimize damage to critical or essential infrastructure and services from natural hazards. (5) Minimize project impacts to the environment		

	and utilize natural solutions to protect people and property from natural hazards. (9) Minimize damage to historic and cultural resources from natural hazards. Aligns with Oregon Planning Goal 7.
Alignment with existing plans and policies	OEM NHMP 2020, City of Hillsboro Comprehensive Plan

Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Fire Chief		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Public Works, Parks, Floodplain Manager	Washington County

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund	HMGP, HMGP-PF-FM, Community Wildfire Defense Grant

Estimated Cost	$126,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Life safety and infrastructure and property protection		$756,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	Summer 2023	Winter 2024

Implementation Benchmarks: How Will Success Be Measured?

Completion of milestones:

- RFP and selection of contractor
- Kick-off meeting
- Workshops
- Gathering data
- Assess risk of occurrence/identify infrastructure at risk
- Establish community base map
- Develop risk assessment
- Assess firefighting capabilities and wildfire readiness

• Develop CWPP • Adopt CWPP • Develop Story Map and present to community
Potential Challenges to Implementation
• Funding, availability of qualified contractor
Resources and References, if Applicable
• Washington County CWPP

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
	No action	0	
Alternative #2	CWPP with no Story Map	$106,000	Would lessen the benefit to the whole community if the Story Map were excluded.
Alternative #3	Full action	$126,000	

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 179: Public Education for Dam Failure

Mitigation Action Information			
Title of action	Public Education for Dam Failure		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	Publish informational materials on City website to provide information on Scoggins Dam and any potential downstream effects that would occur as a result of dam failure. Analyze current preparedness materials and presentations and update as needed.		
Hazard(s) addressed	Dam failure ☒	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Provides education to the public about Scoggins Dam and downstream effects of dam failure at that location.		
Area of action impact	Provides information to the City at large		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	State of Oregon NHMP		
Alignment with existing plans and policies	City of Hillsboro Comprehensive Plan		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Fire – Emergency Management		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Water, Communications	Bureau of Reclamation, JWC
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund	HMGP
Estimated Cost	$5,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Provide information to the public to enhance awareness and preparedness		$30,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	Fall 2023	Fall 2024

Implementation Benchmarks: How Will Success Be Measured?

For website:
- Gathering of information
- Layout
- Web design
- Publishing

For other materials:
- Review materials and presentations
- Update as needed

Potential Challenges to Implementation

- Staff time

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 180: Analyze and Implement Fuel Reduction Strategies to Reduce the Risk and/or Spread of Wildfires Within the City of Hillsboro, Using Findings from the CWPP as a Guide

Mitigation Action Information	
Title of action	Analyze and Implement Fuel Reduction Strategies to Reduce the Risk and/or Spread of Wildfires Within the City of Hillsboro, Using Findings from the CWPP as a Guide
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Hillsboro's Community Wildfire Protection Plan (CWPP) will include actionable tasks that can be taken to prevent or reduce the impact of wildfires within the City and address the following: determining fuel hazards; assessing risk of wildfire occurrence; identifying homes, businesses, and essential infrastructure at risk; and prioritizing fuel treatment. Using the CWPP as a guide, the City will analyze and implement fuel reduction strategies to reduce the risk and/or spread of wildfires within the City of Hillsboro.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	The City will analyze and implement fuel reduction strategies to reduce the risk and/or spread of wildfire in greenspace and adjacent properties.
Area of action impact	Entire City
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	Aligns with the following OEM NHMP goals: (1) Protect life and reduce injuries resulting from natural hazards. (2) Minimize property damage from natural hazards. (3) Minimize damage to critical or essential infrastructure and services from natural hazards. (5) Minimize project impacts to the environment and utilize natural solutions to protect people and property from natural hazards. (9) Minimize damage to historic and cultural resources from natural hazards.
Alignment with existing plans and policies	OEM NHMP 2020, City of Hillsboro Comprehensive Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒

Lead position, office, department, or division responsible for implementation	Fire Chief

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Public Works, Parks, Floodplain Manager	Washington County, ODF, ODFW

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund, Office of State Fire Marshal grants (Defensible Space Local Government Grant)	HMGP, HMGP-PF-FM, Community Wildfire Defense Grant

Estimated Cost	$10,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Life safety, infrastructure, and property protection		$60,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	2025	

Implementation Benchmarks: How Will Success Be Measured?

Potential Challenges to Implementation
• Funding, availability of staff and/or contractors

Resources and References, if Applicable
• Washington County CWPP

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 181: Create Plan to Expedite Translation of Emergency Messaging

Mitigation Action Information	
Title of action	Create Plan to Expedite Translation of Emergency Messaging
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Create plan to expedite translation of emergency messaging and emergency public information for languages spoken by approximately 1,000 or more Limited English Proficiency (LEP) individuals in the City of Hillsboro, based on the current census. This plan may include but is not limited to the following: evaluation of current capabilities, identification of in-house resources, pre-scripting of messages, template creation, analysis of processes, creation of streamlined process for translation with checklists and/or flowcharts.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☒ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Ensures timely emergency messaging and emergency public information is accessible to the whole community.
Area of action impact	Total population
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	City of Hillsboro Comprehensive Plan, City of Hillsboro Emergency Operations Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Fire – Emergency Management

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
City Manager's Office – Communications, City Manager's Office – Diversity, Equity, and Inclusion Manager	Washington County EM, community partners
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund	HMGP
Estimated Cost	$20,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Ensures timely emergency messaging and emergency public information is accessible to the whole community.		$120,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	2023	2025

Implementation Benchmarks: How Will Success Be Measured?

- Evaluation of current capabilities
- Identification of in-house resources
- Evaluation of City contracts for translation services
- Analysis of processes
- Pre-scripting of messages and template creation
- Translation of pre-scripted messages and templates
- Creation of process with checklists and/or flowcharts, as needed

Potential Challenges to Implementation

- Staff time, resources

Resources and References, if Applicable

Three Alternatives Considered, Including No Action

	Action Description	Estimated Cost	Evaluation
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 182: Comprehensive Plan Implementation Measures

Mitigation Action Information			
Title of action	Comprehensive Plan Implementation Measures		
Type of action	Plans/regulations ☒	Natural systems protection ☒	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	The City Council adopted a major update to the Hillsboro Comprehensive Plan (HCP) that took effect in January 2018. Since then, Planning Division staff have been working through the implementation measures of this major update through amendments to the City's Community Development Code (CDC). One section within the HCP that still needs to be implemented is Section 9, Natural Hazards. This section identified policies and goals related to (1) minimizing the impacts of natural hazards on people and property, (2) providing information and services to support hazard preparation and recovery for people of all ages, abilities, cultures, and incomes, (3) improve coordination with public and private partners, (4) building capacity for greater urban resilience, and (5) managing and maintaining spatial, demographic, and economic data to support hazard mitigation planning.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	With the support of a consultant, City staff would update and enhance ordinances and design standards to limit the impact of natural hazards on people and property by limiting/prohibiting future development in hazard areas, enhancing preservation of natural resources, and protecting cultural resources.		
Area of action impact	These amendments would have a City-wide impact with specific focus within the City's Regulatory Floodplain Overlay (RFO) and Significant Natural Resources Overlay (SNRO).		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? The updated standards would impact the placement and design of critical facility(ies) within hazard areas.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	State of Oregon Statewide Land Use Planning Goals 5 and 7		
Alignment with existing plans and policies	This effort would create consistency between the City's long-term goals in policies in the HCP and implementation measures in the CDC.		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Planning Director, Planning Division, Community Development Department		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Staff from the City's Building Division, Emergency Management team, Fire & Rescue Department, Parks & Recreation Department, Public Works Department, Transportation Systems Division, and Water Department		Staff from Clean Water Services and Washington County	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
City general fund		FEMA Building Resilient Infrastructure and Communities Grant	
Estimated Cost	$150,000.00		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Carrying the community's vision on hazard preparation and mitigation into the land development code.	Having consistency among regulatory documents.	$900,000.00	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	July 2023	February 2024	
Implementation Benchmarks: How Will Success Be Measured?			
• Stakeholder engagement (July to August 2023), staff report preparation (September to October 2023), Planning Commission initiation and public hearing (November to December 2023), and City Council readings (January to February 2024)			
Potential Challenges to Implementation			
• Staff resources related to other priorities			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Pushing start of effort back from July 2023 to January 2024	Same	This may be necessary to account for appropriate staff resources
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 183: Natural Resource Regulations Enhancements

Mitigation Action Information			
Title of action	Natural Resource Regulations Enhancements		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐	Natural systems protection ☒ Public education/awareness ☒	
Action description	The Community Development Code (CDC) that was adopted by the City Council and took effect in September 2014 included the City's Significant Natural Resource Overlay (SNRO) as well as tree preservation standards. Since that adoption, only minor amendments have been made to the SNRO and tree preservation standards. While implementing these regulatory provisions, Planning Division staff have identified the need to refine and enhance the SNRO regulations for consistency with Section 12 of the Hillsboro Comprehensive Plan (HCP), for ease of implementation and understanding, and to codify off-site mitigation opportunities. In addition, staff have identified a need to analyze current landscaping recommendations to ensure that species susceptible to drought, pests, and wildland fires are possibly removed from the recommendations.		
Hazard(s) addressed	Dam failure ☐ Drought ☒ Earthquake ☐ Extreme heat ☒	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☒	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	With the support of a consultant, City staff would update and enhance the regulations related to the SNRO to ensure consistency with HCP goals and policies, codify current practices, and ensure that staff recommendations on future tree, shrub, and groundcover plantings are cognizant of changing environmental conditions.		
Area of action impact	These amendments would have a City-wide impact with specific focus within the City's SNRO.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☒	Goal 7 ☐
Integration into other initiatives	State of Oregon Statewide Land Use Planning Goals 5, 6, and 7		
Alignment with existing plans and policies	This effort would create consistency between the City's long-term goals in policies in the Hillsboro Comprehensive Plan (HCP) and implementation measures in the CDC.		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Senior Planner, Planning Division, Community Development Department		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Staff from the City's Emergency Management team, Fire & Rescue Department, and Parks & Recreation Department		Staff from Clean Water Services and Washington County	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
City general fund, State of Oregon Landscape Resiliency Program		Federal Wildland-Urban Interface (WUI) Grants	
Estimated Cost	$75,000.00		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Carrying the community's vision on hazard preparation and mitigation into the land development code.	Having consistency among regulatory documents.	$450,000.00	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	January 2024	January 2026	
Implementation Benchmarks: How Will Success Be Measured?			
• Stakeholder engagement (January to December 2024), staff report preparation (January to June 2025), Planning Commission work sessions, initiation, and public hearing (July to November 2025), and City Council readings (December 2025 to January 2026)			
Potential Challenges to Implementation			
• Staff resources related to other priorities			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Pushing start of effort back from January 2024 to July 2024	Same	This may be necessary to account for appropriate staff resources
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 184: Regulatory Floodplain Overlay Enhancements

Mitigation Action Information			
Title of action	Regulatory Floodplain Overlay Enhancements		
Type of action	Plans/regulations ☒	Natural systems protection ☒	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	In 2016, the City adopted revised countywide November 4, 2016, FIRMs and Flood Insurance Study, which vastly increased the accuracy of Washington County's effective floodplain mapping and provided detailed hydraulic models for floodway project evaluation on all FEMA floodplains. This adoption process necessitated extensive public outreach and internal GIS data updates. In 2016, the City also began participating in the FEMA Region X/DLCD Endangered Species Act (ESA) Biological Opinion (BiOp) work groups, which provided input to state and federal agencies on how the BiOp could be implemented in Oregon more effectively and efficiently. During this period, the City continued implementing its Flood Damage Protection Ordinance, called the "Regulatory Floodplain Overlay" (RFO) within the City's Community Development Code (CDC). This Overlay resulted in 19 Floodplain Activity land use reviews since 2016, which were implemented through subsequent permits incorporating NFIP requirements for buildings in the flood fringe and floodplain land disturbance. After a recent staff transition in which a new City staff member attended the FEMA E0273 NFIP Floodplain Development Course, staff have identified a need to have a more robust response plan in place when overland flooding has impacted structure(s) within the City. Furthermore, City staff expects to need to refine the RFO regulations to implement the recommendations/requirements from the BiOp effort and provide any additional needed clarity on FEMA regulations.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	With the support of a consultant, City staff would update and enhance the regulations related to the RFO to ensure that best practices on limiting the impact of flooding on people and property are reflected. Additionally, refinements would aim to reduce negative impacts from the NFIP on salmon, steelhead, and other species listed as threatened under the ESA.		
Area of action impact	These amendments would have a City-wide impact with specific focus within the City's Regulatory Floodplain Overlay (RFO).		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		

Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☒ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	State of Oregon Statewide Land Use Planning Goals 5, 6, and 7		
Alignment with existing plans and policies	This effort would create consistency between the City's long-term goals in policies in the Hillsboro Comprehensive Plan (HCP) and implementation measures in the CDC.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Senior Planner, Planning Division, Community Development Department		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Staff from the City's Building Division and Emergency Management team	Staff from Clean Water Services and Washington County

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
City general fund	FEMA Flood Mitigation Assistance Grant
Estimated Cost	$75,000.00

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Carrying the community's vision on hazard preparation and mitigation into the land development code.	Having consistency among regulatory documents.	$450,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	January 2024	January 2026

Implementation Benchmarks: How Will Success Be Measured?
• BiOp work groups (TBD), stakeholder engagement (January to December 2024), staff report preparation (January to June 2025), Planning Commission work sessions, initiation, and public hearing (July to November 2025), and City Council readings (December 2025 to January 2026)

Potential Challenges to Implementation			
• Staff resources related to other priorities			
Resources and References, if Applicable			
Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Pushing start of effort back from January 2024 to July 2024	Same	This may be necessary to account for appropriate staff resources
Alternative #2	Implement BiOp regulations without updating CDC	No cost	This could create confusion for staff and customers
Alternative #3			
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 185: Public Outreach Media Analysis and Expansion

Mitigation Action Information	
Title of action	Public Outreach Media Analysis and Expansion
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Analyze current disaster preparedness videos for gaps in content and cultural appropriateness for our area. Expand video library for specific seismic, wind, snow, and/or flood safety tips and seismic retrofitting for single-family homes. Make all videos in English as well as in at least one other language.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Public outreach teaches people how to prepare their home for a natural disaster, make an emergency kit before a natural disaster, respond effectively during a natural disaster, and what to do after a natural disaster (i.e., seismic, wind, snow, and flood events). Proper training and understanding in these areas can save lives and reduce damage costs.
Area of action impact	Citywide
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☐ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	State of Oregon Mitigation Plan
Alignment with existing plans and policies	City of Hillsboro Comprehensive Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Building Director for the Building Division of the Community Development Department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Chief Plans Examiner, Communications Division, Diversity and Equity Director, and IS.	
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Building fund	HMGP and BRIC
Estimated Cost	$100,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Resiliency of the community		$600,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	January 1, 2024	January 1, 2026

Implementation Benchmarks: How Will Success Be Measured?

- Review of current video library. Make new videos. Make matching videos in second language. Make videos available on the city website.

Potential Challenges to Implementation

- Staff time and resources

Resources and References, if Applicable

- FEMA website

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
	Evaluate current gaps	$5,000	5%
Alternative #2	Make current videos in a second language	$50,000	50%
Alternative #3	Complete project as written	$100,000	100%

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 186: Residential Code Revision

Mitigation Action Information			
Title of action	Residential Code Revision		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Purchase revised code books and associated standards. Analyze Oregon residential code revisions based on current model International Residential Code. Analyze outward customer handouts, forms, and web information for required revisions based on new code requirements. Analyze gaps in our permit system software. Revise handouts, forms, and web information accordingly. Revise permit system software as needed. Provide appropriate training for all plan review and inspection staff for implementation of these revisions. Implement revised code review and inspection accordingly on all new projects.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☐	Winter storm ☒
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Revising codes to align with the most current International Residential Code makes single family dwellings more resilient to known natural disaster risks for our area (i.e., seismic, wind, snow, and flood events). This saves lives and reduces damage costs.		
Area of action impact	Citywide		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	State of Oregon Mitigation Plan ORS 455		
Alignment with existing plans and policies	City of Hillsboro Comprehensive Plan		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☐ High ☒		
Lead position, office, department, or division responsible for implementation	Building Director for the Building Division of the Community Development Department		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Chief Plans Examiner, Community Development Director and IS		State Building Codes Division	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
Building fund		HMGP and BRIC	
Estimated Cost	$200,000		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Resiliency of the community		$1,200,000	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	October 1, 2023	January 1, 2024	
Implementation Benchmarks: How Will Success Be Measured?			
• Review of code revisions to the ORS 455. Revised materials and software. Personnel trained appropriately. Effective implementation of revised codes.			
Potential Challenges to Implementation			
• Staff time and resources			
Resources and References, if Applicable			
• State Building Codes Division			

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Purchase books and implement revised codes	$20,000	10%
Alternative #2	Purchase books, train personnel, and implement revised codes	$150,000	75%

Alternative #3	Complete project as written	$200,000	100%
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 187: Emergency Fuel Reserve Development

Mitigation Action Information	
Title of action	Emergency Fuel Reserve Development
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Evaluate existing state of fueling capacity for City (reference Emergency Fuel Reserves, Analysis and Business Case 2/7/2019) and identify gaps and potential solutions. Create a plan to identify funding and development strategy. Implement plan based on need and funding availability.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☒ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Addresses emergency fueling capacity during events that compromise fuel delivery from established provider (Bretthauer Oil).
Area of action impact	Citywide
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Supplement fueling necessary in delivery of critical, life safety response by Police, Fire, Public Works, Parks, and Water Departments
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	Emergency Fuel Reserves, Analysis and Business Case 2/7/2019; Hillsboro Comprehensive Plan; Washington County Emergency (Draft) Fuel Plan; City of Hillsboro EOP
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Public Works Department, Facilities Division Manager

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Office of Innovation; Fire, Police, Water & Parks Depts.; Facilities & Fleet Division	DOE, contractors, DEQ, ODOT, Washington County, Bretthauer

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund (TBD)	BRIC, HMGP, DOE Grants
Estimated Cost	$22,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Fueling capacity	Decreased response time	$132,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	Fiscal Year 2025/2026	Fiscal Year 2034/2035

Implementation Benchmarks: How Will Success Be Measured?

- Secure funding for evaluation
- Contractor hired
- Concept development completion 2025/2026
- Approval of concept
- Adoption by leadership and Council 2026/2027
- Funding approved to begin build
- If approved, infrastructure development begins 2027/2028
- Infrastructure development 50% complete
- Infrastructure development complete

Potential Challenges to Implementation

- Finance
- Availability of land

Resources and References, if Applicable

- Emergency Fuel Resources Analysis: Business Case Report 2/7/2019

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
	Analysis and Plan	$2,000,000	
Alternative #2	Analysis, Plan, and one location	$12,000,000	
Alternative #3	Analysis, Plan and two locations	$22,000,000	

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 188: Tertiary Power Solutions at City-Owned Critical Facilities

Mitigation Action Information	
Title of action	Tertiary Power Solutions at City-Owned Critical Facilities
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Research and analyze alternate energy sources and alternate fuel sources to provide backup power in addition to current diesel generators at City-owned facilities. Develop a plan for implementation based on findings and feasibility. Implement plan based on funding availability.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	In the event the primary power source and diesel generator (or components) are compromised by a natural hazard, this would allow functionality at City-owned critical facilities.
Area of action impact	City-owned critical facilities
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Fire and Police Stations, Water Operations, Public Works facilities, Civic Center
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	State of Oregon NHMP
Alignment with existing plans and policies	City of Hillsboro Comprehensive Plan, City of Hillsboro Emergency Operations Plan
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	Public Works – Facilities Division

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Fire, Police, City Manager's Office, Building, Planning, Water	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund	HMGP, DOE Grants

Estimated Cost	Analysis and Plan – $250,000 Implementation – $10,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Ensures timely emergency messaging and emergency public information is accessible to the whole community.		Plan – $1,500,000 Implementation – $60,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	2025	2035

Implementation Benchmarks: How Will Success Be Measured?

- Analyze current generator capabilities
- Analyze options for expansion of backup power systems
- Develop implementation plan
- Implement based on funding availability

Potential Challenges to Implementation

- Staff time, resources

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
	Analysis only	$125,000	
Alternative #2	Analysis and Plan	$125,000	
Alternative #3	Implementation	$10,000,000	

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 189: Seismic Analysis for Sanitary Sewer Conveyance

Mitigation Action Information	
Title of action	Seismic Analysis for Sanitary Sewer Conveyance
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	This mitigation action proposes a seismic engineering analysis that will assist the City in prioritizing capital projects to upgrade the sanitary sewer system. Planned retrofits will create a sanitary sewer system that is more resilient to earthquakes.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Oregon has the potential for a 9.0+ magnitude earthquake caused by the Cascadia Subduction Zone. Currently, scientists are predicting that there is about a 37% chance that a megathrust earthquake of 7.1+ magnitude in this fault zone will occur in the next 50 years. With the current preparedness levels in Oregon, we can anticipate being without services and assistance for at least 2 weeks when the Cascadia Subduction Zone earthquake occurs. Sanitary sewer system components constructed with older, brittle materials like concrete are likely to collapse during an earthquake. By analyzing the current state and planning upgrades to our sanitary sewer system, we can be more prepared and improve emergency response in the event of an earthquake.
Area of action impact	If the City of Hillsboro were affected by an earthquake, the entire sanitary sewer system would be impacted. Older parts of the conveyance system, or sewer infrastructure constructed of brittle materials like concrete, are more likely to be destroyed.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Sanitary Sewer Conveyance
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☒ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	This analysis can be included as a part of a current City of Hillsboro Sanitary Sewer Master Planning effort. State of Oregon NHMP.
Alignment with existing plans and policies	This mitigation action item will provide City of Hillsboro Public Works with data that will assist with the local initiative to prioritize and implement capital projects. Additionally, this analysis can provide insight to help guide future City of Hillsboro design and construction standards. This effort could be aligned with requiring more sustainable materials for use in public infrastructure. By avoiding materials such as concrete, the City of Hillsboro could be built using materials that require less greenhouse gases and other resource-intensive assets. City of Hillsboro Comprehensive Plan.

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Storm and Sanitary Sewer Division Manager Public Works Director		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Storm and Sanitary Division, Economic Development Division		Clean Water Services	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
Sanitary Sewer Operating Fund, Sanitary Sewer Local Service Fee		FEMA Hazard Mitigation Grant Program FEMA Hazard Mitigation Assistance Grants (BRIC) – Building Resilient Infrastructure and Communities	
Estimated Cost	$1,000,000		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Protection of human life and safety, sanitation	Improved earthquake response and return to services	$6,000,000	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	Start of Fiscal Year 2024	Ongoing Program	
Implementation Benchmarks: How Will Success Be Measured?			
• Complete engineering analysis of current state and potential changes to sanitary sewer system design and construction standards. • Create prioritized list of upgrade/retrofit projects to public sanitary sewer system. • Implement prioritized projects list.			
Potential Challenges to Implementation			
• Potential challenges to implementation include upgrades and retrofits to sanitary sewer systems located in sensitive natural areas and traffic control in areas where projects are located in streets.			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Annex E: City of North Plains

1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for the City of North Plains was the City Manager.

1.2. Annex Organization

This annex includes six sections that satisfy mitigation requirements outlined in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

The information provided in this annex is for the City of North Plains alone. All pertinent information that is not identified in this annex is included in other sections of this NHMP or in the respective appendices.

1.3. NHMP Adoption Process

Once the Washington County NHMP received the designation “Approvable Pending Local Adoption” from the Federal Emergency Management Agency (FEMA), the City presented the plan to City Council for final public comment and local adoption. A copy of the resolution was inserted into the NHMP and is held on file in the City of North Plains and Washington County.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

City officials recognize the benefits of having a long-term, all-hazards approach to mitigating natural hazards. The passage of the Disaster Mitigation Act of 2000 (DMA 2000) enabled City officials to recognize the benefits of having a long-term, all-hazards approach to hazard mitigation and mitigating natural hazards. The City's involvement in the Washington County NHMP represents the collective efforts of the NHMP Steering Committee members, all participating local Technical Committee members, the public, and stakeholders

The City developed this annex in accordance with guidance outlined in 44 CFR §201.6(c)(5) of DMA 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in the geographical area of the City.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP. An open involvement process was established for the public and all stakeholders, which provided an opportunity for everyone to become engaged throughout the planning process and make known their views about perceived hazards and how best to mitigate them.

Two teams worked simultaneously throughout the development of this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of points of contact from each planning participant. The group met to discuss county-wide topics, including hazards and mitigation strategies. The points of contact were the leads of their local Technical Committee.
2. **Local Technical Committee:** Each plan participant formed a Technical Committee that consisted of the Steering Committee representative for that jurisdiction or special district as well as designated representatives from special jurisdictions, county fire departments, and others. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. Technical Committee of the City of North Plains

The City of North Plains annex of the overall NHMP was developed by the local Technical Committee of the City of North Plains with support from IEM, a consulting firm hired to assist with the planning process. The efforts of the committee, which took place throughout 2022, were led by the City Manager.

Table 190: City of North Plains Technical Committee Members for the 2023 NHMP

Job Title and Department	Role in Committee and Planning Process
City Manager, City Manager's Office	General oversight, hazard identification, and plan development.
Public Works Director/Emergency Manager, Public Works Department	Hazard identification and plan development.

IEM also supported or led the following activities associated with the development, approval, and adoption of the plan:

1. Facilitated the NHMP update process.
2. Based on committee direction and stakeholder and community input, prepared the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.

3. Submitted the proposed plan to the State of Oregon Department of Emergency Management (OEM) and FEMA for review and approval, and completed edits or revisions requested by these organizations.
4. Coordinated the plan adoption processes with the City, OEM, and FEMA.

2.3. Public Participation

Public participation is an important component of this NHMP and also a required element as outlined in 44 CFR §201.6(c)(5), FEMA's mitigation planning guidance. Public participation offered community members the opportunity to voice their ideas, interests, and opinions about hazards that affect them and the best way to mitigate hazard impacts. As the City implements the mitigation actions identified in this annex, there will be additional opportunities for public participation.

Plan participants used a survey to collect information about community perceptions of natural hazards and priorities. The Steering and Technical Committees used the results to inform their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP. See Appendix B in the NHMP for additional information about the survey and opportunities for public comment.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist the City of North Plains in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards.

3.1. Community Profile

This section provides information on City-specific characteristics. Additional discussion of the planning area's community characteristics is outlined in Appendix A of the NHMP.

Some community characteristics may suggest how natural hazards may impact communities and how communities choose to plan for natural hazard mitigation. Identifying and considering the City-specific assets during the planning process may assist in identifying appropriate measures for natural hazard mitigation.

The following table reflects the community demographics and vulnerable populations in the City. This information was gathered from the U.S. Census, Portland State University, and the City of North Plains.

Table 191: Community Demographics*

Population	Total	Percent Change
2010 population[410]	1,928	
2021 population[411]	3,446	+79%
2035 forecasted population	6,190	+80%
Race and Ethnicity[412]	**Total**	**Percent of Population**
White alone	2,276	84%
Hispanic/Latino/a/x of any race	195	7%
Asian alone	160	6%
Two or more races	145	5%
Black or African American alone	102	4%
American Indian and Alaska Native alone	9	0.3%
Native Hawaiian and Other Pacific Islander alone	0	0%
Language Spoken at Home[413]	**Percent of Population**	
English only	89%	
Asian and Pacific Island languages	6%	
Indo-European languages	5%	
Spanish	1%	
Other languages	0%	
Vulnerable Age Groups[414]	**Percent of Population**	
Less than 15 years of age	12%	
65 years and older	15%	

[410] United States Census Bureau. (2010). 2010–2015 American Community Survey 5-Year Estimates, Demographic and Housing Estimates, Table DP05. Accessed October 7, 2022, from https://data.census.gov/cedsci/table?g=1600000US4153150&y=2010&tid=ACSDP5Y2010.DP05
[411] Portland State University Population Research Center. (2022). Population Estimate Reports. https://www.pdx.edu/population-research/population-estimate-reports
[412] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates Demographic and Housing Estimates, Table DP05. Accessed September 21, 2022, from https://data.census.gov/cedsci/table?q=North%20Plains%20oregon&tid=ACSDP5Y2020.DP05
[413] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Language Spoken at Home, Table S1601. Accessed September 21, 2022, from https://data.census.gov/cedsci/table?q=North%20Plains%20oregon%20language
[414] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Age and Sex, Table S0101. Accessed September 21, 2022, from https://data.census.gov/cedsci/table?q=North%20Plains%20oregon%20language&tid=ACSST5Y2020.S0101

Disability Status	Percent of Population
Total	Data Not Available
Less than 17 years of age	Data Not Available
65 years and older	

* Due to how respondents identify and answer questions, there may be overlapping responses, and results may equal greater than 100% of the population. Percentages are rounded.

3.1.1. Geography, Topography, and Climate

The City of North Plains, Oregon, is a small, semi-rural city located in western Washington County. The City has an area of 1.09 square miles and has an elevation of 176 feet. The City is surrounded by agricultural land and wooded areas. The climate for North Plains is moderate. Mean daily temperatures range from highs of around 82 °F in August to lows of 34 °F in January. On average, the City receives approximately 41 inches of rain and 3 inches of snow per year.

3.1.2. Transportation, Infrastructure, and Housing

3.1.2.1. Transportation

North Plains is a small community located along US Highway 26, which connects it to the cities of Hillsboro and Portland. Arterial roads include NW Glencoe Road, which runs north–south, and NW Commercial Street, which runs east–west.

The City is served by Ride Connection Community Bus Service, which provides a free shuttle to the Tri-County Metropolitan Transit District (TriMet) public transportation system hub in Hillsboro, the western terminus of the 33-mile metropolitan light rail line that links Portland's west and east suburbs as well as the Portland International Airport. Portland & Western Railroad services the City and operates a 520-mile regional system of rail lines in western Oregon with freight capacity and Class 1 connections. There are spur line opportunities along the North Plains corridor.

3.1.2.2. Infrastructure

In North Plains, Clean Water Services provides wastewater treatment services. The power provider is Portland General Electric (PGE). PGE has a total combined generating capacity of 1,957 megawatts and they also operate several Reliability Centers throughout the region. NW Natural is the natural gas provider that serves residential, commercial, and industrial customers in western Oregon and southwest Washington.

The City of North Plains critical and vulnerable facilities listed below in Table 192 may be vulnerable to one or more natural hazards.

Table 192: Critical Facility and Asset Inventory[415]

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
North Plains City Hall	Infrastructure or Facility	31360 NW Commercial Street	Soon to be moved to new larger building on #2 Water Station Site.
North Plains Water Station #1	Infrastructure or Facility	32175 NW Commercial Street	
North Plains Water Station #2	Infrastructure or Facility	29905 NW West Union Road	

3.1.2.3. Housing

Housing characteristics are an important factor in mitigation planning. The information below shows that most housing units are owner-occupied and consist of one-unit buildings built before 1999. The older the housing, the more at risk it can be to damage from natural hazards such as earthquakes and windstorms, including tornadoes.

The Census estimates North Plains grew 75% between 2010 and 2020. The city grew at nearly 6% per year, adding an average of 147 new residents each year.[416] Housing development has been increasing to meet this need. As of 2021, the City of North Plains had a total of 67 buildable residential acres by zoning designation.[417] Approximately 80% of housing in the City is predominantly single-family detached housing units.[418]

[415] City of North Plains NHMP planning documentation
[416] City of North Plains. (2022, February). Draft Economic Opportunities Analysis. https://www.northplains.org/sites/default/files/fileattachments/city_manager/page/786471/north_plains_eoa_report_append_3_30_22.pdf
[417] City of North Plains. (2022, April). City of North Plain Housing Needs Analysis Consolidated Report. https://www.northplains.org/sites/default/files/fileattachments/city_manager/page/786471/draft_north_plains_hna_04.06.22.pdf
[418] City of North Plains. (2022, April). City of North Plain Housing Needs Analysis Consolidated Report. https://www.northplains.org/sites/default/files/fileattachments/city_manager/page/786471/draft_north_plains_hna_04.06.22.pdf

Table 193: Housing Characteristics*

Households	Total
Total households[419]	1,006
Units in Housing Structure[420]	**Percent of Housing**
One-unit structures	91%
Structures with two or more units	6%
Manufactured homes and all other types	3%
Year Housing Structure Built[421]	**Percent of Housing**
Pre-1979	20%
1980–1999	40%
2000 to present	41%

Housing Tenure and Vacancy	Percent of Housing
Owner-occupied[422]	80%
Renter-occupied[423]	20%
Vacant[424]	3%

* Due to how respondents answer questions, there may be overlapping responses, and results may equal greater than 100%. Percentages are rounded.

[419] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates Households and Families Table S1101. Accessed September 21, 2022, from https://data.census.gov/cedsci/table?q=North%20Plains%20oregon%20housing&tid=ACSST5Y2020.S1101
[420] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates Households and Families Table S1101. Accessed September 21, 2022, from https://data.census.gov/cedsci/table?q=North%20Plains%20oregon%20housing&tid=ACSST5Y2020.S1101
[421] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Physical Housing Characteristics for Occupied Housing Units, Table S2504. Accessed September 21, 2022, from https://data.census.gov/cedsci/table?q=North%20Plains%20oregon%20housing&tid=ACSST5Y2020.S2504
[422] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates Households and Families Table S1101 https://data.census.gov/cedsci/table?q=North%20Plains%20oregon%20housing&tid=ACSST5Y2020.S1101, accessed September 21, 2022
[423] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates Households and Families Table S1101 https://data.census.gov/cedsci/table?q=North%20Plains%20oregon%20housing&tid=ACSST5Y2020.S1101, accessed September 21, 2022
[424] United States Census Bureau. (2021, July 1). 2020 Decennial Census Occupancy Status, Table H1. https://data.census.gov/cedsci/table?q=North%20Plains%20oregon%20housing, accessed September 21, 2022

3.1.3. Economy

Located in the heart of Oregon's Silicon Forest, North Plains is part of a thriving tech scene and is within a short drive to the Portland metro area's larger cities. The residents have access to jobs at multinational employers such as Intel, Genentech, and Nike, along with diverse industries including education, healthcare, agriculture, and craft beer brewing. Oregon Canadian and Jewett Cameron are two of the City's larger employers.

The City has 166 businesses and these businesses attract workers from across the Portland Metro region. The local employment base is largely dominated by small employers of fewer than five employees (65% of firms). There is one employer of over 100 or more employees, and four employers with between 50 and 100 employees.[425] The sectors with the greatest number of employees in 2021 were manufacturing, construction, administration and waste management services, leisure and hospitality, and wholesale trade.[426] The City's location along US Highway 26 provides good transportation access and makes it a gateway to the Oregon Coast. It also is close to major employment centers in western Washington County and has good access to the regional workforce. North Plains is located in an agricultural region, with a diverse offering of agricultural products including fruits, wheat, wine, and nursery plants.[427]

Table 194: Income Characteristics*[428]

Households by Income Category	Percent of Households
Less than $5,000	.3%
$5,000 to $9,999	0%
$10,000 to $14,999	2%
$15,000 to $19,999	4%
$20,000 to $24,999	4%
$25,000 to $34,999	6%
$35,000 to $49,999	5%
$50,000 to $74,999	16%
$75,000 to $99,999	17%
$100,000 to $149,999	20%
$150,000 or more	27%
Median Household Income	
$95,875	

* Due to how respondents answer questions, there may be overlapping responses, and results may equal greater than 100%. Percentages are rounded.

[425] City of North Plains. (2022, February). Draft Economic Opportunities Analysis. https://www.northplains.org/sites/default/files/fileattachments/city_manager/page/786471/north_plains_eoa_report_append_3_30_22.pdf
[426] City of North Plains. (2022, February). Draft Economic Opportunities Analysis. https://www.northplains.org/sites/default/files/fileattachments/city_manager/page/786471/north_plains_eoa_report_append_3_30_22.pdf
[427] North Plains Comprehensive Plan. https://www.northplains.org/sites/default/files/fileattachments/city_council/page/786411/north_plains_comprehensive_plan_adopted_june_3_2019.pdf
[428] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Financial Characteristics, Table S2503. Accessed September 21, 2022, from https://data.census.gov/cedsci/table?q=North%20Plains%20oregon%20income

3.2. Natural Hazard Profiles

The Technical Committee for the City of North Plains utilized the OEM's hazard analysis methodology to examine hazard vulnerability and probability by collecting information about history, probability, vulnerability, and maximum threat for each hazard that impacts the City. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants.

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Volume I, Section 2.

All natural hazards included in the NHMP have the potential to impact the City; however, due to geographic location and topography, the City cannot be directly impacted by dam failure and landslide events. The City assigned relatively low scores to these hazards and identify their potential impacts as secondary and not direct. The scores for each hazard that impacts the City are presented below.

Table 195: Natural Hazard Risk Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	Low	Low	Low	Low	56
Drought	Low	High	High	Medium	170
Earthquake: Cascadia (3–5-minute event)	Low	High	High	Medium	201
Earthquake: Crustal (1-minute event)	Low	Low	Low	Medium	71
Extreme heat	High	Medium	High	High	177
Flooding, including channel migration and streambed erosion	High	High	Medium	High	181
Landslide	Low	Low	Low	Low	24
Volcanic ash	Low	Medium	High	Low	124
Wildland fire	High	Medium	High	High	201
Windstorm, including tornado	High	Medium	Medium	High	132
Winter storm	High	Medium	High	High	187

Full descriptions of each hazard are provided in Volume I, Section 2. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description in this annex and in Volume I, Section 2.

The timeframe of data collected during the planning process for the City of North Plains was from as far back as available to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the City's Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are

presented in the same order, as applicable: populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

In addition to the natural hazards scored above, the City identified water supply disruption and dust storm as hazards that could impact the City. Water supply disruption was given a score of 179, and dust storm was given a score of 138. Brief descriptions of these hazards are included in this section.

3.2.1. Dam Failure

Due to geographic location and topography, the City cannot be directly impacted by dam failure. Any impacts in the City due to dam failure would be minimal. Potential impacts of and vulnerabilities to dam failure are identified below.

3.2.1.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a dam failure event would likely be economic. If a dam were to fail it could disrupt the ability of residents to commute to jobs outside the city and the ability to get to and from other areas that may experience a direct or secondary impact from a failure. The City's drinking water source, the Joint Water Commission (JWC), could experience secondary impacts of a Scoggins Dam failure; however, any effects are considered minimal.

3.2.2. Drought

Drought typically occurs as a regional event and often affects more than one city and county simultaneously. The City's primary drinking water supplier is the JWC, which wholesales to North Plains. Potential impacts of and vulnerabilities to drought are identified below.

3.2.2.1. Potential Impacts

The potential drought impacts are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts include:

- Reduction or loss of water supply, water use restrictions, and lack of potable water supply.
- Health effects, including increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions.
- Reduced economic productivity or business closures, including agriculture, livestock, recreation, energy, tourism, timber, and fisheries.
- Supply chain restrictions, including food shortages.
- Loss of power or reduced availability of electricity due to infrastructure damage and high demand.
- Property and infrastructure damage due to expansive soils, which are clay-based soils that expand and contract based on the amount of moisture in the soil.
- Damage to natural environments, including low water levels in lakes, rivers, and other water bodies, reduced plant growth, local species reduction or extinction, increased water temperature, and deteriorated water quality, which may result in fish kills and increased waterborne pollutants.
- Concurrent hazards, including extreme heat, wildfire, flooding, and landslides.

3.2.2.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to drought. These include:

- People in the City with preexisting health conditions, those without access to clean water, children, pregnant women, and older adults.
- JWC's water supply sources, including the upper Tualatin River, Barney Reservoir, and Scoggins Reservoir.
- Critical infrastructure, including the City's two water stations and city hall.
- Critical transportation infrastructure, including US Highway 26 and arterial roads.
- Natural environments throughout the City, including parks, the community garden, and walking trails.
- Landscaping and trees located throughout the City.

3.2.3. Earthquake

The City could experience earthquakes that originate from the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek Fault Zone. It could also experience liquefaction as the result of an earthquake. Potential impacts of and vulnerabilities to earthquake are identified below.

3.2.3.1. Potential Impacts

The potential impacts of an earthquake event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Mental health impacts, including post-traumatic stress disorder.
- Public health hazards resulting from disruption of drinking water and wastewater systems.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to underground utilities; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, and telecommunications.
- Blocked roads and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction.
- Downed or damaged power lines that can lead to wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Change in water flows, including paths of rivers and streams.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards initiated by an earthquake, including flood, wildland fire, and landslide.

3.2.3.2. Vulnerabilities

All populations, the economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to earthquakes. These include:

- Critical infrastructure and facilities including two water stations and city hall. City facilities, except for the water reservoir and pump house, are not retrofitted.
- The newest two-million-gallon water reservoir and pump house is built to withstand an earthquake; however, should it fail, the City is ready to use the abandoned well as an emergency source of water.
- In 2019, the City worked with a contractor to complete a Water System Seismic Assessment and Mitigation Plan.[429] This assessment evaluated and rated the structural and nonstructural performance of the system's critical facilities, as applicable, and rated them as excellent, good, or poor. The assessment identified several assets vulnerable to earthquakes. The results of the assessment are provided below in the Water System Seismic Assessment section.
- Other critical infrastructure, such as pipelines and utility lines, US Highway 26, arterial roads, communication structures, and emergency generators can be vulnerable to damage from liquefaction due to the type of soil in the City.
- Unreinforced masonry buildings in the older central business district of the City are more vulnerable to potentially substantial damage during an earthquake compared to other nearby structures built to modern standards.[430]
- Wood frame buildings with sill plates not bolted to foundation, cripple wall perimeter systems, and buildings on steep slopes, partially supported on "stilts" are generally substantially vulnerable to major seismic damage.[431]
- Buildings with very high or high collapse potential include residential and commercial buildings constructed prior to 1990.
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.
- Using 2022 Hazus®-MH information, it is estimated a 6.7 magnitude Gales Creek Fault earthquake event could result in 37 yellow-tagged buildings, 7 red-tagged buildings, and $15,449,000 in total economic losses.[432]
- A 2018 Oregon Department of Geology and Mineral Industries (DOGAMI) report shows that a:
  - Cascadia Subduction Zone magnitude 9.0 earthquake in "dry" soil conditions could result in $38,000,000 in building repair costs, 24,000 tons of debris, 7 long-term displaced residents, and up to 41 deaths;
  - Cascadia Subduction Zone magnitude 9.0 earthquake in "wet" soil conditions could result in $61,000,000 in building repair costs, 32,000 tons of debris, 157 long-term displaced residents, and up to 71 deaths;
  - Portland Hills fault magnitude 6.8 earthquake in "dry" soil conditions could results in $53,000,000 in building repair costs, 28,000 tons of debris, 20 long-term displaced residents, and up to 50 deaths; and

[429] Stantec. (2019, April 29). Water System Seismic Assessment and Mitigation Plan–Addendum to 2018 Water Master Plan Update: Technical Memorandum. north_plains_2019_water_system_master_plan_update_10-2-19.pdf
[430] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[431] Washington County Natural Hazard Mitigation Plan. (2017). https://www.co.washington.or.us/EmergencyManagement/plans-and-agreements.cfm
[432] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

- Portland Hills fault magnitude 6.8 earthquake in “wet” soil conditions could results in $92,000,000 in building repair costs, 41,000 tons of debris, 266 long-term displaced residents, and up to 98 deaths.[433]

- Natural environments throughout the City, including parks, the community garden, and walking trails.
- Landscaping and trees located throughout the City.

3.2.3.2.1. Water System Seismic Assessment

In 2019, the City worked with a contractor to complete a Water System Seismic Assessment and Mitigation Plan.[434] This assessment evaluated and rated the structural and nonstructural performance of the system’s critical facilities, as applicable, and rated them as excellent, good, or poor. The structural category was related to the structural building systems, the structural walls, the foundation, and similar elements. The nonstructural category related to architectural, mechanical, and electrical systems. The results of the evaluation are provided below.

3.2.3.2.1.1. JWC Vault

This facility is owned by the City of Hillsboro and is the critical point of connection to the primary water supply of the City of North Plains.

- Structural Performance Level: Good
  - Potential for liquefaction or settlement of the vault; liquefaction may lead to differential settlement.
  - Lateral spreading may occur due to sloping ground to the northeast.
- Nonstructural Performance Level: Poor
  - The interface between the vault and where the pipes enter is a hard connection. If the vault settles during a seismic event, the pipe will be forced to displace. The pipe does not have any expansion joints to accommodate this displacement.
  - Pipe supports provide vertical support only. No horizontal restraint is provided.
- Consequences of Failure:
  - The consequences of a seismic failure at this facility would be significant. This vault is along the only pipeline that provides drinking water to the City. Repair of the vault and associated piping could take weeks.

3.2.3.2.1.2. JWC Supply Pipeline from Hillsboro to North Plains

The 16-inch JWC supply pipeline from Hillsboro to North Plains conveys the water supply from the point of purchase from JWC in the City of Hillsboro to the City of North Plains.

- Overall Performance Level: Poor
  - The overall rating for the JWC pipeline is poor due to the significant length of pipeline constructed with unrestrained joints.

[433] Oregon Department of Geology and Mineral Industries. (2018). Open-File Report O-18-02: Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-18-02/O-18-02_report.pdf

[434] Stantec. (2019, April 29). Water System Seismic Assessment and Mitigation Plan–Addendum to 2018 Water Master Plan Update: Technical Memorandum. north_plains_2019_water_system_master_plan_update_10-2-19.pdf

- Consequences of Failure:
  - The consequences of a seismic failure of the JWC pipeline are significant. Severing of the transmission main pipeline could leave the City without water for a month or more, depending on the number of breaches.

3.2.3.2.1.3. 314th Avenue Pressure-Reducing Valve Vault

This vault contains valves that control the flow of water into the City's distribution system under normal and fire-flow conditions.

- Structural Performance Level: Poor
  - The 314th Avenue vault is located near a McKay Creek Tributary and Wetland, indicating a high groundwater table. Evidence of water infiltration into the vault confirms the high groundwater table.
  - Liquefaction could cause significant soil pressures on the walls and uplift forces on the bottom of the vault. No evidence has been found that the vault design considered liquefaction.
  - Soft soils susceptible to liquefaction are expected in this area due to the high groundwater table and wetland. It is likely that liquefaction settlement and lateral displacements towards the creek at the vault will occur. The vault may move horizontally and vertically and undergo differential settlements associated with the liquefaction in this area.
- Nonstructural Performance Level: Poor
  - The connection between the 314th Avenue vault and the JWC pipeline are at risk of differential settlement and horizontal displacement due to liquefaction and lateral displacement issues in this area.
- Consequences of Failure:
  - The consequences of a seismic failure at this facility would be significant. This vault is along the only pipeline that supplies drinking water to the City. Repair of the vault and associated piping could take weeks, depending on the extent of damage and the availability of materials and labor.

3.2.3.2.1.4. Well #3 at Water Station No. 1

This well is the City's only backup water supply.

- Structural and Nonstructural Performance Levels: Poor
  - The well and its electrical and control gear are located within the Water Station No. 1 booster pump building that is assumed not to be seismically resilient.
  - Well #3 may be susceptible to damage if the seismic lateral loads and seismic velocities on the well are too large for Well #3 to accommodate.
  - The McKay Creek Tributary known as Ghost Creek is within 50 feet of Well #3, indicating that there is likely high groundwater and sloping ground in this area. Lateral displacements due to liquefaction in this area are likely.
  - Due to the lack of information on the construction of Well #3, the uncertainty about whether the well will accommodate the seismic loads and deformations is high.
- Consequences of Failure:
  - Failure of Well #3 would result in the loss of a backup water supply for the City for periods on the order of months. If the JWC connection is maintained, this is not expected to have a significant impact on water supply to the City.

3.2.3.2.1.5. Trunk Distribution Pipes 12 Inches in Diameter or Larger

These pipelines within the City's distribution system are critical to maintaining pressure and flow.

- Overall Performance Level: Good
  - The overall rating for the City's distribution system is good. Use of ductile iron pipe with restrained joints for future construction along with completing looping within the distribution system will continue to improve seismic resiliency.
  - In any areas where the pipeline is near a slope, crossing a slope, or near a creek, it is likely that lateral displacement issues will be present.
  - The extent of unrestrained piping joints is unknown.
  - Looping of distribution piping with redundancy is an important mitigation strategy for pipeline breaks. There are currently some non-looped transmission mains, such as the 14-inch diameter PVC pipeline extending to the east.
- Consequences of Failure:
  - The consequences of these breakages could be significant because loss of large-diameter trunk lines could cause service outages for large portions of the City, especially in areas without looped piping. Pipe breaks in major trunk lines may also limit water distribution to and from Reservoir and Pump Station No. 2, even though that facility is to be built with seismic resiliency.

3.2.4. Extreme Heat

Due to a rise in the frequency, severity, and impacts of extreme heat events, the NHMP Steering Committee chose to include this hazard for the first time in the Washington County NHMP. Potential impacts of and vulnerabilities to extreme heat and previous significant events are identified below.

3.2.4.1. Significant Events

The City identified two significant extreme heat events it has experienced.

- **June 26–29, 2021:** The maximum temperature reached 108 °F, with a heat index of 115 °F. Throughout Washington County there were numerous fatalities, closures and postponements of businesses and events, and buckled roads, and cooling shelters were opened.
- **August 11–24, 2021:** The high temperature at Hillsboro Airport was 103 °F with a heat index of 109 °F on August 11 and 12. Peak afternoon temperatures ranged from 100 °F to 105 °F. Throughout the county there were fatalities, closures and postponements of businesses and events, and cooling shelters were opened.

3.2.4.2. Potential Impacts

The potential impacts of an extreme heat event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, heat stroke, and death.
- Extended operational hours of County staff and additional resources needed for response to the event, including the operation of daytime cooling centers and overnight cooling shelters.
- Strain on or loss of water supply due to increased demand.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic losses from decreased worker efficiency and effectiveness and time lost on the job when workers take more frequent or longer breaks to avoid overheating.
- Economic impacts of closure of outdoor activities and events, such as farmers markets and concerts.
- Property damage, such as roof expansions, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding.
- Disruption of essential infrastructure systems from overheated and damaged utilities, including power, water, transportation, and communication systems.
- Impacts to roadways as heat expands concrete or causes cracking and buckling. Public transit can also be impacted due to melted cables, sagging wires, and warping tracks.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Impacts to greenspaces, such as scorch and sunscald of new foliage, branches or tops of trees dying, and significant stress and die-off of native trees, particularly Douglas fir and cedar. These impacts are intensified if drought is also occurring.
- Concurrent hazards include drought and wildland fire.

3.2.4.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to extreme heat. The City utilizes two city facilities and one private facility as cooling centers within city limits as needed.

Populations substantially vulnerable to extreme heat include:

- People who work or spend a significant amount of time outdoors, including those in construction, landscaping, maintenance and repair, roofing, and solid waste collection.
- People who live and/or work in buildings without air conditioning or cooling equipment.
- People living, working, or spending time in heat islands within the City.
- People living outdoors or in the upper floors of multi-family housing units.
- Populations with higher heat sensitivity, including older adults, infants and children, pregnant women, people with preexisting or chronic diseases, and those who take certain medications that affect thermoregulation or block nerve impulses.
- People with limited mobility and no access to cooling systems who may not be able to travel to cooling centers or shelters.
- People who live in social isolation, including linguistic isolation or those living alone with few social relationships.
- Factors including race and ethnicity, income, and educational attainment are correlated with heat-related illness.

Additional vulnerabilities to extreme heat include:

- Critical infrastructure, including the City's two water stations and city hall.
- Other critical infrastructure, such as pipelines and utility lines, US Highway 26, arterial roads, communication structures, and emergency generators.
- Bridge infrastructure is vulnerable to thermal expansion of bridge joints and paved surfaces and deterioration of steel, asphalt, protective cladding, coats, and sealants.
- Asphalt pavement is vulnerable to accelerated deterioration through softening, rutting, and migration of liquid asphalt.
- Vehicles, including first responder vehicles, are vulnerable to engine overheating and tire deterioration.
- Aboveground utility and power lines can droop or sag and create a heightened fire risk.
- Plants, animals, ecosystems, and natural environments are vulnerable to high rates of mortality due to excessive heat.
- Natural environments throughout the City, including parks, the community garden, and walking trails.
- Landscaping and trees located throughout the City.

3.2.5. Flooding, Including Channel Migration and Streambed Erosion

The City experiences localized flooding typically from October through April. Several homes and business are located within the City's 100-year floodplain. Potential impacts of and vulnerabilities to flooding and previous significant events are identified below.

3.2.5.1. Significant Events

The City identified one significant flooding event it has experienced.

- **February 5–9, 1996:** The combination of heavy rain and rapidly melting snowpack in the mountains swelled rivers and streams. This caused some road closures and debris issues in the City. No facilities were impacted or damaged.

3.2.5.2. Potential Impacts

The potential impacts of a flooding event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts include:

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Need for widespread search and rescue operations, including water rescues.
- Displaced residents in need of sheltering.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal economic impacts of loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.2.5.3. Vulnerabilities

Populations, economies, built environment, critical facility, infrastructure, and natural environment vulnerabilities to a flooding event include:

- Populations without access to private transportation.
- Critical infrastructure, such as pipelines and utility lines, US Highway 26, arterial roads, communication structures, and emergency generators.
- Some homes and businesses along Ghost Creek and McKay Creek could be vulnerable to flooding. Additionally, properties without flood insurance may be more prone to risk from flooding.
- North Plains has 77 acres of floodplain within the 100-year floodplain of McKay Creek and its tributary Ghost Creek; however, there is virtually no development in this area.[435]
- Flood loss estimates determined by Hazus-MH include[436]:
  - 10-year flood scenario
    - Number of buildings lost: 1
    - Loss estimate: $51,000
  - 50-year flood scenario
    - Number of buildings lost: 4
    - Loss estimate: $162,000
  - 100-year flood scenario
    - Number of buildings lost: 9
    - Loss estimate: $383,000
  - 500-year flood scenario
    - Number of buildings lost: 58
    - Loss estimate: $1,963,000

[435] City of North Plains. (n.d.). City 101: Floodplains Explained. https://www.northplains.org/planning/page/city-101-floodplains-explained
[436] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

Table 196: Land Use Type in the 100-Year Floodplain in the City of North Plains

Land Use Type	Total Parcels in 100-Year Floodplain	Total Value of Exposed Parcels	Total Area in Jurisdiction (Acres)	Total Area in the 100-Year Floodplain (Acres)	Percentage of Area in the 100-Year Floodplain
Agriculture	0	$0	39.17	0	0%
Commercial	11	$10,718,870	117.61	18.19	15.5%
Forest	0	$0	2.24	0	0%
Industrial	2	$2,648,250	8.41	8.41	100%
Multi-Family Residential	0	$0	1.77	0	0%
Public	10	$580,520	49.21	18.58	37.8%
Rural	0	$0	0.22	0	0%
Single-Family Residential	100	$46,612,540	185.62	30.40	16.4%
Vacant	12	$464,940	29.49	9.74	33%
Other	17	$7,468,850	79.22	23.09	29.2%
Total	**152**	**$68,493,970**	**512.96**	**108.41**	**21.1%**

Table 197: Buildings in North Plains within FEMA-Mapped Floodplains

Building Classification	Buildings within North Plains	Buildings within 100-Year Floodplain
Total Buildings	1,422	71
Percentage of Buildings within North Plains	100%	5%

3.2.6. Landslide

Due to geographic location and topography, the City cannot be directly impacted by landslides. Any impacts in the City due to landslides are identified as secondary. Potential secondary impacts of and vulnerabilities to landslides are identified below.

3.2.6.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a landslide event would likely be economic. If a landslide outside city limits were to occur, it could disrupt the ability of residents to commute to jobs outside the city and the ability to get to and from other areas that may experience a direct or secondary impact from an event.

3.2.7. Volcanic Ash

Volcanic activity is possible at mountains within 60 miles of the County, including Mount St. Helens and Mount Hood. Ashfall from a volcanic eruption has the potential to impact the County, although the scale and types of impacts and vulnerabilities may differ depending on which volcano erupts, the level of eruption, and the wind direction during and after eruption. Potential ashfall impacts and vulnerabilities to volcanic ash are identified below.

3.2.7.1. Potential Impacts

Though unlikely, the impacts of a significant ashfall can be substantial, including:

- Indirect injuries and deaths, such as those sustained during ash cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation. This includes public water systems that rely on outdoor reservoirs.
- The need to shelter individuals to protect them from poor air quality, including houseless persons and persons displaced from their residences due to poor residential air filtration systems.
- Delayed emergency response times due to decreased visibility and increased traffic hazards.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and cleanup activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.2.7.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to volcanic ash. These include:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults.
- People without access to effective dust masks, eye protection, and drinking water and food uncontaminated by volcanic ash.
- Critical infrastructure, including the City’s two water stations and city hall.

- Critical transportation infrastructure, including US Highway 26 and arterial roads.
- Emergency generators.
- Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of volcanic ash, including manufactured homes and buildings, and the people who live or work in them.
- Natural environments throughout the City, including parks, the community garden, and walking trails.
- Landscaping and trees located throughout the City.

3.2.8. Wildland Fire

Although the City could experience a wildland/urban interface event, historically it is more likely to be affected by smoke and poor air quality due to wildland fires outside its boundaries. Potential impacts of and vulnerabilities to wildland fire and previous significant events are identified below.

3.2.8.1. Significant Event

The City has not been directly impacted by a wildland fire event. However, in September 2020, multiple wildfires occurred concurrently in the county, outside the county, and outside the state, and the City experienced significant smoke from the fires.

3.2.8.2. Potential Impacts

The potential impacts of a wildfire event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Exposure to wildfire smoke, which can lead to eye, nose, and throat irritation and the worsening of chronic heart and lung diseases.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to blocked transportation routes and debris, congested transportation routes due to evacuations, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Strain on or loss of water supply due to increased demand.
- Economic impacts to governments, including costs for fire suppression, staff, equipment, supplies, transportation and mobilization of first responders, evacuations, sheltering operations, post-fire recovery, and rebuilding costs associated with government-owned buildings, property, and infrastructure.
- Economic impacts, including loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity. Scoggins Valley Park receives one million visitors a year, most during summer, which is when wildland fires tend to occur.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property, causing blocked roads and rail transportation routes.

- Downed or damaged power lines. This impact may be compounded since powerline failures can lead to additional wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including air and water quality issues.

3.2.8.3. Vulnerabilities

Given the dynamic nature of wildland fires, all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to this hazard. These include:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults.
- Populations without access to private transportation.
- Drinking water sources and water treatment infrastructure, food supplies and availability, and access to medical resources or care may also be impacted by wildfire and can cause health impacts on a large scale.
- Homes, businesses, and infrastructure, such as power lines and storm sewers, adjacent to the agricultural and wooded areas outside city limits.
- Critical infrastructure, including the City's two water stations and city hall.
- Critical transportation infrastructure, including US Highway 26 and arterial roads.
- Emergency generators.
- Natural environments throughout the City, including parks, the community garden, and walking trails.
- Landscaping and trees located throughout the City.
- Per analysis of the Oregon State University–Extension Service Fire Program and Wildland Fire Associates dataset, there are 184 buildings with a total value of $56,825,000 exposed to a low risk of wildland fire.[437] The dataset did not identify any buildings at a high or moderate risk. Additionally, a community risk profile completed by DOGAMI shows no residents may be potentially displaced due to a wildland fire event.[438]

[437] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[438] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.2.9. Windstorm, Including Tornado

The City has an elevation of 176 feet and historically has not experienced the same frequency of windstorms as those parts of the County at higher elevations. Potential impacts of and vulnerabilities to windstorms are identified below.

3.2.9.1. Potential Impacts

The potential impacts of a windstorm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.2.9.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to windstorms, including tornadoes. These include:

- Older buildings and infrastructure not built to withstand high winds, including manufactured homes and buildings.
- Critical infrastructure, including the City’s two water stations and city hall.
- Critical transportation infrastructure, including US Highway 26 and arterial roads.
- Aboveground utility and power lines.

- Natural environments throughout the City, including parks, the community garden, and walking trails.
- Landscaping and trees located throughout the City.

3.2.10. Winter Storm

The City has an elevation of 176 feet and historically has not experienced the same frequency and intensity of winter storms as those parts of the County at higher elevations. Potential impacts of and vulnerabilities to winter storms are identified below.

3.2.10.1. Potential Impacts

The potential impacts of a winter storm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths, including from carbon monoxide poisoning, falls from slick or icy conditions, frostbite, and hypothermia.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components.
- Stranded travelers due to ice, snow, and transportation impacts.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- An increased number of house fires due to unsafe alternate heating methods.
- Significant property damage and loss of water due to frozen or damaged pipes or the thawing of frozen pipes.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged power lines can lead to wildfires, and tree debris can create fuel load for wildfire.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including flooding.

3.2.10.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to winter storms. These include:

- People who do not have access to sufficient heating, insulated clothing, or dry living conditions, including unhoused populations.
- Older adults and infants, people who take certain medications, people who have certain medical conditions, and people who have been drinking alcohol are at increased risk for hypothermia.
- People in households lacking appropriate and functional heating devices. Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of snow and ice.
- Critical infrastructure, including the City's two water stations and city hall.
- Critical transportation infrastructure, including US Highway 26 and arterial roads.
- Natural environments throughout the City, including parks, the community garden, and walking trails.
- Landscaping and trees located throughout the City.

3.2.11. Additional Hazards Identified by the City

In addition to the core natural hazards identified and scored in this NHMP, the City of North Plains identified two additional hazards that it could be impacted by-dust storm and water contamination.

3.2.11.1. Dust Storm

Due to its more rural location than other NHMP participants, the City can experience dust storms from wind blowing dust into the City from surrounding open farmland areas. Potential impacts of and vulnerabilities to dust storms are identified below.

3.2.11.1.1. Potential Impacts

The potential impacts of a dust storm are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Indirect injuries and deaths, such as those sustained during dust cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of City staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Blocked roads and rail transportation routes due to debris.
- Downed or damaged power lines can lead to wildfires.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.2.11.1.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City are vulnerable to dust storms. These include:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults.
- People without access to effective dust masks, eye protection, and drinking water and food uncontaminated by dust.
- JWC's water supply sources, including the upper Tualatin River, Barney Reservoir, and Scoggins Reservoir.
- Critical transportation infrastructure, including US Highway 26 and arterial roads, may experience large scale accidents and traffic issues.
- Other critical infrastructure, including the City's two water stations.
- Emergency generators and heating, ventilation, and air-conditioning (HVAC) systems.
- Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of dust, including manufactured homes and buildings, and the people who live or work in them.
- Natural environments throughout the City, including parks, the community garden, and walking trails.
- Landscaping and trees located throughout the City.

3.2.11.2. Water Contamination

In addition to the core natural hazards identified in this NHMP, the City has identified water contamination as a hazard that could impact the City. Potential impacts of and vulnerabilities to water contamination are identified below.

3.2.11.2.1. Significant Event

North Plains previously utilized a well system for drinking water until the system became contaminated when former creosote pits near the well locations seeped into the water table. The City has since transitioned to a pipeline that connects to the JWC system. The Commission wholesales water to the City; however, North Plains is looking for an alternative to this system in order to better serve the needs of the community.

3.2.11.2.2. Potential Impacts

Though unlikely, the impacts of a water contamination event can be substantial, including:

- Health effects, such as gastrointestinal illnesses, nervous system or reproductive effects, and chronic diseases such as cancer.[439]
- Damage to or long-term contamination to water infrastructure. Infrastructure may need to be replaced or repaired.
- Need to find short- and long-term alternative drinking water sources.
- Personal and household economic impacts of increased medical costs that may not be covered by insurance.

[439] United States Environmental Protection Agency. (2021, September 28). Drinking Water. https://www.epa.gov/report-environment/drinking-water#:~:text=If%20drinking%20water%20contains%20unsafe,chronic%20diseases%20such%20as%20cancer.

3.2.11.2.3. Vulnerabilities

All populations, economies, structures, improved property, and critical facilities and infrastructure in the City are vulnerable to water contamination. These include:

- People in the City with preexisting health conditions, those without access to clean water, children, pregnant women, and older adults.
- The City and its businesses could lose economic revenue from increased costs resulting from response activities, costs of repair and construction activities, and lost working hours due to personnel being sick or not being able to perform job duties due to lack of clean water.

3.3. Historical Events

The timeframe of data collected during the planning process for the City of North Plains was from as far back as available to February 22, 2022. Hazard events that have affected the entire planning area since adoption of the 2017 NHMP are detailed in Volume I, Section 2. During the data collection period, the City experienced impacts of extreme heat, flooding, wildland fire smoke, and water contamination.

A disaster declaration for the COVID-19 pandemic was in effect from March 12, 2020, to April 7, 2021. Although pandemic is not a hazard included in this NHMP, this declaration is noted because FEMA provided support and Hazard Mitigation Grant Program funding during the event.

3.4. Overall Vulnerability

Based on the analysis completed by the Technical Committee, wildland fire, earthquake, winter storm, flooding, and extreme heat present the highest relative risk to the City of North Plains. These hazards can create widespread events, and all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City can be vulnerable to these hazards.

Areas of greatest vulnerability to these hazards within the City include:

- Populations with higher vulnerability, such as those with preexisting health conditions, older adults, children, and pregnant women.
- Populations that are unhoused, do not have access to private transportation, and/or are without access to air conditioning, cooling equipment, sufficient heating, and clean water.
- Populations with limited income and financial resources.
- Populations whose primary language is not English.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic impacts to the City, including loss of local revenue due to business and property tax losses, reduced future revenues, reduced recreation and tourism activity, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Critical infrastructure, including the City's two water stations and city hall.
    - Older buildings and infrastructure not built to current building codes or seismic standards may be more vulnerable. City facilities, except for the water reservoir and pump house, are not retrofitted.
- Critical transportation infrastructure, including US Highway 26 and arterial roads.

- Other critical infrastructure, including emergency generators and above- or belowground utility and power lines.
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.
- The City purchases treated water from the JWC. The water sources used by JWC could be vulnerable to hazard events.
- Natural environments throughout the City, including parks, the community garden, and walking trails.
- Landscaping and trees located throughout the City.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment and safe growth analysis examine the ability of the City to implement and manage a comprehensive mitigation strategy. Strengths, opportunities, and resources of the jurisdiction are identified to develop an effective hazard mitigation action plan. The capabilities identified in this assessment were evaluated collectively to develop feasible recommendations, which support the implementation of effective mitigation activities.

A capability questionnaire was distributed to the City's Technical Committee to initiate this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities. The Technical Committee also completed a safe growth analysis to identify potential gaps in growth guidance instruments and improvements that could be made to reduce vulnerability to future development.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances within the City that can prevent and reduce the impacts of hazards.

The City's Comprehensive Plan addresses natural hazards, identifies projects that can be included in the mitigation strategy, and can be used to implement mitigation actions. This plan provides adequate space for expected future growth and in areas located outside natural hazard areas. Many of the goals and policies in the City's Comprehensive Plan are related to those in this NHMP and safe growth objectives. The monitoring and implementation section of the NHMP covers these and all other hazard mitigation strategies discussed in the plan. Safety is explicitly included in the Comprehensive Plan's growth and development policies.

The Capital Improvement Plan for the City of North Plains addresses natural hazards, identifies projects that can be included in the mitigation strategy, and can be used to implement mitigation actions. Additionally, this plan's corresponding Capital Improvement Program provides funding for hazard mitigation projects identified in this NHMP; however, the program does not limit expenditures on projects that would encourage development in areas vulnerable to natural hazards. The City's infrastructure policies do not limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.

The City's Capital Improvement Plan, Local Emergency Operations Plan, Stormwater Management Plan, and Transportation System Plan address natural hazards, identify projects that can be included in the

mitigation strategy, and can be used to implement mitigation actions. North Plains has included an evacuation order and shelter location in Appendix 5 of their Emergency Operations Plan.

The North Plains Transportation System Plan allows for its current and future infrastructure growth, encourages walking and biking with walkways and bike trails that reduce vehicle use, and provides a street grid system that provides good connectivity, thereby reducing the environmental impact.

Land use planning and ordinances, including zoning, subdivision, floodplain, and open space preservation regulations, are adequately administered and enforced and are an effective measure for reducing hazard impacts. The City has a future land use map that clearly identifies natural hazard areas. Additionally, land use policies discourage development or redevelopment within natural hazard areas.

The City's zoning and ordinances recognize the need to avoid or mitigate natural hazards. The City has zoning ordinances that conform to the Comprehensive Plan in terms of discouraging development or redevelopment within natural hazard areas. Any development in the floodplain goes through extensive scrutiny and must meet strict boundaries. The ordinance also contains natural hazard overlay zones that set conditions for land use within such hazard zones. Rezoning procedures recognize natural hazard areas as off limits to any zoning changes that would allow for increased activity or development in the area. The City does not have subdivision regulations that restrict the subdivision of land within or adjacent to natural hazard areas, provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources, or allow density transfer where hazard areas exist.

The City's Planning Manager leads and facilitates review of land use applications and enforces site plan review requirements. The City's building code contains provisions to strengthen or elevate construction to withstand hazard forces. The City of North Plains utilizes the most current building codes as they are adopted by the State of Oregon.[440] A city permit is needed to obtain a building permit from Washington County for construction of any structure in the City. The Land Use Process application is used for the following Type II, III, and IV land use processes (except home occupations): annexation, appeal, comprehensive plan amendment (text), comprehensive plan amendment (map), conditional use (residential/industrial/commercial), design review (Type II and III), floodplain permit, partition (with and without street dedication), lot line adjustment, non-conforming use, subdivision, manufactured home park, modification (minor and major), significant natural resources permit, similar use, street vacation, Urban Growth Boundary expansion, variance (administrative and Planning Commission hearing), and zoning code amendments.

Tualatin Valley Fire & Rescue services the residents of North Plains and has an Insurance Services Office (ISO) rating of 2. The last Public Protection Classification survey was completed in January 2003.

The City has environmental systems that protect development from hazards identified and mapped and policies that maintain and restore protective ecosystems, including land use policies. North Plains manages 6.24 acres of land designated as parks, open spaces, trails and recreational facilities. McKay Creek and Ghost Creek present excellent opportunities for usable open space withing the City. The City does not have policies that provide incentives to development that is located outside protective ecosystems.

4.1.1. National Flood Insurance Program Compliance

Participation in the National Flood Insurance Program (NFIP) is based on a voluntary agreement between a community and FEMA. For communities that adopt a floodplain management ordinance to reduce flood risks to new construction, federally backed flood insurance is made available to property owners in the community. Compliance with the NFIP, however, extends beyond participation in the program. The three

[440] City of North Plains. (2022). Codes & Standards
https://www.northplains.org/search/site/codes%20and%20standards?f[0]=im_field_microsite%3A20

basic components of the NFIP include floodplain identification and mapping risk, responsible floodplain management, and flood insurance.

A repetitive loss (RL) property is a property insured under the NFIP for which the program has paid at least two claims of more than $1,000 in any 10-year period since 1978, regardless of any change(s) of ownership during that period. As of September 30, 2021, there were no FEMA-identified RL properties in the City.

4.1.1.1. National Flood Insurance Program Details

Insurance Summary

The number of NFIP policies, dollar amount of coverage in force, dollar amount of premiums paid annually, and number and dollar amount of claims paid in the City was not available at the time this NHMP was published. Identifying this information is an improvement for the next planning cycle.

There are 15 structures exposed to flood risk within the community.

Staff Resources

There are no barriers to running an effective NFIP program in the City. The City Manager and Community Development Department enforce the floodplain ordinance and administer the NFIP. The City Manager oversees the reviewing, recommending, and approving of planning permits and related land use applications. The City partners with Washington County on certain permit applications.

Compliance History

The City is in good standing with the NFIP and there are no outstanding compliance issues.

The City will continue NFIP compliance during the next five years of NHMP implementation by enforcing floodplain management requirements, including new construction and substantial improvements, maintaining and using floodplain mapping, and undertaking any code amendments needed to maintain compliance.

Regulation

The City entered the NFIP on July 16,1976. The initial flood insurance rate map (FIRM) was identified on April 1, 1982, and the current effective map date is October 19, 2018. Floodplain development regulations meet or exceed the minimum FEMA and state requirements. The City works with FEMA and Washington County to regulate development and to periodically update the delineation of the floodplain to minimize risk and enable residents to qualify for flood insurance.[441]

The City of North Plains has adopted a floodplain ordinance and enforces building codes that detail rules and requirements to protect people and property and reduce future flood losses. In North Plains, the City handles straightforward permits for development within floodplains and works with Washington County on more complex applications.

Community Rating System

The City does not participate in the Community Rating System.

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff and their skills and tools that can be used for mitigation planning and implementing specific mitigation actions.

[441] City of North Plains. (n.d.). City 101: Floodplains Explained. https://www.northplains.org/planning/page/city-101-floodplains-explained

The City's Planning Manager oversees the reviewing, recommending, and approving of planning permits and related land use applications. The City's Planning, Land Use, and Building section of the Community Development Department implements the goals of the City Council and community through objective and consistent application of City development standards and state law. The Planning Commission reviews designs for future structures and remodels, develops standards for building in North Plains, and assists City Council with policy development. Significant documents developed with the Planning Commission's guidance are the Comprehensive Plan, which is Chapter 15 of the Municipal Code, and zoning and development standards, which can be found in Chapter 16 of the Municipal Code.

The City administers maintenance programs to reduce risk, including tree trimming, clearing drainage systems, and landscape maintenance of open spaces and rights of way. The City also has multiple effective mutual aid agreements and planning partnerships, including intergovernmental agreements and a partnership with the Washington County Emergency Management Cooperative.

The Public Works Director acts as the City's Emergency Manager. The City of North Plains has adequate staffing levels to enforce regulations, staff are trained on hazards and mitigation efforts, and coordination on mitigation initiatives with staff is effective. The floodplain ordinance is enforced by Community Development Department staff. The City handles straightforward permits for development within the floodplain and works with Washington County on more complex building permit applications.

Multiple City departments have staff who can support the mitigation strategy, including planners and engineers (contracted) with an understanding of natural hazards, engineers and professionals trained in construction practices related to buildings and infrastructure, staff with education or expertise to assess vulnerability to hazards, and staff with geographic information system (GIS) knowledge and capabilities.

Additionally, the City has many technical capabilities that have been used to assess or mitigate risk and could be used in future efforts. Warning systems include Everbridge and OR-Alert in partnership with Washington County. Grant writing is completed by individual departments as needed. The City has access to GIS programs and can create mapping products for specific projects, and hazard data and information can be pulled from a variety of sources, including historical records and DOGAMI.

4.3. Education and Outreach Assessment

Education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information were assessed to determine the City's capabilities.

The City's Emergency Management Division maintains a website that promotes disaster preparedness for hazards and provides information on basic disaster response skills. These online resources include the Take 5 to Survive campaign, Red Cross survival kit supplies, the Neighborhood Ready program, and how to access the Preparing Together Discussion Guide and Toolkit from any library in Washington County. The Emergency Management website also includes information specific to seniors and vulnerable populations and encourages citizens to have a plan for their animals in case they need to evacuate.

4.4. Financial Assessment

The City has access to or is eligible to potentially use the following funding resources for hazard mitigation initiatives:

- Capital improvements project funding
- Fees for water, sewer, gas, and/or electric services
- Impact fees for new development
- Transportation utility fees

- Incurrence of debt through general obligation bonds and/or special tax bonds
- Incurrence of debt through private activities
- Federal funding sources, including the Community Development Block Grant, Urban Areas Security Initiative, Building Resilient Infrastructure and Communities, and Hazard Mitigation Assistance Grants
- State funding programs, including the State Homeland Security Program

4.5. Capability Expansion and Improvement

Actions that can expand and improve existing authorities, plans, policies, and resources for mitigation include continuing to update City plans as necessary to ensure they are current and reflect the needs of the community; further developing warning systems and messaging; increasing dedicated grant writing staff; creating and implementing additional public education and outreach offerings and increasing the volume of translated materials; and ensuring grant opportunities are capitalized upon to meet goals.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iv), §201.6(c)(3)(iii), and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) directs local mitigation plans to describe hazard mitigation actions and establish a strategy to implement those actions. Therefore, all other requirements for a local mitigation plan lead to and support the mitigation strategy.

5.1. Mitigation Goals

The City of North Plains did not participate in the 2017 Washington County NHMP; therefore, the Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 City of Beaverton NHMP, 2011 Cities of Cornelius and Forest Grove NHMPs, and 2020 State of Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals detailed in Volume I, Section 3. These goals are the basis of this plan and summarize what the Steering Committee will accomplish by implementing this plan.

5.2. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on mitigation plan requirement 44 CFR §201.6(c)(4)(ii), the vulnerability and capabilities assessment for the City was carefully reviewed and considered when developing the mitigation actions for this plan. The City's Technical Committee will establish a process in which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into the existing local planning strategies.

Once the plan is adopted, the committee will coordinate implementation with the responsible parties in the City and with external stakeholders as needed. The primary means for integrating mitigation strategies will be through the revision, update, and implementation of plans and regulations, such as comprehensive plans, capital improvement plans, and land development regulations, as feasible.

The members of the City's Technical Committee will remain charged with ensuring that the goals and strategies of new and updated local planning documents for their jurisdictions and special districts are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.2.1. Comprehensive Plan

The goals in the City's Comprehensive Plan align with the Oregon Statewide Planning Goals and include the goals related to land use planning; natural resources and open spaces; air, water, and land resources quality; and natural hazards. Through a coordinated strategy, the City will focus on objectives and policies that will protect people and property from natural hazards and improve resiliency in the community. The most recent plan update was completed on April 20, 2022. Additional details about hazard mitigation will be added to the plan when it is updated, as applicable.

5.2.2. Building and Zoning Codes

Title XV, Land Usage, Chapter 155, Zoning and Development, of the City's Code of Ordinances addresses the area's comprehensive building and zoning codes. Updates to this chapter and addition of hazard mitigation strategies to other code sections can be made during future amendment efforts, as appropriate.

5.2.3. Public Engagement, Education, and Outreach

The City's emergency management personnel will continue public engagement campaigns during National Preparedness Month. The City's website will continue to be updated with preparedness information for individuals, families, populations at higher risk, businesses, and schools.

5.2.4. Land Development Regulations

Title XV, Land Usage, Chapter 155, Zoning and Development, of the City's Code of Ordinances addresses land development regulations. This includes the floodplain and significant natural resources overlay districts, subdivision ordinances, and design review requirements. Updates to this chapter and addition of hazard mitigation strategies to other code sections can be made during future amendment efforts, as appropriate.

5.2.5. Floodplain Management Program and/or National Flood Insurance Program

The City Manager and Community Development Department will continue to review the City's compliance with NFIP program requirements and will incorporate any new findings into the City's mitigation strategy, as appropriate.

The City's floodplain management program is implemented through Chapter 155 of the City's Code of Ordinances. Updates to this chapter can be integrated into future amendment efforts, as necessary and appropriate.

5.2.6. Stormwater Management Plans

The City of North Plains has a Stormwater Management Plan. This plan includes information on floodplains, watersheds, and drainage basins and proposes water quality, stormwater detention, and

aquatic habitat enhancement improvements. Additional details about hazard mitigation will be added to the plan when it is updated, as applicable. Additionally, the City works with Clean Water Services on stormwater-related issues.

5.2.7. Emergency Plans That Address Evacuation and Sheltering

Evacuation and sheltering are addressed in the City's Emergency Operations Plan, and the City works with the Washington County Sherriff's Office and Tualatin Valley Fire & Rescue on sheltering and evacuation efforts as needed. The City Manager and Public Works Director will review and update this section of the Emergency Operations Plan as needed to meet the needs of the City and its residents.

5.2.8. Enforcement of Existing Polices

The City will continue to enforce the policies that are in place and include hazard mitigation elements, including building and zoning codes, land development regulations, and NFIP regulations.

5.2.9. Funding Opportunities

The City Manager and the City's Public Works Director will continue to monitor local, state, and federal funding opportunities that could be utilized for hazard mitigation. This includes Hazard Mitigation Assistance opportunities and non-traditional mitigation funding sources.

6. Actions Items

Action items for the 2023 NHMP were determined by the City's Technical Committee based on the review of its risk assessment and its existing capabilities. This comprehensive range of actions includes local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.1 and 6.2 below. Additional information about how these actions were developed, evaluated, and prioritized is in Volume I, Section 3.

6.1. City of North Plains Action Items: 2023 Washington County NHMP

Table 198: City of North Plains Action Items

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
1	Potable Water Tank Pillows	Dam failure, earthquake	Medium
2	Aquifer Storage and Recovery	Dam failure, earthquake	Medium
3	JWC Supply Pipeline Joint Strengthening	Dam failure, earthquake	Medium
4	Participate in programs that provide advance warning to the public of imminent natural hazard events that will impact the people of the City, such as the National Weather Service's StormReady Program, USGS' ShakeAlert, National Weather Service HeatRisk, and others.	All hazards	Medium
5	Develop partnership strategy for the City to foster natural hazard program coordination and collaboration with infrastructure owners including public and private utility providers in the City of North Plains.	All hazards	Medium

6.2. Mitigation Action Information Worksheets

Table 199: Portable Water Tank Pillows

Mitigation Action Information			
Title of action	Portable Water Tank Pillows		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Procure water-related equipment and materials needed to provide emergency water.		
Hazard(s) addressed	Dam failure ☒ Drought ☒ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☒ Volcanic ash ☒ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Per the City's Water System Master Plan Update, the key seismic vulnerability for the City is the loss of supply from the JWC water supply transmission main. This could result in the City being without water for weeks or months, depending on the degree of damage and the availability of repair materials and labor. To mitigate this vulnerability, it is suggested that two 10,000-gallon potable water pillow tanks at a total cost of $25,000 be purchased to store water from Well No. 1 in the case of an emergency. This would allow the City additional backup storage in the case that Well No. 3 became unusable.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☒	Goal 7 ☐
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	City of North Plains Emergency Operations Plan City of North Plains Water System Master Plan Update		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	City Manager		

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC grants through FEMA
Estimated Cost	$25,000

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Provides the City additional backup storage in the case that Well No. 3 became unusable due to any natural hazard event.	$150,000

Project Timeline
Expected Timeline for Completion
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 200: Aquifer Storage and Recovery

Mitigation Action Information			
Title of action	Aquifer Storage and Recovery (ASR)		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Complete an ASR feasibility study. Based on study results, implement an ASR facility that could store water and supply the City with seasonal independence from the JWC supply pipeline.		
Hazard(s) addressed	Dam failure ☒ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Per the City's Water System Master Plan Update, the key seismic vulnerability for the City is the loss of supply from the JWC water supply transmission main. This could result in the City being without water for weeks or months, depending on the degree of damage and the availability of repair materials and labor. To mitigate this vulnerability, it is recommended that the City implement an Aquifer Storage and Recovery facility that could store water and supply the City with seasonal independence from the JWC supply pipeline.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☒	Goal 7 ☒
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	City of North Plains Emergency Operations Plan City of North Plains Water System Master Plan Update		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	City Manager		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC grants through FEMA	
Estimated Cost	$6,100,000 (per Water System Master Plan Update)		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Water storage that would supply the City with seasonal independence from the JWC supply pipeline and provide water in case of a dam failure or earthquake event.	$36,600,000
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 201: Joint Water Commission Supply Pipeline Joint Strengthening

Mitigation Action Information			
Title of action	Joint Water Commission Supply Pipeline Joint Strengthening		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	The JWC Pipeline crosses McKay Creek between NW Wren Road and NE Evergreen Road and the alignment is adjacent to the McKay Creek tributary and wetland near the 314 St Vault. It is expected that this area will also have increased liquefaction potential and lateral displacement issues due to the high ground water table, slopes, and soft soils. It is likely that increased pipeline displacements will occur in these areas, increasing the likelihood of breakage. It is recommended that site-specific lateral displacements be evaluated in these areas to ensure the JWC pipeline can accommodate the displacements expected. The JWC water transmission main has unrestrained pipe joints that could pull apart during an earthquake, particularly if permanent ground deformation occurs. A mitigation project to improve seismic resiliency could involve retrofit installation of split harnesses to restrain the currently unrestrained joints. A rough estimate of the number of joints to be strengthened is 688.		
Hazard(s) addressed	Dam failure ☒	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Per the City's Water System Master Plan Update, the JWC water transmission main has unrestrained pipe joints that could pull apart during an earthquake, particularly if permanent ground deformation occurs. A mitigation project to improve seismic resiliency could involve retrofit installation of split harnesses to restrain the currently unrestrained joints.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	City of North Plains Emergency Operations Plan City of North Plains Water System Master Plan Update		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	City Manager		

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	BRIC grants through FEMA
Estimated Cost	$1,430,000 (per Water System Master Plan Update)

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Preservation of the JWC supply pipeline so it continues to provide water in case of a dam failure or earthquake event.	$8,580,000

Project Timeline
Expected Timeline for Completion
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 202: Advance Warning Systems Programs

Mitigation Action Information			
Title of action	Advance Warning System Programs		
Type of action	Plans/regulations ☒		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	Participate in programs that provide advance warning to the public of imminent natural hazard events that will impact the people of the City, such as the National Weather Service's StormReady Program, USGS' ShakeAlert, National Weather Service HeatRisk, and others.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	Working through the application and implementation process by participating in advance warning programs will help in identifying additional mitigation opportunities prior to the event occurring as well as providing early warning for responses and public notifications.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☒	
Integration into other initiatives	NWS early warning programs USGS early warning programs		
Alignment with existing plans and policies	City of North Plains Emergency Operations Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	City Manager		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General budget		BRIC and FMA grants through FEMA	
Estimated Cost	$5,000		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Incorporates program elements into preparedness and response plans.	$30,000
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 203: Develop Partnership Strategy for Public/Private Infrastructure Owners and Managers

Mitigation Action Information			
Title of action	Develop Partnership Strategy for Public/Private Infrastructure Owners and Managers		
Type of action	Plans/regulations ☒		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	Develop partnership strategy for the City to foster natural hazard program coordination and collaboration with infrastructure owners including public and private utility providers in the City of North Plains.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	This will improve the City's relationships with water providers, wastewater treatment agency, electrical service providers, communications providers, solid waste programs and others to connect them to funding sources for mitigation and infrastructure hardening and construction projects.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined.		
Alignment with existing plans and policies	City of North Plains Comprehensive Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	City Manager		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC and FMA grants through FEMA Rural Development Assistance, USDA	
Estimated Cost	$10,000		

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s) (Est. Cost x 6)**
Identifying funding resources for infrastructure projects; improving relationships for planning and emergency response	$60,000
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	
Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Annex F: City of Sherwood

1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for the City of Sherwood was the Emergency Management Coordinator.

1.2. Annex Organization

This annex has six sections that satisfy mitigation requirements in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

The information provided in this annex is for the City of Sherwood alone. All pertinent information that is not identified in this annex is identified in other sections of this NHMP or within the respective appendices.

1.3. NHMP Adoption Process

Once the Washington County NHMP received the designation “Approvable Pending Local Adoption” from the Federal Emergency Management Agency (FEMA), the City presented the plan to City Council for final public comment and local adoption. A copy of the resolution was inserted into the NHMP and is held on file in the City of Sherwood and Washington County.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

City officials recognize the benefits of having a long-term, all-hazards approach to mitigating natural hazards. The passage of the Disaster Mitigation Act of 2000 (DMA 2000) enabled City officials to recognize the benefits of having a long-term, all-hazards approach to hazard mitigation and mitigating natural hazards. The City's involvement in the Washington County NHMP represents the collective efforts of the NHMP Steering Committee members, all participating local Technical Committee members, the public, and stakeholders

The City developed this annex in accordance with guidance outlined in 44 CFR §201.6(c)(5) of DMA 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in the geographical area of the City.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP. An open involvement process was established for the public and all stakeholders, which provided an opportunity for everyone to be involved in the planning process and make their views known.

Two teams worked simultaneously on this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of points of contact from each plan participant. The group met to discuss countywide topics, including hazards and mitigation strategies. The points of contact were the leads of their local Technical Committee.
2. **Local Technical Committee:** Each plan participant had a Technical Committee that consisted of the Steering Committee representative for that jurisdiction or special district as well as designated representatives from within the organization. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. Technical Committee of the City of Sherwood

This annex within the NHMP was developed by the City of Sherwood's local Technical Committee with support from IEM, a consulting firm hired to assist with the planning process. The efforts of the committee were led by the City's Emergency Management Coordinator throughout 2022.

Table 204: City of Sherwood Technical Committee Members for the 2023 NHMP

Job Title and Department	Role in Committee and Planning Process
Emergency Management Coordinator, Public Works	General oversight, hazard identification, and plan development
Utilities Manager, Public Works	Hazard identification and plan development
Planning Manager, Planning	Hazard identification and plan development
Public Works Technician (GIS), Public Works	Hazard identification and plan development

IEM also supported or led the following activities associated with the development, approval, and adoption of the plan:

1. Facilitated the NHMP update process.
2. Based on committee direction and stakeholder and community input, prepared the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.

3. Submitted the proposed plan to the State of Oregon Department of Emergency Management (OEM) and FEMA for review and approval, and completed edits or revisions requested by these organizations.
4. Coordinated the plan adoption processes with the City, OEM, and FEMA.

2.3. Public Participation

Public participation is an important component of this NHMP and also a required element as outlined in 44 CFR §201.6(c)(5), FEMA's mitigation planning guidance. Public participation offered community members the opportunity to voice their ideas, interests, and opinions about hazards that affect them and the best way to mitigate hazard impacts. As the City implements the mitigation actions identified in this annex, there will be additional opportunities for public participation.

Plan participants used a survey to collect information about community perceptions of natural hazards and priorities. The Steering and Technical Committees used the results to inform their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP. See Appendix B in the NHMP for additional information about the survey and opportunities for public comment.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist the City of Sherwood in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards.

3.1. Community Profile

This section provides information on City-specific characteristics. Additional discussion of the planning area's community characteristics is outlined in Appendix A of the NHMP.

Some community characteristics may suggest how natural hazards may impact communities and how communities choose to plan for natural hazard mitigation. Identifying and considering the City-specific assets during the planning process may assist in identifying appropriate measures for natural hazard mitigation.

Table 205 below reflects the community demographics and vulnerable populations in the City. This information was gathered from the U.S. Census, Portland State University, and the City of Sherwood.

Table 205: Community Demographics*

Population	Total	Percent Change
2010 population[442]	18,194	-
2021 population[443]	20,496	+13%
2035 forecasted population[444]	19,342	-6%
Race and Ethnicity[445]	**Total**	**Percent of Population**
White alone	17,289	88%
Two or more races	1,226	6%
Hispanic/Latino/a/x of any race	979	5%
Asian alone	656	3%
American Indian and Alaska Native alone	86	0.4%
Native Hawaiian and Other Pacific Islander alone	43	0.2%
Black or African American alone	14	0.1%
Language Spoken at Home[446]	**Percent of Population**	
English only	90%	
Indo-European languages	4%	
Spanish	3%	
Asian and Pacific Island languages	1%	
Other languages	2%	
Vulnerable Age Groups[447]	**Percent of Population**	
Less than 15 years of age	23%	
65 years and older	10%	

[442] United States Census Bureau. (2010, April 1). QuickFacts: Sherwood City, Oregon. Accessed September 7, 2022, from https://www.census.gov/quickfacts/fact/table/sherwoodcityoregon/PST045221
[443] Portland State University Population Research Center. (2022). 2021 Certified Population Estimates, July 1. https://www.pdx.edu/population-research/population-estimate-reports
[444] Oregon Metro. (2013, January 15). 2035 Forecast of Population by City and County. https://www.oregonmetro.gov/sites/default/files/2014/05/29/population_housing_forecasts_by_city_county.pdf
[445] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Demographic and Housing Estimates, Table DP05. Accessed September 9, 2022, from https://data.census.gov/cedsci/table?q=sherwood,%20oregon&tid=ACSDP5Y2020.DP05
[446] United States Census Bureau. (2021 July 1). 2016–2020 American Community Survey 5-Year Estimates, Language Spoken at Home, Table S1601. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=sherwood%20oregon%20language&tid=ACSST5Y2020.S16012
[447] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Age and Sex, Table S0101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=sherwood%20oregon%20language&tid=ACSST5Y2020.S0101

Disability Status of Non-Institutional Civilians[448]	Percent of Population
Total	9%
Less than 17 years of age	6%
65 years and older	67%

* Due to how respondents identify and answer questions, there may be overlapping responses, and results may equal greater than 100% of the population. Percentages are rounded.

3.1.1. Geography, Topography, and Climate

Sherwood is located in southwest Washington County and has an area of 4.5 square miles.

It is bordered by the Tualatin River National Wildlife Refuge to the north, the Chehalem Mountains on the west, Yamhill County to the south, and the City of Tualatin to the east. The City is bisected by Cedar Creek and is also crossed by Rock Creek on the northeast. Sherwood boasts a historic downtown, miles of walking trails, a new Center for the Arts, and numerous annual community events.
Sherwood has a moderate climate. Mean daily temperatures range from highs around 81 degrees Fahrenheit (°F) in July and August to lows near 34 °F in December and January. Winters are mild, with primarily rain showers and little snow. The average annual rainfall is about 43 inches, compared to the national average of 37 inches. There is an average of 147 days with precipitation annually, with most precipitation between October and April.

3.1.2. Transportation, Infrastructure, and Housing

3.1.2.1. Transportation

Critical transportation routes in Sherwood include Oregon Route 99W, also called Pacific Highway, which is a primarily north-south route connecting Sherwood to Interstate 5 and the surrounding region. SW Tualatin Sherwood Road is a major east–west road that crosses the north part of Sherwood, connecting to the City of Tualatin on the east. SW Edy Road provides additional access to the northwest portion of the City from 99W. Another major east–west route is Sunset Boulevard, which transects the southern portion of the City. SW Sherwood Boulevard, SW Oregon Street, SW Meinecke Road, SW Langer Farms Parkway, SW Pine Street, and SW Main Street provide access to many city facilities, schools, parks, and businesses in the city center. SW Murdoch Road runs north-south along the east end of the City, connecting to SW Baker Road leading to the south, and SW Oregon Street to the north. SW Elwert Road and Old Highway 99 follow the city's western border.

In the City of Sherwood, 77.5% of workers drive a private vehicle alone to work, 11.5% work from home, and 7.7% carpool.[449] Public transportation, walking, and other methods of transportation are less common. The average commute time is 26 minutes.[450]

The Tri-County Metropolitan Transit District (TriMet) provides commuter rail, light rail, and bus commuter service to several communities in Washington County and bus service throughout the tri-county region.

[448] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Disability Characteristics, Table S1810. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=sherwood%20oregon%20disability&tid=ACSST5Y2020.S1810
[449] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5–Year Estimates, Commuting Characteristics by Sex, Table S0801. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=sherwood%20oregon%20commute&tid=ACSST5Y2020.S0801
[450] City of Sherwood. (n.d.). Sherwood Demographics. https://www.sherwoodoregon.gov/planning/page/sherwood-demographics

Bus service is available within Sherwood and the Westside Express Service Commuter Rail is available in the neighboring City of Tualatin.

3.1.2.2. Infrastructure

The City of Sherwood critical and vulnerable facilities listed below in Table 206 may be vulnerable to one or more natural hazards.

Table 206: Critical Facility and Asset Inventory[451]

Name of Infrastructure, Facility, or Resource	Type of Asset	Address
Sherwood City Hall	Infrastructure or Facility	22560 SW Pine Street
Sherwood Public Works	Infrastructure or Facility	15527 SW Willamette Street
Sherwood Police Department	Infrastructure or Facility	20498 SW Borchers Drive
Sherwood Emergency Operations Center	Infrastructure or Facility	20498 SW Borchers Drive
Sherwood Center for the Arts	Infrastructure or Facility	22689 SW Pine Street
Sherwood Senior Community Center	Infrastructure or Facility	21907 SW Sherwood Boulevard
Snyder Reservoir	Infrastructure or Facility	15365 SW Sunset Boulevard

3.1.2.3. Housing

Housing characteristics are an important factor in mitigation planning. The information below shows that most housing units are owner-occupied and consist of one-unit buildings built before 1999. The older the housing, the more at risk it can be to damage from natural hazards such as earthquakes and windstorms, including tornadoes.

Table 207: Housing Characteristics*

Households	Total
Total households[452]	6,690
Units in Housing Structure[453]	**Percent of Housing**
One-unit structures	83%
Structures with two or more units	16%
Manufactured homes and all other types	1%

[451] City of Sherwood 2023 NHMP Planning Documentation
[452] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=sherwood%20oregon%20household&tid=ACSST5Y2020.S1101,
[453] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=sherwood%20oregon%20household&tid=ACSST5Y2020.S1101

Year Housing Structure Built[454]	Percent of Housing
Pre-1979	13%
1980–1999	47%
2000 to present	40%
Housing Tenure and Vacancy	**Percent of Housing**
Owner-occupied[455]	76%
Renter-occupied[456]	25%
Vacant[457]	3%

* Due to how respondents answer questions, there may be overlapping responses, and results may equal greater than 100%. Percentages are rounded.

3.1.3. Economy

Sherwood's largest industries include health care and social assistance, manufacturing, retail trade, and professional, scientific, management, and administrative services. Most of Sherwood's workers commute outside of the city for work. Sherwood's 2040 Comprehensive Plan identified goals to promote local business growth and economic development to balance the City's tax base and provide stable, high-wage jobs to residents.[458]

Table 208: Income Characteristics[459]*

Households by Income Category	Percent of Households
Less than $5,000	2%
$5,000 to $9,999	0%
$10,000 to $14,999	2%
$15,000 to $19,999	2%
$20,000 to $24,999	2%
$25,000 to $34,999	5%

[454] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Physical Housing Characteristics for Occupied Housing Units, Table S2504. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=sherwood%20oregon%20s2504&tid=ACSST5Y2020.S2504

[455] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022https://data.census.gov/cedsci/table?q=hillsboro oregon housing&tid=ACSST5Y2020.S1101 from https://data.census.gov/cedsci/table?q=sherwood%20oregon%20household&tid=ACSST5Y2020.S1101

[456] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=sherwood%20oregon%20household&tid=ACSST5Y2020.S1101

[457] United States Census Bureau. (2021, July 1). 2020 Decennial Census, Occupancy Status, Table H1. Accessed September 12, 2022, from https://data.census.gov/cedsci/table?q=sherwood%20oregon%20occupancy&tid=DECENNIALPL2020.H1

[458] City of Sherwood. (2022, September 7). Sherwood 2040 Comprehensive Plan Update. Sherwood 2040 Comprehensive Plan Update | City of Sherwood Oregon

[459] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Financial Characteristics, Table S2503. Accessed September 7, 2022, from https://data.census.gov/cedsci/table?q=sherwood,%20oregon&t=Income%20%28Households,%20Families,%20Individuals%29%3AIncome%20and%20Earnings&tid=ACSST5Y2020.S2503

Households by Income Category	Percent of Households
$35,000 to $49,999	7%
$50,000 to $74,999	15%
$75,000 to $99,999	13%
$100,000 to $149,999	26%
$150,000 or more	28%
Median Household Income	
$107,537	

* Due to how respondents answer questions there may be overlapping responses and results may equal greater than 100%. Percentages are rounded.

3.2. Natural Hazard Profiles

The City of Sherwood's Technical Committee utilized the OEM's hazard analysis methodology to examine hazard vulnerability and probability by collecting information about history, probability, vulnerability, and maximum threat for each hazard that impacts the City. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants.

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Volume I, Section 2.

All natural hazards included in the NHMP have the potential to impact the City. The scores for each hazard that impacts the City are presented below.

Table 209: Natural Hazard Risk Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	Low	Medium	Medium	Low	74
Drought	Low	High	High	Medium	175
Earthquake: Cascadia (3–5-minute event)	Low	High	High	Medium	186
Earthquake: Crustal (1-minute event)	Low	Medium	Medium	Medium	158
Extreme heat	Medium	Medium	High	Medium	162
Flooding, including channel migration and streambed erosion	Medium	Low	Medium	Low	79
Landslide	Low	Low	Low	Low	61
Volcanic ash	Low	Medium	High	Low	119
Wildland fire	Medium	Medium	Medium	Medium	142
Windstorm, including tornado	Medium	Medium	High	Medium	178
Winter storm	High	High	High	High	208

Full descriptions of each hazard are provided in Volume I, Section 2. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description in this annex and in Volume I, Section 2.

The timeframe of data collected during the planning process for the City of Sherwood was from as far back as available to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the City's Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events since adoption of the 2017 NHMP, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are presented in the same order, as applicable: populations,

economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

3.2.1. Dam Failure

Due to geographic location and topography, the City cannot be directly impacted by dam failure. There are no high or significant hazard dams in proximity to the City of Sherwood. Scoggins Dam is the closest at approximately 30 miles away. Any impacts in the City due to dam failure are identified as secondary and minimal. Potential impacts of and vulnerabilities to dam failure are identified below. It is anticipated that flooding caused by a dam failure event would have similar impacts and create similar vulnerabilities as routine flooding.

3.2.1.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a dam failure event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event; however, all impacts and vulnerabilities are considered minimal to negligible.

- Oregon Route 99W, the City's main thoroughfare, could potentially flood and receive damage. Disruption of 99W could have significant economic impacts on the City.
- Cedar Creek and Rock Creek run through the City and may be affected by rising water levels. Agricultural land, property, and the natural environment could be vulnerable to rising waters along these creeks.

3.2.2. Drought

Drought typically occurs as a regional event and often affects more than one city and county simultaneously. Potential impacts of and vulnerabilities to drought are identified below.

3.2.2.1. Potential Impacts

The potential impacts of a drought event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Reduction or loss of water supply.
- Water use restrictions and lack of drinkable water supply.
- Health effects including increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions.
- Reduced economic productivity or business closures in such industries as agriculture, livestock, recreation, energy, tourism, timber, and fisheries.
- Supply chain restrictions, including food shortages.
- Loss of power or reduced availability of electricity due to infrastructure damage and high demand.
- Property and infrastructure damage due to expansive soils.
- Damage to natural environments, including low water levels in lakes, rivers, and other water bodies, reduced plant growth, local species reduction or extinction, increased water temperature, and deteriorated water quality, which may result in fish kills and increased waterborne pollutants.
- Concurrent hazards, including extreme heat, wildfire, flooding, and landslides.

3.2.2.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to drought. Specific vulnerabilities include:

- People in the City with preexisting health conditions, those without access to clean water, children, pregnant women, and older adults. This may include those spending time at the Sherwood Senior Community Center.
- Critical transportation routes and infrastructure, including Oregon Route 99W, SW Tualatin Sherwood Road, Sunset Boulevard, arterial roads and streets, and TriMet bus service.
- Other critical infrastructure, including the Snyder Reservoir and electric generating systems.
    - The City has three storage reservoirs totaling 31 million gallons of treated water storage capacity.
- The City’s primary source for water comes from the Willamette River Water Treatment Plant.
- Two backup sources of water include local ground water wells and the Bull Run Watershed northwest of Portland.
- Natural environments, such as groundwater tables and parks.

3.2.3. Earthquake

The City could experience earthquakes that originate from the Cascadia subduction zone, Portland Hills fault zone, and Gales Creek fault zone. It may also experience liquefaction and coseismic landslides as the result of an earthquake. Potential impacts of and vulnerabilities to earthquake are identified below.

3.2.3.1. Potential Impacts

The potential impacts of an earthquake event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Mental health impacts, including post-traumatic stress disorder.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Collapsed buildings.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Blocked or impassible roads and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction.
- Downed or damaged power lines can lead to wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Change in water flows, including paths of rivers and streams.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including flood, wildland fire, and landslide.

3.2.3.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to earthquakes. These include:

- Critical infrastructure and facilities, including city hall, the public works facility, the police department, the emergency operations center, the Sherwood Center for the Arts, the Sherwood Senior Community Center, and the Snyder Reservoir.
- Other critical infrastructure, including communication structures, in-ground water and power lines, and emergency generators.
- Critical transportation routes and infrastructure, including Oregon Route 99W, SW Tualatin Sherwood Road, Sunset Boulevard, arterial roads and streets, and TriMet bus service.
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.
    - 26% of buildings in Sherwood are designated as pre-code or low-code seismic design level and could be more prone to damage from a 6.7 magnitude Gales Creek fault earthquake event.[460] Many public properties have not undergone seismic updates been seismically updated. Private structures also may not have undergone seismic updates.
    - Using 2022 Hazus®-MH information, it is estimated that a 6.7 magnitude Gales Creek fault earthquake event would result in 11 yellow-tagged buildings, one red-tagged building, and $15,740,000 in total economic losses due to building damage.[461]
- A 2018 Oregon Department of Geology and Mineral Industries (DOGAMI) report shows the following:
    - A Cascadia subduction zone magnitude 9.0 earthquake in “dry” soil conditions could result in $140,000,000 in building repair costs, 87,000 tons of debris, 27 long-term displaced residents, and up to 144 deaths;
    - A Cascadia subduction zone magnitude 9.0 earthquake in “wet” soil conditions could result in $217,000,000 in building repair costs, 113,000 tons of debris, 534 long-term displaced residents, and up to 263 deaths;
    - A Portland Hills fault magnitude 6.8 earthquake in “dry” soil conditions could result in $148,000,000 in building repair costs, 80,000 tons of debris, 34 long-term displaced residents, and up to 114 deaths; and
    - A Portland Hills fault magnitude 6.8 earthquake in “wet” soil conditions could result in $295,000,000 in building repair costs, 130 thousand tons of debris, 963 long-term displaced residents, and up to 341 deaths.[462]
- Commerce could be disrupted for an extended period, particularly by transportation infrastructure damage.
- Natural environments throughout the City.

[460] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[461] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[462] Bauer, J.M., Burns, W.J., & Madin, I.P. (2018). Open-File Report 0-18-02: Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon. Oregon Department of Geology and Mineral Industries. DOGAMI Open-File Report O-18-02, Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon (oregongeology.org)

3.2.4. Extreme Heat

Due to a rise in the frequency and severity of extreme heat events and the impacts of those events, extreme heat events, the NHMP Steering Committee chose to include this hazard for the first time in the Washington County NHMP. Previous significant events and the potential impacts of and vulnerabilities to extreme heat are identified below.

3.2.4.1. Significant Events

Extreme heat was not included in previous NHMPs. Although data on specific impacts to the City of Sherwood is not included, significant events have occurred in the region that provide insight into the impacts of extreme heat.

- **June 26–29, 2021:** A high-pressure heat dome over the region led to a stretch of extreme heat. Maximum temperature records were broken by 8 to 10 degrees. Throughout Washington County there were numerous fatalities, closures and postponements of businesses and events, and buckled roads, and cooling shelters were opened.[463]
- **August 11–12, 2021:** Peak afternoon temperatures of 100 °F to 105 °F drove people to seek relief in bodies of water. Heat caused slowdowns of MAX light rail (Portland Metro area) systems and some business closures. Cooling shelters were opened in several counties.[464]

3.2.4.2. Potential Impacts

The potential impacts of an extreme heat event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, and heat stroke, and death.
- Extended operational hours of City staff and resources needed for response to the event, including the operation of daytime cooling centers and overnight cooling shelters.
- Strain on or loss of water supply due to increased demand.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Supply chain and personal economic impacts, such as increased cost of food, goods, and services, including energy.
- Economic losses from less overall worker efficiency and effectiveness, and time lost on the job when people need to take more frequent or longer breaks to avoid overheating.
- Short-term duration economic impacts of closure of outdoor activities and events, such as farmers markets and concerts.
- Property damage, such as roof expansion, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding.
- Disruption of essential infrastructure systems from overheated and damaged utilities, including power, water, transportation, and communication systems.

[463] National Centers for Environmental Information (NCEI) Database: Excessive heat 1/1/1950 to 12/31/2021 Greater Portland Metro Area and Coast Range of NW Oregon Zones, Hazard History for Washington County
[464] National Centers for Environmental Information (NCEI) Database: Excessive heat 1/1/1950 to 12/31/2021 Greater Portland Metro Area and Coast Range of NW Oregon Zones, Hazard History for Washington County

- Impacts to roadways as heat expands concrete or causes cracking and buckling. Public transit can also be impacted due to melted cables, sagging wires, and warping tracks.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Impacts to greenspaces, such as scorch and sunscald of new foliage, branches or tops of trees dying due to cavitation, and significant stress and die-off of native trees, particularly Douglas firs and cedars. These impacts are intensified if drought is also occurring.
- Concurrent hazards, including drought and wildland fire.

3.2.4.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to extreme heat.

Populations substantially vulnerable to extreme heat include:

- People who work or spend a significant amount of time outdoors, including those in construction, landscaping, maintenance and repair, roofing, and solid waste collection.
- Populations with higher heat sensitivity, including older adults, infants and children, pregnant women, people with preexisting or chronic diseases, and those who take certain medications that affect thermoregulation or block nerve impulses. This may include those spending time at the Sherwood Senior Community Center.
- People with limited mobility and no access to cooling systems who may not be able to travel to cooling centers or shelters.
- People who live in social isolation, including linguistic isolation or those living alone with few social relationships.
- People with mental health conditions. Extreme heat can be associated with higher levels of aggression, violence, and suicidal behavior.
- Factors including race and ethnicity, income, and educational attainment are correlated with heat-related illness.

Additional vulnerabilities to extreme heat include:

- Critical infrastructure and facilities, including city hall, the public works facility, the police department, the emergency operations center, the Sherwood Center for the Arts, the Sherwood Senior Community Center, and the Snyder Reservoir.
- Critical transportation routes and infrastructure, including Oregon Route 99W, SW Tualatin Sherwood Road, Sunset Boulevard, arterial roads and streets, and TriMet bus service.
- Other critical infrastructure, including communication structures and emergency generators.
- Bridge infrastructure is vulnerable to thermal expansion of bridge joints and paved surfaces and deterioration of steel, asphalt, protective cladding, coats, and sealants.
- Asphalt pavement is vulnerable to accelerated deterioration through softening, rutting, and migration of liquid asphalt.
- Equipment at the City's police department and public works facilities. Vehicles, including first responder vehicles, are vulnerable to engine overheating and tire deterioration.
- Aboveground utility and power lines can droop or sag and create a heightened fire risk.
- Plants, animals, ecosystems, and natural environments, such as those in the City's parks, are vulnerable to high rates of mortality due to excessive heat.

3.2.5. Flooding, Including Channel Migration and Streambed Erosion

The City experiences localized flooding typically from October through April; however, historically, it has not been significant or severe. Potential impacts of and vulnerabilities to flooding are identified below. It is anticipated that flooding caused by a dam failure event would have similar impacts and create similar vulnerabilities as routine flooding.

3.2.5.1. Potential Impacts

The potential impacts of a flooding event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to chemicals, hazardous materials, and debris, and water quality issues.
- Need for widespread search and rescue operations, including high-water rescues.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Mobility or access issues for residents due to surrounding water.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Disruption of traffic due to flooded, damaged, or destroyed transportation systems.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.2.5.2. Vulnerabilities

Population, economic, built environment, critical facility, infrastructure, and natural environment vulnerabilities to a flooding event include the following:

- Populations without access to private transportation.
- While the 100-year floodplains in the City largely overlap existing wetlands and creek beds, some individually developed lots lie within the floodplain.[465] All structures within the floodplain are subject to damage, and others may be subject to damage from localized flooding.
- Properties without flood insurance.
- Critical transportation routes and infrastructure, including Oregon Route 99W, SW Tualatin Sherwood Road, Sunset Boulevard, arterial roads and streets, and TriMet bus service.
- Portions of the City outside of the mapped floodplains are subject to flooding from local storms.
- Oregon Route 99W, the City's main thoroughfare, could flood and incur damage. Disruption of 99W could have significant economic impacts on the City.
- Cedar Creek and Rock Creek run through the City and may be affected by rising water levels. Agricultural land, property, and the natural environment could be vulnerable to rising waters along these creeks.
- Flood loss estimates determined by Hazus-MH include[466]:
  - 10-year flood scenario
    - Number of buildings lost: 1
    - Loss estimate: $10,000
  - 50-year flood scenario
    - Number of buildings lost: 1
    - Loss estimate: $20,000
  - 100-year flood scenario
    - Number of buildings lost: 1
    - Loss estimate: $30,000
  - 500-year flood scenario
    - Number of buildings lost: 1
    - Loss estimate: $50,000
- Natural environments throughout the City.

[465] City of Sherwood. (2016, October 18). Ordinance 2016-015: Amending Chapter 7 of Volume II of the Sherwood Comprehensive Plan and Adopting the Sherwood Stormwater Master Plan. https://www.sherwoodoregon.gov/sites/default/files/fileattachments/Engineering/page/504/ordinance_2016-015_amend_chap_7_stormwater_masterplan_10.18.16.pdf

[466] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

Table 210: Land Use Type in the 100-Year Floodplain in the City of Sherwood

Land Use Type	Total Parcels in 100-Year Floodplain	Total Value of Exposed Parcels	Total Area in Jurisdiction (Acres)	Total Area in the 100-Year Floodplain (Acres)	Percentage of Area in the 100-Year Floodplain
Agriculture	0	$0	17.02	0	0%
Commercial	6	$23,463,330	492.79	64.51	13.0%
Forest	4	$6,728,730	66.73	40.33	60.0%
Industrial	0	$0	33.21	0	0%
Multi-Family Residential	13	$2,152,480	46.36	0.13	0.03%
Public	45	$10,023,880	594.94	165.34	28.0%
Single-Family Residential	13	$15,717,100	995.8	44.86	0.5%
Vacant	2	$422,100	74.7	1.74	0.2%
Other	4	$818,830	260.74	45.11	17.3%
Total	**87**	**$59,326,450**	**2,582.29**	**362.02**	**0.14%**

Table 211: Buildings in Sherwood within FEMA-Mapped Floodplains

Building Classification	Buildings within Sherwood	Buildings within 100-Year Floodplain	Buildings within 500-Year Floodplain	Buildings within Combined 500-Year & 100-Year Floodplain
Total Buildings	6,174	2	0	2
Percentage of Buildings within Sherwood	100%	0.03%	0%	0.03%

3.2.6. Landslide

The possibility of landslides occurring in the City is low, and any impacts in the City due to landslides are considered minimal. Potential impacts of and vulnerabilities to landslides are identified below.

3.2.6.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a landslide event are identified below. The type, magnitude, and extent of these can vary based on the scale of the event.

- The potential for landslide impacts in the City is minimal, with the possible exception of very small areas immediately adjacent to creek channels such as Rock Creek or Cedar Creek.
- Oregon Route 99W, the City's main thoroughfare, could receive damage from a landslide event. Disruption of 99W could have significant economic impacts on the City and cause traffic disruptions.
- Per DOGAMI,[467] there are 83 buildings with high susceptibility and 1,972 buildings with moderate susceptibility to landslide exposure. This does not indicate that these properties will be impacted by a landslide event, but rather that they are exposed to the potential of a landslide occurring.
- Landslide hazard is ubiquitous in a large percentage of undeveloped land and may present challenges for future planning and mitigation efforts. Awareness of nearby areas of landslide hazard is beneficial for reducing risk for every community in Washington County.

[467] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.2.7. Volcanic Ash

Volcanic activity is possible from mountains near Washington County. It is anticipated that ashfall from a volcanic eruption has the potential to impact the City, although the scale and types of impacts and vulnerabilities may differ depending on which volcano erupts, the level of eruption, and the wind direction during and after eruption. Potential impacts of and vulnerabilities to volcanic ash are identified below.

3.2.7.1. Potential Impacts

Though unlikely, the impacts of a significant ashfall event could be substantial. Impacts may include:

- Indirect injuries and deaths, such as those sustained during ash cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of City staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Blocked roads and rail transportation routes due to debris.
- Downed or damaged power lines can lead to wildfires.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.2.7.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to volcanic ash. These include:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults. This may include those spending time at the Sherwood Senior Community Center.

- People without access to effective dust masks, eye protection, and drinking water and food uncontaminated by ash.
- Critical infrastructure and facilities, including city hall, the public works facility, the police department, the emergency operations center, the Sherwood Center for the Arts, the Sherwood Senior Community Center, and the Snyder Reservoir.
- Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of volcanic ash, including manufactured homes and buildings and the people who live or work in them.
- Equipment at the City's police department and public works facilities.
- Other critical infrastructure, including communication structures, drainage systems, and emergency generators.
- Critical transportation routes and infrastructure, including Oregon Route 99W, SW Tualatin Sherwood Road, Sunset Boulevard, arterial roads and streets, and TriMet bus service.
- Potential for damage to heating, ventilation, and air-conditioning (HVAC) systems in public and private buildings and emergency generators.
- Business closures due to unsafe air conditions.
- Natural environments throughout the City.

3.2.8. Wildland Fire

Although the City could experience a wildland–urban interface event, historically it is more likely for the City to be affected by smoke and poor air quality due to wildland fires outside its boundaries. Potential impacts of and vulnerabilities to wildland fire and previous significant events are identified below.

3.2.8.1. Significant Events

The City has not been directly impacted by a wildland fire event. However, in September 2020, multiple wildfires occurred concurrently in Washington County, outside Washington County, and outside the state, and the City experienced significant smoke from the fires, resulting in unsafe air quality.

3.2.8.2. Potential Impacts

The potential impacts of a wildfire event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Exposure to wildfire smoke, which can lead to eye, nose, and throat irritation and the worsening of chronic heart and lung diseases.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of City staff and resources needed for response to the event.
- Strain on or loss of water supply due to increased demand.
- Economic impacts to governments, including costs for fire suppression, staff, equipment, supplies, transportation and mobilization of first responders, evacuations, sheltering operations, post-fire recovery, and rebuilding costs associated with government-owned buildings, property, and infrastructure.
- Economic impacts, including loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged power lines can lead to additional wildfires.

- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including flood, landslide and erosion, and air and water quality issues.

3.2.8.3. Vulnerabilities

Given the dynamic nature of wildland fires, all populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to this hazard. These include:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults. This may include those spending time at the Sherwood Senior Community Center.
- Populations without access to private transportation.
- First responders and other personnel working directly on fire protection, suppression, and patrols or near a wildfire can experience burns, smoke exposure, heat-related impacts such as heat stroke, heat exhaustion, dehydration, physical fatigue, mental health challenges, injuries, and death.
- Critical infrastructure and facilities, including city hall, the public works facility, the police department, the emergency operations center, the Sherwood Center for the Arts, the Sherwood Senior Community Center, and the Snyder Reservoir.
- Homes, businesses, and infrastructure, such as power lines and storm sewers, adjacent to the wooded areas near the creeks throughout the City.
- Potential for damage to HVAC systems in public and private buildings and emergency generators.
- Business closures due to unsafe air conditions.
- A community risk profile completed by DOGAMI shows 39 residents could be displaced due to a wildland fire event. The profile also indicates there are 12 buildings with a total value of $3,241,000 at high risk of wildland fire exposure, 3 buildings with a total value of $1,789,000 at moderate risk of wildland fire exposure, and 327 buildings with a total value of $123,245,000 at low risk of wildland fire exposure.[468]
- Critical transportation routes and infrastructure, including Oregon Route 99W, SW Tualatin Sherwood Road, Sunset Boulevard, arterial roads and streets, and TriMet bus service.
- Natural environments throughout the City.

[468] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.2.9. Windstorm, Including Tornado

The City has an elevation of 193 feet and historically has not experienced the same frequency of windstorms as those parts of the County at higher elevations. Potential impacts of and vulnerabilities to windstorms and a previous significant event are identified below.

3.2.9.1. Significant Event

The City identified one significant windstorm event in 1996 that caused scattered damage throughout the area.

3.2.9.2. Potential Impacts

The potential impacts of a windstorm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of City staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.2.9.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to windstorms, including tornadoes. These include:

- Older buildings and infrastructure not built to withstand high winds, including manufactured homes and buildings.
- Critical infrastructure and facilities, including city hall, the public works facility, the police department, the emergency operations center, the Sherwood Center for the Arts, the Sherwood Senior Community Center, and the Snyder Reservoir.
- Critical transportation routes and infrastructure, including Oregon Route 99W, SW Tualatin Sherwood Road, Sunset Boulevard, arterial roads and streets, and TriMet bus service.
- Equipment at the City's police department and public works facilities.
- Aboveground utility and power lines.
- Natural environments throughout the City.

3.2.10. Winter Storm

Winter storm was scored as the highest hazard risk to the City. Potential impacts of and vulnerabilities to winter storms are identified below.

3.2.10.1. Potential Impacts

The potential impacts of a winter storm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths, including from carbon monoxide poisoning and falls from slick or icy conditions.
- Frostbite or hypothermia.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components.
- Extended operational hours of City staff and resources needed for response to the event.
- Stranded travelers due to ice, snow, and transportation impacts.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- An increased number of house fires due to improper use of heating methods.
- Significant property damage due to thawing of frozen pipes.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged power lines can lead to wildfires, and tree debris can create fuel load for wildfire.
- Power outages.
- Frozen, damaged, or thawing pipes leading to loss of water.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including drought, wildfire, and flooding.

3.2.10.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to winter storms. These include:

- People who do not have access to sufficient heating, insulated clothing, or dry living conditions, including unhoused populations.
- Older adults and infants, people who take certain medications, people who have certain medical conditions, and people who have been drinking alcohol are at increased risk for hypothermia. This may include those spending time at the Sherwood Senior Community Center.
- People improperly using generators and heating devices.
- Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of snow and ice.
- Possible business closures due to staffing limitations, particularly if transportation routes are disrupted.
- Slick driving conditions can cause traffic accidents and associated increases in emergency response needs.
- All streets within the City are vulnerable to impacts of a winter storm, including snow and ice accumulation and slick driving conditions.
- Critical transportation routes and infrastructure, including Oregon Route 99W, SW Tualatin Sherwood Road, Sunset Boulevard, arterial roads and streets, and TriMet bus service.
- Critical infrastructure and facilities, including city hall, the public works facility, the police department, the emergency operations center, the Sherwood Center for the Arts, the Sherwood Senior Community Center, and the Snyder Reservoir.
- Critical infrastructure, including aboveground power lines and electric generating systems.
- Natural environments throughout the City.
- Tree located throughout the City may be damaged by accumulation of snow and ice.

3.3. Historical Events

Hazard events that have affected the entire planning area since adoption of the 2017 NHMP are detailed in Volume I, Section 2. The City has experienced limited impacts of widespread extreme heat, wildfire smoke, windstorms, and winter storm events.

One disaster declaration has been issued by the City. A disaster declaration for the COVID-19 pandemic was in effect from March 12, 2020, to March 26, 2020. Although pandemic is not a hazard included in this NHMP, this declaration is noted because many businesses were closed and many services were closed or altered, and FEMA provided support and Hazard Mitigation Grant Program (HMGP) funding during the event.

3.4. Overall Vulnerability

Based on the analysis completed by the Technical Committee, winter storms, earthquakes, windstorms, including tornado, drought, and extreme heat present the highest relative risk to the City of Sherwood. These hazards can create widespread events, and all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City can be vulnerable to these hazards.

Areas of greatest vulnerability to these hazards within the City include:

- Populations with higher vulnerability, such as those with preexisting health conditions, older adults, children, and pregnant women. This may include those spending time at the Sherwood Senior Community Center.
- Populations that are unhoused, do not have access to private transportation, and/or are without access to air conditioning, cooling equipment, sufficient heating, and clean water.
- Populations with limited income and financial resources.
- Populations whose primary language is not English.
- Industries that can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic impacts to the City, including loss of local revenue due to business and property tax losses, reduced future revenues, reduced recreation and tourism activity, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Critical infrastructure and facilities, including city hall, the public works facility, the police department, the emergency operations center, the Sherwood Center for the Arts, the Sherwood Senior Community Center, and the Snyder Reservoir.
    - Older buildings and infrastructure not built to current building codes or seismic standards may be more vulnerable.
- Critical transportation routes and infrastructure, including Oregon Route 99W, SW Tualatin Sherwood Road, Sunset Boulevard, arterial roads and streets, and TriMet bus service.
- Equipment at the City's police department and public works facilities.
- Other critical infrastructure, including communication structures, emergency generators, and aboveground utility and power lines.
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.

- There are facilities that store hazardous materials within the City, which can become a secondary hazard during or after an earthquake.
- The City's primary source for water comes from the Willamette River Water Treatment Plant, the City's primary source of water. Two backup sources of water include local groundwater wells and the Bull Run Watershed northwest of Portland. This water source could be vulnerable to hazard events.
- Natural environments, such as those in the City's parks system.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment and safe growth analysis examine the ability of the City to implement and manage a comprehensive mitigation strategy. Strengths, opportunities, and resources of the jurisdiction are identified to develop an effective hazard mitigation action plan. The capabilities identified in this assessment were evaluated collectively to develop feasible recommendations, which support the implementation of effective mitigation activities.

A capability questionnaire was distributed to the City of Sherwood Technical Committee to initiate this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities. The Technical Committee also completed a safe growth analysis to identify potential gaps in growth guidance instruments and improvements that could be made to reduce vulnerability to future development.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances within the City that can prevent and reduce the impacts of hazards.

The City's Comprehensive Plan, capital improvement plan, local emergency operations plan, continuity of operations plan, and stormwater management plan address natural hazards, identify projects that can be included in the mitigation strategy, and can be used to implement mitigation actions. Many of the goals and policies in the City's Comprehensive Plan are related to those in this NHMP and safe growth objectives. The monitoring and implementation section of the NHMP covers these and all other hazard mitigation strategies discussed in the plan. Safety is explicitly included in the City's growth and development policies in the Comprehensive Plan.

The Sherwood Transportation System Plan acknowledges the need to identify hydrological, topographical, and other geological constraints that could hinder alignment of planned streets, but it does not identify projects that can be included in the mitigation strategy and cannot currently be used to implement mitigation actions. The Sherwood Transportation System Plan limits access to identified hazard areas and is used to guide growth into safe locations. The City and the plan identify movement systems designed to function under disaster conditions, such as during an evacuation. The City's corridor plans recognize the need to avoid or mitigate natural hazards. The Regional Disaster Preparedness Organization and Metro are working to create Emergency Transportation Route maps, and the City is a part of this effort.

Land use planning and ordinances are adequately administered and enforced and are an effective measure for reducing hazard impacts. These include zoning, subdivision, and floodplain ordinances and

the utilization of flood insurance rate maps. City ordinances also address erosion prevention and sediment control, energy conservation, and fire prevention. The City has a future land use map that clearly identifies natural hazard areas. Additionally, land use policies discourage development or redevelopment within natural hazard areas, and the City's Comprehensive Plan provides adequate space for expected future growth in areas located outside natural hazard areas.

The City has environmental systems that prevent development in natural hazard areas or zones that have been identified and mapped and has policies that maintain and restore protective ecosystems, including land use policies and an Environmental Sustainability Plan. The City has policies that provide incentives to development outside protective ecosystems.

The City's Community Development Division includes the Planning, Engineering, and Building Departments and leads and facilitates review of land use applications and enforces site plan review requirements. The City of Sherwood utilizes the most current building codes as they are adopted by the State of Oregon.[469] Tualatin Valley Fire & Rescue Station 33 has an Insurance Services Office (ISO) rating of 2 as of February 1, 2018.[470]

The City's building code contains provisions to strengthen or elevate construction to withstand hazard forces, and economic development or redevelopment strategies include provisions for mitigating natural hazards. The City has zoning ordinances that conform to the Comprehensive Plan in terms of discouraging development or redevelopment within natural hazard areas, including prohibiting development within, or filling of, wetlands, floodways, and floodplains. The ordinance also contains natural hazard overlay zones that set conditions for land use within such hazard zones. Rezoning procedures recognize natural hazard areas as off limits to any zoning changes that would allow for increased activity or development in the area. The City has subdivision regulations that restrict the subdivision of land within or adjacent to natural hazard areas, provide for conservation subdivisions or cluster subdivisions to conserve environmental resources, and allow density transfer where hazard areas exist. The City's infrastructure policies limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.

4.1.1. National Flood Insurance Program Compliance

Participation in the National Flood Insurance Program (NFIP) is based on a voluntary agreement between a community and FEMA. For communities that adopt a floodplain management ordinance to reduce flood risks to new construction, federally backed flood insurance is made available to property owners in the community. Compliance with the NFIP, however, extends beyond participation in the program. The three basic components of the NFIP include floodplain identification and mapping risk, responsible floodplain management, and flood insurance.

A repetitive loss (RL) property is a property insured under the NFIP for which the program has paid at least two claims of more than $1,000 in any 10-year period since 1978, regardless of any change(s) of ownership during that period. As of September 30, 2021, there were no FEMA-identified RL properties in the City.

4.1.1.1. National Flood Insurance Program Details

Insurance Summary

The number of NFIP policies, dollar amount of coverage in force, dollar amount of premiums paid annually, and number and dollar amount of claims paid in the City was not available at the time this NHMP was published. Identifying this information is an improvement for the next planning cycle.

[469] City of Sherwood. (n.d.). Code Administration and Resources. https://www.sherwoodoregon.gov/building/page/code-administration-and-resources
[470] Tualatin Valley Fire & Rescue. (n.d.). Fire Protection Rating. https://www.tvfr.com/344/Fire-Protection-Rating

There is one building exposed to flood risk within the community.[471]

Staff Resources

There are no barriers to running an effective NFIP program in the City. The City Engineer is the designated local Floodplain Administrator. This position is full-time and located in the Engineering Department. NFIP administration services in the City include permit review for new development, review of capital projects affecting the floodplain, and enforcement of the City's Code of Ordinances related to floodplains.

Compliance History

The City is in good standing with the NFIP, and there are no outstanding compliance issues. The most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC) was conducted by the State NFIP Coordinator on May 19, 2022, and involved the City Engineer, Civil Engineer, and Planning Manager for the City of Sherwood.

The City will continue NFIP compliance during the next five years of the Natural Hazards Mitigation Plan (NHMP) implementation by enforcing floodplain management requirements, including prohibiting of new construction and substantial improvements within the Special Flood Hazard Area (SFHA), maintaining and using floodplain mapping, and undertaking any code amendments needed to maintain compliance.

Regulation

The City entered into the NFIP on August 13, 1976, and has both digital and paper flood insurance rate maps (FIRMs). The initial FIRM was identified on January 6, 1982, and the current effective map date is October 19, 2018. Floodplain development regulations meet the minimum FEMA and state requirements. Permitting and review codes, policies, and regulations regarding development in the floodplain are detailed in the City's Code of Ordinances, Chapter 16.134. These rules ensure that floodway flow or floodplain capacity are not impeded and that floodplains in the City are preserved, protected, and effectively managed.[2]

Community Rating System

The City does not participate in the Community Rating System.

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff and their skills and tools that can be used for mitigation planning and implementing specific mitigation actions.

The City's Planning Commission is responsible for assisting the City Council to develop, maintain, update, and implement the City's Comprehensive Plan and development code provisions and to review and take action on development projects. The Community Development Department maintains compliance with Oregon's Statewide Planning Goals, provides support to the Planning Commission, and reviews projects for compliance with the City's codes and plans. The Mitigation Technical Committee works together effectively to update and maintain the NHMP.

The City's Parks and Recreation Department administers maintenance programs to reduce risk, including tree trimming, clearing drainage systems, and landscape maintenance of open spaces and rights of way.

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[471] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

[2] City of Sherwood Code of Ordinances. (n.d.). Chapter 16.134-Floodplain (FP) Overlay. https://library.municode.com/or/sherwood/codes/code_of_ordinances?nodeId=TIT16ZOCODECO_DIVVIIIENRE_CH16.134FLFPOV_16.134.080FLDE

The City also has multiple effective mutual aid agreements and planning partnerships, including intergovernmental agreements and partnerships with the Oregon Water/Wastewater Agency Response Network, Washington County Emergency Management Cooperative, Regional Disaster Preparedness Organization, and Cooperative Public Agencies of Washington County.

The City of Sherwood has adequate staffing levels to enforce regulations, staff are trained on hazards and mitigation efforts, and coordination on mitigation initiatives with staff is effective. The Chief Building Official is part of the Community Development Department and is a full-time position. The Community Development Department also has several full-time positions, including planners. The City Engineer is the designated local Floodplain Administrator. This position is full-time and is located in the Engineering Department. The Emergency Management Office is located within the Public Works Department.

Multiple City departments have staff who can support the mitigation strategy, including planners and engineers with an understanding of natural hazards, engineers and professionals trained in construction practices related to buildings and infrastructure, staff with education or expertise to assess vulnerability to hazards, and geographic information system (GIS) staff and coordinators. The City utilizes a private company to execute surveying duties.

Additionally, the City has many technical capabilities that have been used to assess or mitigate risk and could be used in future efforts. Warning systems include Everbridge and OR-Alert in partnership with Washington County. Grant writing is completed by individual departments as needed. The City has a robust GIS program and has created mapping products specific to each department, and hazard data and information can be pulled from a variety of sources, including historical records and DOGAMI.

4.3. Education and Outreach Assessment

Education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information were assessed to determine the City's capabilities.

Fire prevention and safety information is distributed at annual community events such as the Robin Hood Festival. The City also uses social media to promote emergency preparedness, particularly during National Preparedness Month. Other public education and outreach efforts include distributing door hangers with information and online educational activities. Additionally, Sherwood is a Tree City USA and works with contractors to maintain landscaping and properties to reduce natural hazards vulnerabilities and impacts. Sherwood is working to establish a Community Emergency Response Team (CERT) to promote disaster preparedness and train members in basic disaster response skills.

There are many nonprofit organizations and community groups that can assist with implementing future mitigation actions, including those that provide food security resources and healthcare, sheltering and emergency assistance, extreme heat sheltering, and emergency management-specific groups. A partnership with the YMCA includes providing testing stations for COVID-19 and a cooling center during an extreme heat event. Other partners include the Regional Disaster Preparedness Organization, Washington County Emergency Management Cooperative, Local Emergency Managers group, and the Local Emergency Planning Committee.

4.4. Financial Assessment

The City has access to or may be eligible to use the following funding resources for hazard mitigation initiatives:

- Capital improvements project funding
- Authority to levy taxes for specific purposes
- Fees for water, sewer, gas, and/or electric services

- Stormwater utility fees
- Incurrence of debt through general obligation bonds and/or special tax bonds
- Federal funding sources, including the Building Resilient Infrastructure and Communities (BRIC) and Hazard Mitigation Assistance grants
- State funding programs, including the State Homeland Security Program

The City's Capital Improvement Program does not currently provide funding for hazard mitigation projects identified in this NHMP; however, the program limits expenditures on projects that would encourage development in areas vulnerable to natural hazards.

4.5. Capability Expansion and Improvement

Actions that can expand and improve existing authorities, plans, policies, and resources for mitigation include continuing to update City plans as necessary to ensure they are current and reflect the needs of the community; continuing to seek out a variety of funding sources and increase grant writing capabilities; creating and implementing additional public education and outreach offerings; establishing a CERT; and solidifying staffing capabilities and training the new staff, as required.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iii), §201.6(c)(3)(iv), and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) directs local mitigation plans to describe hazard mitigation actions and establish a strategy to implement those actions. Therefore, all other requirements for a local mitigation plan lead to and support the mitigation strategy.

5.1. Mitigation Goals

The Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 City of Beaverton NHMP, 2011 Cities of Cornelius and Forest Grove NHMPs, and 2020 State of Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals detailed in Volume I, Section 3. These goals are the basis of this plan and summarize what the Steering Committee will accomplish by implementing this plan.

5.2. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on mitigation plan requirement 44 CFR §201.6(c)(4)(ii), the vulnerability and capabilities assessments for the City were carefully reviewed and considered when developing the mitigation actions for this plan. The City's Technical Committee will establish a process in which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into the existing local planning strategies.

Once the plan is adopted, the committee will coordinate implementation with the responsible parties in the City and with external stakeholders as needed. The primary means for integrating mitigation strategies

will be through the revision, update, and implementation of plans and regulations, such as comprehensive plans, capital improvement plans, and land development regulations, as feasible.
The members of the City's Technical Committee will remain charged with ensuring the goals and strategies of new and updated local planning documents for their jurisdictions and special districts are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.2.1. Comprehensive Plan

The City of Sherwood's 2040 Comprehensive Plan includes goals and policies related to hazard mitigation. Through a coordinated resiliency strategy, the City will focus on five goals related to natural hazards: minimizing risk, increasing preparedness, improving coordination, building resilience, and mitigating hazards. The City will enhance ordinances and standards as part of this effort—especially those relating to the siting of essential facilities and other development—minimizing the potential risk of natural hazards to people and property. Sherwood will also coordinate emergency preparedness, resilience building, and hazard mitigation efforts with local and regional partners in both the public and private sectors.[472] When the plan goes through a regular update, additional details about hazard mitigation will be added, as applicable.

5.2.2. Building and Zoning Codes

The City will continue to enforce building and zoning codes and adopt new codes as necessary. Sherwood's zoning code, known as the Community Development Code (CDC), addresses the mitigation of flooding hazards in Section 16.134.020. Updates to this section and additions for other areas of hazard mitigation strategies can be integrated into future CDC amendment efforts.

5.2.3. Public Engagement, Education, and Outreach

The City of Sherwood will ensure information about natural hazard measures is available to the public in a variety of formats, media, and languages. These efforts will focus on actionable items, such as informing residents on retrofitting structures for earthquake and personal preparedness supplies.

5.2.4. Day-to-Day Government Functions

The City of Sherwood will continue to enforce policies and review prioritized policies and update them as necessary. The City will maintain adequate supplies on hand to ensure day-to-day government and functions are operational, such as making certain that ample chlorine is available for water treatment activities.

5.2.5. Land Development Regulations

The City will continue to enforce land development regulations and adopt new regulations as necessary. The Sherwood 2040 Comprehensive Plan includes goals to minimize risk to life and property from natural and human-made hazards. As detailed in Governance and Growth Management Goal 8 of the Comprehensive Plan, the City prohibits development in the floodplain as well as regulating development in areas of runoff or erosion hazard. The plan also addresses the preservation and maintenance of natural resources as a means of mitigating the impact of natural hazards.

[472] City of Sherwood. (2021, December 7). Sherwood 2040 Comprehensive Plan. https://www.sherwoodoregon.gov/planning/page/sherwood-2040-comprehensive-plan

5.2.6. Floodplain Management Program and/or National Flood Insurance Program

The City of Sherwood Emergency Management Office will continue to review any RL properties and incorporate any new findings into the City's mitigation strategy, as appropriate.

The City's floodplain management program is implemented through CDC Section 16.134.020. Updates to this section and additions for other areas of hazard mitigation can be integrated into future CDC amendment efforts.

5.2.7. Economic Development Plans and Policies

The City will incorporate mitigation projects, policies, and procedures into public building spaces as applicable and appropriate. This includes incorporating solar power equipment where applicable.

5.2.8. Stormwater Management Plans and Procedures

The City will continue to enforce procedures and update plans as required. Sherwood updated its Stormwater System Master Plan in 2016. Findings from the Master Plan will be supported by future city projects, such as the creation of catch basins and filter island objects to filter out oil.

5.2.9. Emergency Plans That Address Evacuation and Sheltering

Evacuation and sheltering are addressed in an annex of the City's Emergency Operations Plan, and the City will continue to work with Washington County on sheltering efforts as needed.

5.2.10. Enforcement of Existing Policies

Current policies will continue to be enforced and upheld and will be updated as necessary to meet the needs of the City and residents.

5.2.11. Funding Opportunities

The City of Sherwood's Emergency Management Office will continue to review annual, post-disaster, and stand-alone grant opportunities for potential mitigation project funding opportunities, including BRIC, HMGP, and state funding sources.

5.2.12. Day-to-Day Development, Review, and Prioritization of Policies

The City will continue to enforce policies and review prioritized policies and update them as necessary to support a comprehensive mitigation strategy.

6. Action Items

Action items for the 2023 NHMP were determined by the City's Technical Committee based on the review of its risk assessment, its existing capabilities, and the status of its previous action items. This comprehensive range of actions includes local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.1 and 6.2 below. Additional information about how these actions were developed, evaluated, and prioritized is in Volume I, Section 3.

6.1. City of Sherwood Action Items: 2023 Washington County NHMP

Table 212: City of Sherwood Action Items

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
1	Coordinate with Washington County and GIS efforts to provide mapping to the public.	Dam failure	High
2	Educate the public on the risk potential and the potential effects of a dam failure, including water service, power utilities, and others.	Dam failure	High
3	Educate the community about water conservation.	Drought	Low
4	Install low-flow water fixtures in schools and public facilities.	Drought	Low
5	Plant drought-resistant xeriscape gardens and landscaping. Capture rainwater in cisterns and rain barrels for future use on gardens, trees, and other planted areas.	Drought	Low
6	Adopt future required seismic building code revisions as they become introduced. Enforce the current building code standards to ensure that only the appropriate land uses are allowed, especially in high hazard areas.	Earthquake, flooding, and landslide	Medium

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
7	Conduct seismic evaluations on identified community assets, including shelters, critical and essential facilities, and high-risk school and emergency service buildings. Implement appropriate structural and non-structural upgrades and mitigation strategies.	Earthquake	Low
8	Adopt codes and regulations that incentivize the installation of green roofs, solar panels, and solar parking area covers, which provide shade and remove heat from roof and paving surfaces and surrounding air. Incentivize and encourage cool roofing products, such as white roofs, that reflect sunlight and heat away from buildings. Increase tree plantings around buildings to shade parking lots and along public rights-of-way.	Extreme heat	High
9	Educate City employees on Occupational Safety and Health Administration rules and how the City will support operations during extreme heat events. Train employees and supervisors on heat illness indicators and prevention.	Extreme heat	High
10	Offer resources and material about cooling tips to vulnerable populations. Inform populations about rights and rules regarding landlord and housing regulations and how to get help if needed.	Extreme heat	Medium
11	Review and study the liquefaction survey to identify areas that may be prone to landslides. Monitor nearby infrastructure for vulnerabilities.	Flooding and landslide	Medium
12	Investigate flood risk within the jurisdiction and plan for high-water contingencies as appropriate.	Flooding	Medium
13	Build resilient infrastructure to combat the effects of floods and high water.	Flooding	Medium
14	Maintain flood insurance.	Flooding	Medium
15	Follow the stormwater program and maintenance procedures and enhance them as needed to fit evolving needs.	Flooding	Medium
16	Heighten awareness of flood risk by incorporating the procedures for tracking high water marks following a flood into emergency response plans.	Flooding	Medium
17	Landslide risk and damage can be mitigated by being aware of risk factors and development codes and regulations.	Landslide	Low

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
18	Identify critical facilities and industries that may be affected by ash fall and assist them in emergency response plan development.	Volcanic ash	Low
19	Collaborate with County environmental health staff for immediate warnings to communities about degraded air quality following volcanic eruptions, particularly in areas with high concentration of vulnerable groups (e.g., retirement facilities and schools).	Volcanic ash	Low
20	Collaborate with state agencies such as National Oceanic and Atmospheric Administration and DOGAMI, who can assist in developing ashfall models for Washington County and Sherwood.	Volcanic ash	Low
21	Increase public education and awareness of wildfire smoke by informing the public about wildfire smoke impacts. This includes producing and distribute family emergency preparedness information about wildfire smoke hazards. Including tips to mitigate impacts such as: staying indoors, limiting indoor pollution, staying cool, limiting driving, wearing a mask outdoors, and using an air purifier when possible.	Wildland fire, wildland fire smoke	Medium
22	Develop and implement defensible space programs to reduce risk to structures and infrastructure.	Wildland fire	Medium
23	Inform residents of shelter options and evacuation protocols.	Windstorm, including tornado	Low
24	Educate homeowners on the benefits of wind retrofits, provide outreach material to property owners on how to properly install temporary window coverings before a storm, and educate homeowners on larger tree maintenance and management.	Windstorm, including tornado	Low
25	Educate design professionals to include wind mitigation during building design.	Windstorm, including tornado	Low
26	Establish and enforce standards for all utilities regarding tree pruning around lines.	Winter storm	Low
27	Bury overhead power lines.	Winter storm	Low

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
28	Use designed-failure mode for power line design to allow lines to fall or fail in small sections rather than as a complete system to enable faster restoration.	Winter storm	Low
29	Install redundancies and loop feeds.	Winter storm	Low
30	Produce and distribute family and traveler emergency preparedness information about severe winter weather hazards, including safety strategies for severe weather in driver education classes and materials.	Winter storm	Low
31	Encourage homeowners to install carbon monoxide monitors and alarms and educate citizens that all fuel-burning equipment should be vented to the outside.	Winter storm	Low

6.2. Mitigation Action Information Worksheets

Table 213: Dam Failure – Provide Information on Risk

Mitigation Action Information			
Title of action	Dam Failure – Provide Information on Risk		
Type of action	Plans/regulations ☐		Natural systems protection ☒
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	1. Coordination with the county and GIS efforts to provide mapping to the public. 2. Educate the public on risk potential and the effects of a failure. Including: water service, power utilities and others.		
Hazard(s) addressed	Dam failure ☒	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	A high-volume water surge upstream from a catastrophic Scoggins Dam failure can cause the rise of downstream tributaries anywhere from 4 feet to 5 feet. High water surges can be devastating, causing flooding, severe bank erosion, and property damage along the immediate tributary. Furthermore, water can rise very rapidly due to the surge, posing a serious threat to people remaining in lower-lying inundation areas.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives			
Alignment with existing plans and policies	Statewide Planning Goal 7, Comprehensive Plan (CH&S Goal 7), Emergency Operations Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Community Development, PW, Emergency Management, Army Corp of Engineers		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		SHSP Citizen Corps Grant Program, UASI Citizen Corp Grant Program	

Estimated Cost	Low – Less than $50,000	
Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 214: Drought

Mitigation Action Information			
Title of action	Drought		
Type of action	Plans/regulations ☐		Natural systems protection ☒
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	1. Educate community about water conservation. 2. Install low flow water fixtures in schools and public facilities. 3. Plant-drought resistant "xeriscape" garden and landscape. Capture rainwater in cisterns and rain barrels for future use on gardens, trees, and other planted areas.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☒	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Partner with local schools to implement water conservation strategies to maximize water use in schools and home.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	Comprehensive Plan (H&VE Goal 4)		
Alignment with existing plans and policies	Comprehensive Plan, Water Management and Conservation Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Public Works, Sherwood Schools District, USDA, ODOA, OSU Extension and Soil/Water Conservation		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Potential Federal Grant opportunity	
Estimated Cost	Low – Less than $50,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property		$300,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐		

Table 215: EQ – Seismic Building Resilience

Mitigation Action Information			
Title of action	EQ – Seismic Building Resilience		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☒	
Action description	Adopt future required seismic building code revisions as they become introduced. Enforce the current building code standards to ensure only the appropriate land uses are allowed, especially in high-hazard areas.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☒	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Promoting effective land use planning based on identified hazards. Adopting and enforcing building codes and standards. Buying earthquake insurance to protect personal property and belongings.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☒	
Integration into other initiatives			
Alignment with existing plans and policies	Current building code, Comprehensive Plan (CH&S Goal 8), The Disaster Mitigation Act of 2000, Washington County NHMP, State Land Conservation and Development Goal 7 State of Oregon's NHMP		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development and PW Engineering		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low – Less than $50,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☒		

Table 216: EQ – Earthquake Evaluation and Mitigation

Mitigation Action Information			
Title of action	EQ – Earthquake Evaluation and Mitigation		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Conduct seismic evaluations on identified community assets (shelters, critical and essential facilities) and "high-risk" school and emergency service buildings and implement appropriate structural and non-structural upgrades mitigation strategies.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identify current or future risks and vulnerabilities?	The Disaster Mitigation Act of 2000 requires communities to identify mitigation actions that are being considered by the community to reduce the effect that natural hazards will have on the community. Developing and implementing programs to reduce the potential for earthquakes to cause damage can assist a community in mitigating its overall risk to earthquakes. Pre-disaster mitigation strategies will reduce post-disaster response needs by lessening life loss, injury, damage, and disruption.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Community Resiliency Plan, Comprehensive Plan 8		
Alignment with existing plans and policies	Comprehensive Plan (CH&S Goal 8), The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒ Medium ☐ High ☐		
Lead position, office, department, or division responsible for implementation	Community Development, PW Engineering, and Emergency Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Seismic Rehabilitation Grant Program, Hazard Mitigation Assistance Grants	
Estimated Cost	High – More than $100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☒		

Table 217: EH – Reduce Urban Heat Island Effect

Mitigation Action Information			
Title of action	EH – Reduce Urban Heat Island Effect		
Type of action	Plans/regulations ☒	Natural systems protection ☒	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Adopting codes and regulations the incentivize the installation of green roofs, solar panels, and solar parking area covers, which provide shade and remove heat from roof and paving surfaces and surrounding air. Incentivizing and encouraging cool roofing products such as white roofs that reflect sunlight and heat away from a building. Increasing tree plantings around buildings to shade parking lots and along public rights-of-way.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☒	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Urban areas develop and buildings and roads replace open land and vegetation, urban regions become warmer than their rural surroundings, forming an “island” of heat.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives			
Alignment with existing plans and policies	OR OSHA Permanent Heat Rule, City Heat Policy, The Disaster Mitigation Act of 2000, Comprehensive Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Community Development, PW Engineering		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Green building grants (EPA, DOE, etc.)	
Estimated Cost	High – More than $100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☒		

Table 218: Extreme Heat – Policy

Mitigation Action Information			
Title of action	Extreme Heat – Policy		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	Educate City employees on the OSHA rules and how the City will support operations during EH events. Train employees and supervisors on illness indicators and prevention.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☒	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Extreme heat events can cause decline in public health safety. Education on the effects can prevent employee injury and enable early identification of illness.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives			
Alignment with existing plans and policies	OSHA Heat Rule, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Emergency Management, Risk Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low – Less than $50,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property		$300,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 219: EH – Educate Vulnerable Populations

Mitigation Action Information			
Title of action	EH – Educate Vulnerable Populations		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	Offer resources and material to vulnerable populations about cooling tips. Inform populations about rights and rules regarding landlord/housing regulations and how to get help.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☒	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Measures should be taken to ensure vulnerable populations are adequately protected from the impacts of extreme temperatures.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	Emergency Operations Plan, OSHA Permanent Heat Rule, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Community Development, City Council, PH, Emergency Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low– Less than $50,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property		$300,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 220: LS – Landslide Monitoring and Awareness

Mitigation Action Information			
Title of action	LS – Landslide Monitoring and Awareness		
Type of action	Plans/regulations ☐		Natural systems protection ☒
	Structure and infrastructure project ☐		Public education/awareness ☐
Action description	Review and study the liquefaction survey to see areas that may be prone to landslides. Monitor nearby infrastructure for vulnerabilities.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☒	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Landslides can also damage or temporarily disrupt utility services, roads, and other transportation/communication systems, including emergency response, fire, medical, police, etc.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Comprehensive Plan (CH&S Goal 8)		
Alignment with existing plans and policies	The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development, PW, Engineering		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	High – More than $100,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property Environment		$600,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 221: FL – Evaluate Risk of Potential High Water Affected Areas

Mitigation Action Information			
Title of action	FL – Evaluate Risk of Potential High Water Affected Areas		
Type of action	Plans/regulations ☐		Natural systems protection ☒
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	1. Investigate flood risk within the jurisdiction. Plan for the high-water contingencies. 2. Build resilient infrastructure to combat the effects of floods and high water. 3. Maintain flood insurance. 4. Follow storm water program and maintenance.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Reduces risk to infrastructure if such even occurs. Proper maintenance of our storm and sanitary utilities will reduce the potential of certain weather events causing flooding or high water.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☒	
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	Comprehensive Plan (CH&S Goal 7), Storm Water Master Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development, PW		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low – Less than $50,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property		$300,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 222: FL – Flood Risk Assessment

Mitigation Action Information			
Title of action	FL – Flood Risk Assessment		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	Heighten awareness of flood risk. Incorporating the procedures for tracking high water marks following a flood into emergency response plans. Incorporating the procedures for tracking high water marks following a flood into emergency response plans.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Conducting cumulative impact analyses for multiple development projects within the same watershed using GIS to map areas that are at risk of flooding. Obtaining depth grid data and using it to illustrate flood risk to citizens. Incorporating digital floodplain and topographic data into GIS systems, in conjunction with Hazus, to assess risk. Coordination with the county and GIS efforts to provide mapping to the public.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development, Emergency Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low – Less than $50,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 223: LS – Manage Development

Mitigation Action Information			
Title of action	LS – Manage Development		
Type of action	Plans/regulations ☒		Natural systems protection ☒
	Structure and infrastructure project ☐		Public education/awareness ☐
Action description	Landslide risk/damage can be mitigated by being aware of risk factors and development codes and regulations.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☒	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Follow codes and laws regarding natural systems protection and setbacks. Restrict or limit the building in areas suspected of high potential for landslide.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	CH&S Goal 8		
Alignment with existing plans and policies	Flood Plain Management, Comprehensive Plan, Emergency Operations Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒ Medium ☐ High ☐		
Lead position, office, department, or division responsible for implementation	NOAA, OR Water Resource, USGS, Community Development, Public Works		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Federal Grant Opportunities, BRIC	
Estimated Cost	High – More than $100,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property		$600,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Table 224: Volcanic Ash – 1

Mitigation Action Information			
Title of action	Volcanic Ash – 1		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Identify critical facilities and industries that may be affected by ash fall and assist them in emergency response plan development		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☒ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identify current or future risks and vulnerabilities?	Volcanic ash can lead to respiratory problems for vulnerable sectors of residents, such as the elderly and youth. Increasing awareness through public outreach reduces the impact of a volcano on vulnerable groups residing in Sherwood.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	Emergency Operations Plan, Facility Emergency Action Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	USGS-CVO, DOGAMI, Major Industries, City Facility Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low – Less than $50,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property		$300,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐		

Table 225: Volcanic Ash – 2

Mitigation Action Information	
Title of action	Volcanic Ash – 2
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	1. Collaborate with county environmental health for immediate warnings to communities about degraded air quality following volcanic eruptions, particularly in areas with high concentrations of vulnerable groups (e.g., retirement facilities and schools). 2. Work with state agencies such as NOAA and DOGAMI that can assist in developing ash fall models for Washington County and Sherwood.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☒ Extreme heat ☐ Wildland fire ☐
How does the action address identify current or future risks and vulnerabilities?	Volcanic ash can lead to respiratory problems for vulnerable sectors of residents such as the elderly and youth. Increasing awareness through public outreach reduces the impact of a volcano on vulnerable groups residing in Sherwood.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☒ Goal 5 ☐ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	Everbridge ENS
Alignment with existing plans and policies	County Environmental Health, Emergency Operations Plan, Facility Emergency Action Plan, City GIS, The Disaster Mitigation Act of 2000
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	USGS-CVO, DOGAMI, County Environmental Health, Emergency Management
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	Not Applicable
Estimated Cost	Low – Less than $50,000

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 226: WF Smoke – Public Education/Awareness of Wildfire Smoke

Mitigation Action Information			
Title of action	WF Smoke – Public Education/Awareness of Wildfire Smoke		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐		Natural systems protection ☐ Public education/awareness ☒
Action description	Public education/awareness of wildfire smoke can be improved. Inform the public about wildfire smoke impacts. Produce and distribute family emergency preparedness information about wildfire smoke hazards, including tips to mitigate impacts such as: Stay indoors, limit indoor pollution, stay cool, limit driving, wear a mask outdoors, and use an air purifier when possible.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildfire smoke ☒	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identify current or future risks and vulnerabilities?	Larger and more frequent and intense wildfires are a growing public health problem, contributing to reduced air quality for people living near or downwind of fire. Health problems related to wildfire smoke exposure can be as mild as eye and respiratory tract irritation and as serious as worsening of heart and lung disease, including asthma, and even premature death.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐ Goal 2 ☐ Goal 3 ☒	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	U.S. EPA: Wildfire Smoke Guide for Public Officials U.S. EPA: Smoke Ready Toolbox City Smoke/AQI Policy, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	OHA, NOAA, WC Public Health, Emergency Management, OSFM, Fire Defense Board, ODF		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Hazard Mitigation Grant Program	
Estimated Cost	Low – Less than $50,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 227: WF – Develop and Implement Defensible Space Program

Mitigation Action Information			
Title of action	WF – Develop and Implement Defensible Space Program		
Type of action	Plans/regulations ☒	Natural systems protection ☒	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Develop and implement defensible space programs to reduce risk to structures and infrastructure.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildfire ☒	
How does the action address identify current or future risks and vulnerabilities?	Create buffers around residential and non-residential structures through the removal or reduction of flammable vegetation, including vertical clearance of tree branches. Replace flammable vegetation with less flammable species. Create defensible zones around power lines, oil and gas lines, and other infrastructure systems. Regulate new development in and near natural areas, incorporating design principles that create defensible space.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	Fire District Wildfire Interface Policy City Smoke/AQI Policy, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	State Fire Marshal, TVFR, Code Enforcement, Emergency Management, Community Development		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC	
Estimated Cost	Medium – $50,000–$100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000-$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐		

Table 228: WS – Increase Windstorm Risk Awareness

Mitigation Action Information			
Title of action	WS – Increase Windstorm Risk Awareness		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	1. Inform residents of shelter options and evacuation protocols. 2. Educate homeowners on the benefits of wind retrofits. Provide outreach material to property owners on how to properly install temporary window coverings before a storm. Educate homeowners on larger tree maintenance and management. 3. Educate design professionals to include wind mitigation during building design.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm ☒
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Severe wind can occur alone, such as during straight-line wind events and derechos, or it can accompany other natural hazards, including hurricanes and severe thunderstorms. Severe wind poses a threat to lives, property, and vital utilities primarily because of flying debris or downed trees and power lines. Severe wind will typically cause the greatest damage to structures of light construction, particularly manufactured homes.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	Comprehensive Plan (CH&S Goal 8), Emergency Operations Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management, Community Development, PW		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Federal grant opportunities, Hazard Mitigation Grant Program	
Estimated Cost	Low – Less than $50,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 229: WS – Protect Power Lines

Mitigation Action Information			
Title of action	WS – Protect Power Lines		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	**1.** Establish and enforce standards for all utilities regarding tree pruning around lines**.** 2. Burying overhead power lines. 3. Use designed-failure mode for power line design to allow lines to fall or fail in small sections rather than as a complete system to enable faster restoration. 4. Install redundancies and loop feeds.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm ☐
	Drought ☐	Landslide ☐	Winter storm ☒
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Power lines can be protected from the impacts of winter storms. Severe winter weather can down trees, cause widespread power outages, damage property, and cause fatalities and injuries. By taking the three steps above the impacts can be lessened.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	Building Code, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	PGE, Community Development, Engineering		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC	
Estimated Cost	Medium – $50,000–$100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000-$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☐ Ongoing ☒		

Table 230: WS – Conduct Winter Weather Risk Awareness Activities

Mitigation Action Information			
Title of action	WS – Conduct Winter Weather Risk Awareness Activities		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	1. Produce and distribute family and traveler emergency preparedness information about severe winter weather hazards, including safety strategies for severe weather in driver education classes and materials. 2. Encourage homeowners to install carbon monoxide monitors and alarms. Educate citizens that all fuel-burning equipment should be vented to the outside.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm ☐
	Drought ☐	Landslide ☐	Winter storm ☒
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Severe winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Public awareness of severe winter storms can be improved. Inform the public about severe winter weather impacts.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	To be determined		
Alignment with existing plans and policies	Emergency Operations Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	OSFM, TVFR, Emergency Management, ODOT		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low – Less than $50,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Annex G: City of Tigard

1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for the City of Tigard was the Emergency Services Coordinator.

1.2. Annex Organization

This annex has six sections that satisfy mitigation requirements in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

The information provided in this annex is for the City of Tigard alone. All pertinent information that is not identified in this annex is identified in other sections of this NHMP or within the respective appendices.

1.3. NHMP Adoption Process

Once the Washington County NHMP received the designation “Approvable Pending Local Adoption” from the Federal Emergency Management Agency (FEMA), the City presented the plan to City Council for final public comment and local adoption. A copy of the adoption resolution was inserted into the NHMP and is held on file in the City of Tigard and Washington County.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

City officials recognize the benefits of having a long-term, all-hazards approach to mitigating natural hazards. This approach has been implemented through the NHMP and five-year NHMP updates as required by law. This has led to a gradual decrease of hazard-associated impacts by building on risk reduction measures outlined in previous iterations of the NHMP. The City's involvement in the Washington County NHMP represents the collective efforts of the Hazard Mitigation Steering Committee members, participating local Technical Committee members, the public, and stakeholders.

The City of Tigard developed this annex in accordance with guidance outlined in 44 CFR §201.6(c)(5) of DMA 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in the geographical area of the City.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP. An open involvement process was established for the public and all stakeholders, which provided an opportunity for everyone to be involved in the planning process and make their views known.

Two teams worked simultaneously on this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of points of contact from each plan participant. The group met to discuss countywide topics, including hazards and mitigation strategies. The points of contact were the leads of their local Technical Committee.
2. **Local Technical Committee:** Each plan participant had a Technical Committee that consisted of the Steering Committee representative for that jurisdiction or special district as well as designated representatives from within the organization. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. City of Tigard Technical Committee

This annex within the NHMP was developed by the City of Tigard's local Technical Committee with support from IEM, a consulting firm hired to assist with the planning process. The efforts of the committee were led by the City's Emergency Services Coordinator throughout 2022.

Table 231: City of Tigard Technical Committee Members for the 2023 NHMP

Position	Department	Role in Committee and Planning Process
Emergency Services Coordinator	Public Works, Emergency Management Program	General oversight, hazard identification, and plan development
Assistant Public Works Director	Public Works	Hazard identification and plan development
City Engineer	Public Works	Hazard identification and plan development
Senior Project Planner	Public Works	Hazard identification and plan development
Street Supervisor	Public Works	Hazard identification and plan development
Wastewater Supervisor	Public Works	Hazard identification and plan development
Green Team Supervisor	Public Works	Hazard identification and plan development

Position	Department	Role in Committee and Planning Process
Water Operations Supervisor	Public Works	Hazard identification and plan development
City Building Official	Community Development, Building Services Division	Hazard identification and plan development.
Assistant Community Development Director	Community Development	Hazard identification and plan development.
Geographic Information System (GIS) Technician	Information Technology	Hazard identification and plan development
GIS Coordinator	Information Technology	Hazard identification and plan development.
Facilities Services Supervisor	Facilities and Fleet	Hazard identification and plan development.
Fleet and Facilities Operations Manager	Facilities and Fleet	Hazard identification and plan development.
Commander and Emergency Operations Center Manager	Police and Emergency Operations Center	Hazard identification and plan development
Community Engagement Program Coordinator	Public Works	Hazard identification and plan development.
Digital Communication Coordinator	Community Development	Hazard identification and plan development.

IEM also supported or led the following activities associated with the development, approval, and adoption of the plan:

1. Facilitated the NHMP update process.
2. Based on committee direction and stakeholder and community input, prepared the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.
3. Submitted the proposed plan to the State of Oregon Department of Emergency Management (OEM) and FEMA for review and approval; and completed edits or revisions requested by these organizations.
4. Coordinated the plan adoption processes with the City, Washington County, OEM, and FEMA.

2.3. Public Participation

Public participation is an important component of this NHMP and also a required element as outlined in 44 CFR §201.6(c)(5), FEMA's mitigation planning guidance. Public participation offered community members the opportunity to voice their ideas, interests, and opinions about hazards that affect them and the best way to mitigate hazard impacts. As the City implements the mitigation actions identified in this annex, there will be additional opportunities for public participation.

Plan participants used a survey to collect information about community perceptions of natural hazards and priorities. The Steering and Technical Committees used the results to inform their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP. See Appendix B of the NHMP for additional information about the survey and opportunities for public comment.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist the City in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards.

3.1. Changes in Development Since Adoption of the 2017 NHMP

(In compliance with 44 CFR §201.6(d)(3))

The population of the City of Tigard has grown approximately 13% since 2015, and the number of people per square mile increased by almost 600. As of 2019, there are more millennials than baby boomers living in the City, and there was an increase in single adults living alone.[473] More immigrant families were moving to the City, and there was a record number of multigenerational households.[474]

There has been an increase in housing to meet the demand of population growth, with a focus on middle housing. This type of housing decreases the average square footage and footprint of homes and groups homes together on one or more lots. Areas with middle housing options are often designed differently than traditional suburban or urban residential neighborhoods, so the unique features and needs of these communities should be a mitigation planning consideration.

Automobile traffic density has also grown significantly since the 2017 NHMP update. This has created several high-traffic intersections and frequently congested highways and main thoroughfares. The City of Tigard is working to increase multimodal transportation options to mitigate congestion. Heavy vehicle traffic should also be a mitigation planning consideration.

Tigard is focusing future residential development/growth into the River Terrace, and projected growth is around 4,500 units in the next 10 years. The Tigard Triangle area is projected to grow by over 400 multi-family units over the next decade, and downtown Tigard will also likely be a focus area for future development.

3.2. Community Profile

This section provides information on City-specific characteristics. Additional discussion of the planning area's community characteristics is outlined in Volume III, Appendix A of the NHMP.

Some community characteristics may suggest how natural hazards may impact communities and how communities choose to plan for natural hazard mitigation. Identifying and considering the Tigard-specific assets during the planning process may assist in identifying appropriate measures for natural hazard mitigation.

Table 232 below reflects the community demographics and vulnerable populations in Tigard. This information was gathered from the U.S. Census, Portland State University, and the City of Tigard.

[473] City of Tigard. (n.d.). Housing and Demographic Trends, Planning for Housing Choice in Tigard. https://www.tigard-or.gov/home/showpublisheddocument/1422/637697292819400000
[474] City of Tigard. (n.d.). Housing and Demographic Trends, Planning for Housing Choice in Tigard. https://www.tigard-or.gov/home/showpublisheddocument/1422/637697292819400000

Table 232: Community Demographics*

Population	Total	Percent Change
2010 population[475]	48,035	
2021 population[476]	55,854	+16%
2035 forecasted population[477]	60,213	+8%
Race and Ethnicity[478]	**Total**	**Percent of Population**
White alone	43,457	80%
Hispanic/Latino/a/x of any race	6,453	12%
Asian alone	4,618	9%
Two or more races	3,961	7%
Black or African American alone	543	1%
American Indian and Alaska Native alone	213	0.4%
Native Hawaiian and Other Pacific Islander alone	325	0.6%
Language Spoken at Home[479]	**Percent of Population**	
English only	81%	
Asian and Pacific Island languages	7%	
Spanish	6%	
Indo-European languages	5%	
Other languages	2%	
Vulnerable Age Groups[480]	**Percent of Population**	
Less than 15 years of age	12%	
65 years and older	16%	

[475] United States Census Bureau. (2010, April 1). QuickFacts Tigard City, Oregon. Accessed October 3, 2022, from https://www.census.gov/quickfacts/fact/table/tigardcityoregon/PST045221
[476] Portland State University Population Research Center. (2022). Population Estimate Reports. 2021 Certified Population Estimates,, July 1. https://www.pdx.edu/population-research/population-estimate-reports
[477] Oregon Metro. (2013, January 15). 2035 Forecast of Population by City and County. https://www.oregonmetro.gov/sites/default/files/2014/05/29/population_housing_forecasts_by_city_county.pdf
[478] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Demographic and Housing Estimates,, Table DP05. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon&tid=ACSDP5Y2020.DP05
[479] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Language Spoken at Home Table S1601. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon%20language
[480] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Age and Sex Estimates,, Table S0101. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon%20age&tid=ACSST1Y2021.S0101

Disability Status of Non-Institutional Civilians[481]	Percent of Population
Total	11%
Less than 17 years of age	8%
65 years and older	65%

* Due to how respondents identify and answer questions, there may be overlapping responses, and results may equal greater than 100% of the population. Percentages are rounded.

3.2.1. Geography, Topography, and Climate

Tigard is in eastern Washington County, adjacent to Portland's southwestern border. The City of Tigard has an area of 11.71 square miles. Situated in the Willamette Valley, the climate in the City is relatively mild throughout the year, characterized by cool, wet winters and warm, dry summers. The valley's weather is characterized by a predominant winter rainfall climate, with about 50% of the total annual precipitation falling between December and February each year. Average temperatures range from the low 80s in the summer down to about 40 degrees in the coldest months. Tigard is predominately urban and abuts open green space to the east and lies in the Tualatin River watershed.

3.2.2. Transportation, Infrastructure, and Housing

3.2.2.1. Transportation

Oregon Highways 99W and 217 and Interstate 5 are predominant transportation features in the City. Other major roads include Boones Ferry Road, Hall Boulevard, and Oregon Route 210.

The City's central location means that thousands of non-Tigard residents travel through the City each day. Heavy automobile traffic regularly occurs in the City, which is an important consideration for evacuation routes and procedures. Per the Tigard Transportation System Plan, connectivity in the City is severely challenged by Highway 217, Interstate 5, and the railroad, as well as Fanno Creek, Bull Mountain, and other natural features.[482] Approximately 21,000 residents commute out of the city for work, and around 44,000 employees commute into the City. Major visitor destinations in Tigard include Washington Square Mall and Bridgeport Village.

The Tri-County Metropolitan Transit District (TriMet) provides public transportation through eight bus lines and the Westside Express Service commuter rail line, which connects Tigard to the City of Wilsonville to the south and the City of Beaverton to the northwest. Due to Tigard's central location, much of the City's transportation system has regional significance, and there are two transit centers within the City that provide regional bus and commuter rail services. The City has been focusing on increasing multimodal transportation options, including biking and walking trails, notably the regional Fanno Creek Trail.

The Portland & Western Railroad (PNWR) runs through Tigard, and trains mostly ship woodchips, paper, agriculture goods, and aggregates. PNWR and TriMet share the same track.

The City of Tigard includes a diversity of land uses, including commercial, residential, and industrial. Tigard is primarily residential, with almost 70% of the land area zoned for residential use. In 2018, City Council approved code amendments to the Tigard Development Code, allowing for a wider range of housing types within the City, including middle housing. These houses generally consist of smaller

[481] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Disability Characteristics Estimates,, Table S1810. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon%20disability

[482] City of Tigard. (2022, January). Tigard On the Move: Transportation System Plan. https://www.tigard-or.gov/home/showpublisheddocument/1875/637792201890230000

housing units with a limited footprint that are sometimes grouped together on one or more lots. This allows more people to live in Tigard and increases walkability; however, it also increases population and built environment density and should be a planning consideration when creating and implementing a mitigation strategy.

Special districts that operate within the City's boundaries are Tualatin Valley Fire & Rescue, Clean Water Services, and Tualatin Valley Water District.

3.2.2.2. Infrastructure

The City of Tigard critical and vulnerable facilities listed below in Table 233 may be vulnerable to one or more natural hazards.

Table 233: Critical Facility and Asset Inventory

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
City of Tigard Facilities Operations Building	Infrastructure or Facility	8955 SW Burnham Street	Not vulnerable to landslides; leased facility
Just Compassion Shelter	Infrastructure or Facility	12280 SW Hall Boulevard	Not vulnerable to flooding; nonprofit-owned and -operated.
Transportation Portland Western Railroad	Infrastructure or Facility	7787 SW Tech Center Drive	Freight railroad line
TriMet Transportation Westside Express Service	Infrastructure or Facility	7787 SW Tech Center Drive	Commuter rail line
Tualatin Valley Fire & Rescue Station 50	Infrastructure or Facility	12617 SW Walnut Street	
Tualatin Valley Fire & Rescue Station 51	Infrastructure or Facility	8935 SW Burnham Street	
Tualatin Valley Fire & Rescue Command & Business Operations Center	Infrastructure or Facility	11945 SW 70th Avenue, Portland, 97223	
Tigard City Hall & Police Department	Infrastructure or Facility	13125 SW Hall Boulevard	
City of Tigard Public Works Building	Infrastructure or Facility	8777 SW Burnham Street	
City of Tigard Streets and Parks Operations Building	Infrastructure or Facility	13125 SW Hall Boulevard	
City of Tigard Permit Center	Infrastructure or Facility	13125 SW Hall Boulevard	
City of Tigard Senior Center	Infrastructure or Facility	8815 SW Omara Street, Portland, 97223	
City of Tigard Library	Infrastructure or Facility	13500 SW Hall Boulevard	Alternate Emergency Operations Center
Niche	Infrastructure and Facility	8720 SW Burnham Street	City’s GIS and IT facility

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Washington Square	Infrastructure or Facility	9585 SW Washington Square Road, Portland, 97223	Shopping mall
Lincoln Center	Infrastructure or Facility	10200 SW Greenburg Road	Office building
Suburban Propane	Infrastructure or Facility	10075 SW Cascade Avenue	Hazardous materials
The Pool and Spa House	Infrastructure or Facility	13025 SW Pacific Highway	Hazardous materials
Alberta Rider Elementary School	Infrastructure or Facility	14850 SW 132nd Avenue	
Gaarde Christian School	Infrastructure or Facility	11265 SW Gaarde Street	
Islamic School of Muslim Educational Trust (MET) (Ismet)	Infrastructure or Facility	10330 SW Scholls Ferry Road	
James Templeton Elementary School	Infrastructure or Facility	9500 SW Murdock Street	
Guidepost Montessori at Tigard	Infrastructure or Facility	10540 SW Hall Boulevard	
Tigard High School	Infrastructure or Facility	9000 SW Durham Road	
Twality Middle School	Infrastructure or Facility	14650 SW 97th Avenue	
Durham Elementary School	Infrastructure or Facility	7980 SW Durham Road	
Fowler Middle School	Infrastructure or Facility	10865 SW Walnut Street	
Charles F. Tigard Elementary School	Infrastructure or Facility	12855 SW Grant Avenue	
Mary Woodward Elementary School	Infrastructure or Facility	12325 SW Katherine Street	

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Metzger Elementary School	Infrastructure or Facility	10350 Lincoln Street	
St. Anthony Roman Catholic School	Infrastructure or Facility	12645 SW Pacific Highway, Portland, 97223	
Deer Creek Elementary School	Infrastructure or Facility	16155 SW 131st Avenue	
Mitch Charter School	Infrastructure or Facility	19550 SW 90th Court	
Westgate Christian School	Infrastructure or Facility	12930 SW Scholls Ferry Road	
Tigard–Tualatin School District Administration Building	Infrastructure or Facility	6960 SW Sandburg Street	
Student Transportation of America	Infrastructure or Facility	13000 SW Hall Boulevard	
Tigard–Tualatin School District Bus Yard	Infrastructure or Facility	18340 SW Pacific Highway	
Providence Immediate Care –Bridgeport	Infrastructure or Facility	18040 SW Lower Boones Ferry Road, Suite 100A	
Providence Bridgeport Family Medicine	Infrastructure or Facility	18040 SW Lower Boones Ferry Road, Suite 304	
Providence Immediate Care –Scholls	Infrastructure or Facility	12442 SW Scholls Ferry Road, Suite 100	
Providence St. Vincent Urgent Care Clinic	Infrastructure or Facility	12442 SW Scholls Ferry Road, Suite 100	
Metropolitan Pediatrics: Bridgeport	Infrastructure or Facility	7213 SW Hazel Fern Road	
Bridgeport Family Medicine	Infrastructure or Facility	16083 SW Upper Boones Ferry Road, Suite 130	Formerly Tigard Family Medical Center
The Portland Clinic – Tigard	Infrastructure or Facility	9250 SW Hall Boulevard	

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Rise Church (Calvin Presbyterian Church)	Infrastructure or Facility	10445 SW Canterbury Lane	Potential shelter site
Hall Boulevard Baptist Church	Infrastructure or Facility	14145 SW Hall Boulevard	Potential shelter site
Christ the King Lutheran Church	Infrastructure or Facility	11305 SW Bull Mountain Road	Potential shelter site
Good Neighbor Center	Infrastructure or Facility	11130 SW Greenburg Road	Potential shelter site for single mothers and children
St. Anthony Catholic Church	Infrastructure or Facility	9905 SW McKenzie Street	
Southwest Church of Christ	Infrastructure or Facility	9725 SW Durham Road	
Tigard First Church of Christ	Infrastructure or Facility	14325 SW 112th Avenue	
Tigard Church of God	Infrastructure or Facility	15670 SW 98th Avenue	
St. James Episcopal	Infrastructure or Facility	11511 SW Bull Mountain Road	
Grace Point Community Church	Infrastructure or Facility	11075 SW Gaarde Street	Potential shelter site
Horizon Community Church	Infrastructure or Facility	23370 SW Boones Ferry Road	
Tigard First Church of Christ	Infrastructure or Facility	14325 SW 112th Avenue	Potential shelter site
Tigard Covenant Church	Infrastructure or Facility	11321 SW Naeve Street	
The Church of Jesus Christ of Latter-day Saints	Infrastructure or Facility	11065 SW North Dakota Street	
Tigard First Church of Christ	Infrastructure or Facility	14325 SW 112th Avenue	

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Tigard Community Friends Church	Infrastructure or Facility	15800 SW Hall Boulevard	
Faith Journey Church	Infrastructure or Facility	11265 SW Gaarde Street	
Tigard United Methodist	Infrastructure or Facility	9845 SW Walnut Place	
Transportation networks in the City	Infrastructure or Facility	Throughout the City	• State Highway 99W • State Highway 217 • Hall Boulevard • Durham Road • 72nd Avenue • Interstate 5 • Walnut Street • Gaarde Street • Bull Mountain Road • Beef Bend Road • Scholls Ferry Road • Bonita Road • Greenberg Road • McDonald Street

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Water facilities in the City	Infrastructure or Facility	Throughout the City	• 12 city reservoirs • 7 pump stations • 1 river intake pump station – West Linn (Lake Oswego (LO)-Tigard Water Partnership) • 5 wells: 2 capped and 3 active • 2 SCADA systems • 36” main • 24” mains (2) • Double sewerage siphon structure • 1 sewer lift station • ASR 3 • Clean Water Services Treatment Plant • 1 water treatment plant in L/O (LO-Tigard Water Partnership)
Private utilities in the City	Infrastructure or Facility	Throughout the City	• 2 NW Natural Gas Pipelines • 5 Portland General Electric Substations • 2 Verizon Central Switch Offices • 3 Communication Towers • 1 Kinder Morgan Liquid Petroleum Line
Phil Lewis School	Historical Property		
Shaver–Bilyeu House	Historical Property	16445 SW 92nd Avenue	
Windmill	Historical Property	12130 SW Katherine Street, Portland, 97223	
John Tigard House Museum	Cultural Resource	14601 SW 103rd Avenue	
Crescent Grove Cemetery	Cultural Resource	9925 SW Greenberg Road	
St. Anthony’s Cemetery and Columbarium	Cultural Resource	11585 SW Gaarde Street	

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Sunset Pioneer Tigard Evangelical Cemetery	Cultural Resource	State Highway 99W and SW Canterbury Lane 45.4230016, 122.7784192	
Dirksen Nature Park	Natural Resource	11450 SW Winter Lake Drive	
Starks Reservoir	Natural Resource	11450 SW Winter Lake Drive	
Scoggins Dam/Henry Hagg Lake	Natural Resource	City of Forest Grove, 45.472845, -123.203958	

3.2.2.3. Housing

Housing characteristics are an important factor in mitigation planning. The information below shows that most housing units are owner-occupied and consist of one-unit buildings built before 1999. The older the housing, the more at risk it can be to damage from natural hazards such as earthquakes and windstorms, including tornadoes.

Table 234: Housing Characteristics*

Households	Total
Total households[483]	21,257
Units in Housing Structure[484]	**Percent of Housing**
One-unit structures	68%
Structures with two or more units	32%
Manufactured homes and all other types	.6%
Year Housing Structure Built[485]	**Percent of Housing**
Pre-1979	39%
1980–1999	42%
2000 to present	19%
Housing Tenure and Vacancy	**Percent of Housing**
Owner-occupied[486]	63%
Renter-occupied[487]	37%
Vacant[488]	5%

* Due to how respondents answer questions, there may be overlapping responses, and results may equal greater than 100%. Percentages are rounded.

[483] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon%20housing
[484] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon%20housing&tid=ACSST5Y2020.S1101
[485] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Physical Housing Characteristics for Occupied Housing Units Table S2504. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon%20housing&tid=ACSST5Y2020.S2504
[486] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon%20housing&tid=ACSST5Y2020.S1101
[487] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon%20housing&tid=ACSST5Y2020.S1101
[488] United States Census Bureau. (2021, July 1). 2020 Decennial Census Occupancy Status, Table H1. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon%20housing&tid=DECENNIALPL2020.H1

3.2.3. Economy

Tigard is home to around 3,400 businesses from a variety of industries, employing around 45,000 workers from around the region.[489] The top employment sectors in the City are management and professional, administrative services, manufacturing and supply chain, and consumer-related.[490] The vast majority of firms in the City are small businesses with one to four employees.[491]

Major employment and commercial centers include Lincoln Tower, Washington Square Mall, 72nd Industrial Corridor, the Highway 99W commercial and transportation corridor, and the heavy rail switching yard off Hall Blvd at Wall Street. Nike and Intel Corporations also have a heavy economic presence in the City. Essential businesses identified by the Technical Committee include Costco, WinCo Foods, Fred Meyer, Safeway, Walmart, Home Depot, and Lowes.

The number of full-time, year-round workers earning $100,000 or more per year increased by 26% between 2012 and 2017.[492] Meanwhile, the number of workers earning $25,000 or less per year declined by 3%.[493]

Table 235: Income Characteristics[494]*

Households by Income Category	Percent of Households
Less than $5,000	2%
$5,000 to $9,999	1%
$10,000 to $14,999	3%
$15,000 to $19,999	3%
$20,000 to $24,999	4%
$25,000 to $34,999	6%
$35,000 to $49,999	9%
$50,000 to $74,999	16%
$75,000 to $99,999	14%
$100,000 to $149,999	20%
$150,000 or more	22%
Median Household Income	
$86,757	

* Due to how respondents answer questions, there may be overlapping responses, and results may equal greater than 100%. Percentages are rounded.

[489] City of Tigard. (n.d.). Tigard Economy: At A Glance. https://www.tigard-or.gov/business-development/economic-development/tigard-economy-at-a-glance#ad-image-0
[490] City of Tigard. (n.d.). Tigard Economy: At A Glance. https://www.tigard-or.gov/business-development/economic-development/tigard-economy-at-a-glance#ad-image-0
[491] City of Tigard. (n.d.). Tigard Economy: At A Glance. https://www.tigard-or.gov/business-development/economic-development/tigard-economy-at-a-glance#ad-image-0
[492] City of Tigard. (n.d.). Tigard Economy: At A Glance. https://www.tigard-or.gov/business-development/economic-development/tigard-economy-at-a-glance#ad-image-0
[493] City of Tigard. (n.d.). Tigard Economy: At A Glance. https://www.tigard-or.gov/business-development/economic-development/tigard-economy-at-a-glance#ad-image-0
[494] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Financial Characteristics, Table S2503. Accessed October 3, 2022, from https://data.census.gov/cedsci/table?q=Tigard%20oregon%20income&tid=ACSST5Y2020.S2503

3.3. Natural Hazard Profiles

The City of Tigard's Technical Committee utilized the OEM's hazard analysis methodology to examine hazard vulnerability and probability by collecting information about history, probability, vulnerability, and maximum threat for each hazard that impacts the City. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants. The score range for this methodology is 24 (lowest possible) to 240 (highest possible).

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Volume I, Section 2.

The scores for each hazard that impact the City are presented below. All natural hazards included in the NHMP have the potential to impact the City.

Table 236: Natural Hazard Risk Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	Low	Medium	Medium	Medium	95
Drought	High	Medium	Medium	High	167
Earthquake	Low	High	High	Medium	203
Extreme heat	High	Medium	Medium	High	162
Flooding, including channel migration and streambed erosion	High	Medium	Medium	High	162
Landslide	Low	Medium	Low	Low	73
Volcanic ash	Low	Medium	Medium	Medium	137
Wildland fire	Medium	Medium	High	Medium	168
Windstorm, including tornado	High	Medium	High	High	205
Winter storm	High	Medium	High	High	205

Full descriptions of each hazard are provided in Volume I, Section 2. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description in this annex and in Volume I, Section 2.

The timeframe of data collected during the planning process for the City of Tigard was from November 1, 2016, to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the City's Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events since adoption of the 2017 NHMP, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are presented in the same order, as applicable: populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

3.3.1. Dam Failure

The City of Tigard has two potential dams of concern: the Stark Reservoir and Scoggins Dam. Stark Reservoir may present a high water threat; however, the risk associated with this threat is low because a spillover was installed that mitigates any potential catastrophic impacts. A Scoggins Dam failure could affect South Tigard, Tualatin Riverbank neighborhoods, Tualatin, and Clean Water Services, depending on the time of year. If Scoggins Dam failed, it is estimated that there would be 10-foot surge. Potential impacts of and vulnerabilities to dam failure are identified below.

3.3.1.1. Potential Impacts

The potential impacts from a dam failure event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Need for widespread search and rescue operations, including water rescues.
- Displaced residents in need of sheltering.
- Reduction or loss of water supply.
- Water use restrictions and lack of potable and irrigation water supplies.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Economic impacts, including loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity. Interruptions to commercial transportation routes could take an economic toll on the County. Scoggins Valley Park receives one million visitors a year and could be severely damaged by a dam failure.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal economic impacts from loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Erosion and flooding.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.1.2. Vulnerabilities

Built environment, critical facility, infrastructure, and natural environment vulnerabilities to a dam failure event include:

- If Scoggins Dam were to fail, areas in the southern portions of the City could be affected. The expected surge would be 10 feet; however, a Scoggins Dam failure is also considered a low risk.
- Clean Water Services has a facility in the inundation zone of Scoggins Dam and could be affected if the dam failed, especially in fall, winter, and early spring.
- Residences in the inundation zones could be vulnerable to flooding.
- Local bridges crossing Highway 210 and Borrows Road may be flooded.
- Summer Lake Park and Cook Park could be flooded.

3.3.2. Drought

Drought typically occurs as a regional event and often affects more than one city and county simultaneously. The City's main source of drinking water comes from the Clackamas River. The cities of Lake Oswego and Tigard formally became partners in 2008 and have also designed an underground aquifer for water storage. During dangerously low water conditions, the City considers limiting access to creeks, rivers, and lakes to protect already stressed aquatic life. They may also temporarily reduce water rights and initiate mandatory water use curtailment restrictions. Potential impacts of and vulnerabilities to drought are identified below.

3.3.2.1. Potential Impacts

The potential impacts from a drought event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Reduction or loss of water supply.
- Water use restrictions and lack of drinkable water supply.
- Health effects, including increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions.
- Reduced economic productivity or business closures, including agriculture, livestock, recreation, energy, tourism, timber, and fisheries.
- Supply chain restrictions, including food shortages.
- Loss of power or reduced availability of electricity due to infrastructure damage and high demand.
- Property and infrastructure damage due to expansive soils.
- Damage to natural environments, including low water levels in lakes, rivers, and other water bodies, reduced plant growth, local species reduction or extinction, increased water temperature, and deteriorated water quality, which may result in fish kills and increased waterborne pollutants.
- Concurrent hazards, including extreme heat, wildfire, flooding, and landslides.

3.3.2.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to drought. These include:

- People in the City with preexisting health conditions, those without access to clean water, children, pregnant women, and older adults. This may include those living in or spending time in the City's 20 schools and education administration buildings, 7 medical facilities, the Just Compassion Shelter, and the City of Tigard Senior Center.
- Those who are employed in water-dependent sectors, such as agriculture and recreation, may experience a reduction in income.
- The Clackamas River, the City's water supply source.
- The City operates three aquifer and recovery systems and three wells that provide six million gallons of water a day. The operations and outputs of these facilities may be vulnerable to drought.
- Critical infrastructure and facilities, including 8 city buildings, 14 roads throughout the City, 1 freight rail line, 1 commuter rail line, water infrastructure throughout the City, 1 Clean Water Services Treatment Plant, 3 fire stations, 19 school and education administration buildings, 2

hazardous material sites, 7 medical facilities, 18 religious facilities, 13 private utilities throughout the City, 3 historical properties, 4 cultural sites, 3 natural resources, 1 overnight shelter, 1 shopping center, and 1 office building.

- Critical transportation infrastructure, including Oregon Highways 99W and 217, Interstate 5, arterial roads, TriMet services, and the Portland & Western Railroad.
- Other critical infrastructure, including communication structures and emergency generators.
- Essential businesses, including Costco, WinCo Foods, Fred Meyer, Safeway, Walmart, Home Depot, and Lowes.
- Natural environments located throughout the City of Tigard, such as protected wetlands and small tributaries.

3.3.3. Earthquake

The City could experience earthquakes that originate from the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek Fault Zone. It could also experience liquefaction and coseismic landslides as the result of an earthquake. Potential impacts of and vulnerabilities to earthquake are identified below.

3.3.3.1. Potential Impacts

The potential impacts from an earthquake event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Mental health impacts, including post-traumatic stress disorder.
- Public health hazards resulting from disruption of drinking water and wastewater systems.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to ground utilities; residential, public, and private buildings; and transportation systems above and below.
- Disruption of essential infrastructure systems, such as power systems, public utilities, and telecommunications.
- Blocked roads and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction.
- Downed or damaged power lines that can lead to wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Change in water flows, including paths of rivers and streams.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards initiated by an earthquake, including flood, wildland fire, and landslide.

3.3.3.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to earthquakes. These include:

- Critical infrastructure and facilities, including 8 city buildings, 14 roads throughout the City, 1 freight rail line, 1 commuter rail line, water infrastructure throughout the City, 1 Clean Water Services Treatment Plant, 3 fire stations, 19 school and education administration buildings, 2 hazardous material sites, 7 medical facilities, 18 religious facilities, 13 private utilities throughout the City, 3 historical properties, 4 cultural sites, 3 natural resources, 1 overnight shelter, 1 shopping center, and 1 office building.
- Other critical infrastructure, including aboveground power lines, communication structures, and emergency generators.
- Essential businesses, including Costco, WinCo Foods, Fred Meyer, Safeway, Walmart, Home Depot, and Lowes.
- Underground infrastructure, such as pipelines and utility lines, buildings, and roads are vulnerable to damage from liquefaction due to the type of soil in the City. The concentration of soft soils is the highest along the Tualatin River and its tributaries.
- Older buildings and infrastructure. This includes historical structures and properties, Tigard City Hall, the Public Works Operations Building, and the Highway 99W viaduct over downtown and a heavily trafficked rail line.
- Buildings with very high or high collapse potential include residential and commercial buildings constructed prior to 1990 and unreinforced masonry buildings.
    - Approximately 65% of residential buildings were built prior to 1990.
    - A 2007 Oregon Department of Geology and Mineral Industries (DOGAMI) study identified that these buildings had “high” collapse potential:
        - Tigard Police Department
        - Durham Elementary School
        - James Templeton Elementary School
        - Mary Woodward Elementary School
        - Thomas R Fowler Middle School
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.
- Critical transportation infrastructure, including Oregon Highways 99W and 217, Interstate 5, arterial roads, TriMet services, and the Portland & Western Railroad.
- An estimated 51% of the City’s economy could be vulnerable to impacts from an event.
- Natural environments located throughout the City.
- Using 2022 Hazus®-MH information, it is estimated a 6.7 magnitude Gales Creek Fault earthquake event would result in 31 yellow-tagged buildings, 2 red-tagged buildings, and $44,742,000 in total economic losses.[495]

[495] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

- A 2018 DOGAMI report shows that a:
  - Cascadia Subduction Zone magnitude 9.0 earthquake in “dry” soil conditions could result in $756,000,000 in building repair costs, 405,000 tons of debris, 329 long-term displaced residents, and up to 533 deaths;
  - Cascadia Subduction Zone magnitude 9.0 earthquake in “wet” soil conditions could result in $1,087,000,000 in building repair costs, 516,000 tons of debris, 2,306 long-term displaced residents, and up to 920 deaths;
  - Portland Hills Fault magnitude 6.8 earthquake in “dry” soil conditions could result in $1,873,000,000 in building repair costs, 870,000 tons of debris, 1,404 long-term displaced residents, and up to 1,452 deaths; and
  - Portland Hills Fault magnitude 6.8 earthquake in “wet” soil conditions could result in $2,783,000,000 in building repair costs, 1,164,000 tons of debris, 7,409 long-term displaced residents, and up to 2,569 deaths. [496]

[496] Oregon Department of Geology and Mineral Industries. (2018). Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon. https://www.oregongeology.org/pubs/ofr/O-18-02/O-18-02_report.pdf

3.3.4. Extreme Heat

Due to a rise in the frequency and severity of extreme heat events and the impacts from those events, the NHMP Steering Committee chose to include this hazard for the first time in the Washington County NHMP. Previous significant events and the potential impacts of and vulnerabilities to extreme heat are identified below.

3.3.4.1. Significant Events

Extreme heat was not included in previous NHMPs. The City identified two significant extreme heat events it has experienced.

- **June 16–20, 2021:** The maximum temperature reached 108 °F, with a heat index of 115 °F. Throughout the County there were fatalities, closures and postponements of businesses and events, and buckled roads, and cooling shelters were opened.
- **August 11–15, 2021:** Peak afternoon temperatures ranged from 100 °F to 105 °F. Throughout the County there were fatalities and closures and postponements of businesses and events, and cooling shelters were opened.

3.3.4.2. Potential Impacts

The potential impacts from an extreme heat event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, heat stroke, and death.
- Extended operational hours of County staff and additional resources needed for response to the event, including the operation of daytime cooling centers and overnight cooling shelters.
- Strain on or loss of water supply due to increased demand.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic losses from decreased worker efficiency and effectiveness and time lost on the job when workers take more frequent or longer breaks to avoid overheating.
- Economic impacts from closure of outdoor activities and events, such as farmers markets and concerts.
- Property damage, such as roof expansions, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding.
- Disruption of essential infrastructure systems from overheated and damaged utilities, including power, water, transportation, and communication systems.
- Impacts to roadways as heat expands concrete or causes cracking and buckling. Public transit can also be impacted due to melted cables, sagging wires, and warping tracks.
- Damage to crops, livestock, vegetation, parks, and natural systems.

- Impacts to greenspaces, such as scorch and sunscald of new foliage, branches or tops of trees dying, and significant stress and die-off of native trees, particularly Douglas fir and cedar. These impacts are intensified if drought is also occurring.
- Concurrent hazards include drought and wildland fire.

3.3.4.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to extreme heat.

Populations substantially vulnerable to extreme heat include:

- People who work or spend a significant amount of time outdoors. An estimated 27% of Tigard's workforce works outdoors. There have been cases of extreme heat exposure resulting from the Balloon Festival, Street Fair, and Latino Festival outdoor events.
- People who live and/or work in buildings without air conditioning or cooling equipment. It is estimated that 10–15% of manufactured home parks and multi-dwelling structures in the City do not have cooling equipment.
- People living outdoors or in the upper floors of multi-family housing units.
- Populations with higher heat sensitivity, including older adults, infants and children, pregnant women, people with preexisting or chronic diseases, and those who take certain medications that affect thermoregulation or block nerve impulses. This may include those living in or spending time in the City's 20 schools and education administration buildings, 7 medical facilities, the Just Compassion Shelter, and the City of Tigard Senior Center.
- People with limited mobility and no access to cooling systems who may not be able to travel to cooling centers or shelters.
- People who live in social isolation, including linguistic isolation or those living alone with few social relationships.
- People with mental health conditions. Extreme heat can be associated with higher levels of aggression, violence, and suicidal behavior.
- Factors including race and ethnicity, income, and educational attainment are correlated with heat-related illness.

Additional vulnerabilities to extreme heat include:

- Critical infrastructure and facilities, including 8 city buildings, 14 roads throughout the City, 1 freight rail line, 1 commuter rail line, water infrastructure throughout the City, 1 Clean Water Services Treatment Plant, 3 fire stations, 19 school and education administration buildings, 2 hazardous material sites, 7 medical facilities, 18 religious facilities, 13 private utilities throughout the City, 3 historical properties, 4 cultural sites, 3 natural resources, 1 overnight shelter, 1 shopping center, and 1 office building.
- Critical transportation infrastructure, including Oregon Highways 99W and 217, Interstate 5, arterial roads, TriMet services, and the Portland & Western Railroad.
- Railroad tracks can be vulnerable to damage from high heat.
- Bridge infrastructure is vulnerable to thermal expansion of bridge joints and paved surfaces and deterioration of steel, asphalt, protective cladding, coats, and sealants.
- Asphalt pavement is vulnerable to accelerated deterioration through softening, rutting, and migration of liquid asphalt.

- Vehicles, including first responder vehicles, are vulnerable to engine overheating and tire deterioration.
- Aboveground utility and power lines can droop or sag and create a heightened fire risk.
- Other critical infrastructure, including aboveground power lines, communication structures, and emergency generators.
- Essential businesses, including Costco, WinCo Foods, Fred Meyer, Safeway, Walmart, Home Depot, and Lowes.
- Natural environments located throughout the City.
- Plants, animals, ecosystems, and natural environments are vulnerable to high rates of mortality due to excessive heat, especially during repetitive high-heat days.

3.3.5. Flooding, Including Channel Migration and Streambed Erosion

Some degree of flooding is not uncommon in the County, and events typically occur from October through April. The City experiences localized flooding that has caused disruptions. Tigard is located in the Tualatin Basin, with the Tualatin River defining the city's southern border. Streams within the city's border include Fanno Creek, which has two primary tributaries, Ash Creek and Summer Creek, and eight smaller tributaries, including Red Rock, Pinebrook, Ball, Derry Dell, Krueger, Hiteon and two unnamed streams. Two small perennial streams, Copper Creek and an unnamed stream, flow directly into the Tualatin River. Tigard also has two lakes and ponds in residential areas All of these water sources are susceptible to annual flooding events. Potential impacts of and vulnerabilities to flooding and a previous significant event are identified below.

3.3.5.1. Significant Event Since Adoption of the 2017 NHMP

The City identified one previous significant event that impacted the area.

- **April 8–11, 2019:** Local flooding impacted and disrupted emergency transportation routes, and multiple outfall and stream bank damage impacts occurred.

3.3.5.2. Potential Impacts

The potential impacts from a flooding event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Need for widespread search and rescue operations, including water rescues.
- Displaced residents in need of sheltering.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal economic impacts from loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.5.3. Vulnerabilities

Population, economic, built environment, critical facility, infrastructure, and natural environment vulnerabilities to a flooding event include:

- Populations without access to private transportation.
- There are 14 bridges and 1 Portland General Electric power station located inside the floodplain. The North Dakota Street and Tigard Street/Outfall on 113th Avenue have been damaged during previous flooding events.
- There have been past flooding challenges at the Clean Water Services Treatment Plan during fast, heavy rain events.
- Other critical infrastructure, including communication structures and emergency generators.
- Critical transportation infrastructure, including Oregon Highways 99W and 217, Interstate 5, arterial roads, TriMet services, and the Portland & Western Railroad.
    - Highway 99W and Highway 217 are major transportation routes between Portland and cities such as Tigard, Sherwood, Lake Oswego, and Tualatin. The floodplain does not contain a large amount of property, but damage could be significant as it would affect residential, commercial, and public property.
    - The following streets in the City have been identified as prone to flash flooding. When flooded, neighborhoods and main routes to commercial areas and highways may be blocked.
        - SW Dartmouth Street
        - SW Tigard Street
        - SW North Dakota Street
        - SW Tiedeman Avenue
- There are two repetitive loss (RL) properties within the City.
- Properties without flood insurance.
- Special flood hazard areas within the City. These include areas along the Tualatin River and areas along smaller tributary creeks, such as Fanno Creek, Red Rock Creek, Summer Creek, Ash Creek, and Hiteon Creek.
- Portions of the City outside of the mapped floodplains are also subject to flooding from local storm water drainage.
- There is a potential for property damage from the Tualatin River, Tigard creeks, and Scoggins Dam. The inadequate size and moderate grade of the channel for the Tualatin River and Fanno Creek causes over-bank flooding, even in mild storms. The flow of Fanno Creek is constricted by many culverts and bridges, resulting in increased upstream heights. The potential for damage is significant due to extensive development in the Fanno Creek flood basin.
- Commercial areas in Tigard along Fanno Creek are at risk of flooding.[497]
- Flood loss estimates determined by Hazus-MH include[498]:
    - 10-year flood scenario
        - Number of buildings lost: 15

[497] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[498] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

        - Loss estimate: $213,000
    - 50-year flood scenario
        - Number of buildings lost: 37
        - Loss estimate: $889,000
    - 100-year flood scenario
        - Number of buildings lost: 45
        - Loss estimate: $1,392,000
    - 500-year flood scenario
        - Number of buildings lost: 78
        - Loss estimate: $2,959,000
- There is one building with a value of $130,000 exposed to channel migration.[499]
- Natural environments located throughout the City.

Table 237: Land Use Type in the 100-Year Floodplain in the City of Tigard

Land Use Type	Total Parcels in 100-Year Floodplain	Total Value of Exposed Parcels	Total Area in Jurisdiction (Acres)	Total Area in the 100-Year Floodplain (Acres)	Percentage of Area in the 100-Year Floodplain
Agriculture	0	$0	51.76	0	0%
Commercial	73	$216,101,070	1400.05	157.64	11.26%
Forest	0	$0	77.61	0	0%
Industrial	1	$472,160	28.57	0.96	3.36%
Multi-Family Residential	17	$196,114,700	341.52	63.7	18.65%
Public	99	$307,265,400	921.94	459.96	49.89%
Single-Family Residential	189	$92,299,910	3,063.82	74.62	2.4%
Vacant	30	$3,007,160	297.98	38.19	12.82%
Other	39	$43,476,260	596.91	97.16	16.28%
Total	**448**	**$858,736,660**	**6780.16**	**892.23**	**13.16%**

[499] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

Table 8: Buildings in Tigard within FEMA-Mapped Floodplains

Building Classification	Buildings within Tigard	Buildings within 100-Year Floodplain	Buildings within 500-Year Floodplain	Buildings within Combined 500-Year & 100-Year Floodplain
Total Buildings	19,308	145	24	169
Percentage of Buildings within Tigard	100%	0.75%	0.12%	0.88%

3.3.6. Landslide

The City can be directly impacted by landslides, and northwest Tigard on Bull Mountain and Roy Rogers Road are particularly susceptible. The two lanes eastbound on State Highway 99W are also susceptible. Potential impacts of and vulnerabilities to landslides are identified below.

3.3.6.1. Potential Impacts

The potential impacts from a landslide event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Mobility or access issues for residents due to blocked or damaged transportation routes.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income and property damage that may not be covered by insurance.
- Debris flows.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Power outages and natural gas leaks.
- Disruption of traffic due to damaged or destroyed transportation systems.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.6.2. Potential Vulnerabilities

Population, economic, built environment, critical facility, infrastructure, and natural environment vulnerabilities to a landslide event include:

- Populations without access to private transportation.
- Populations that live in, work in, or use highly susceptible areas for recreation.
- Areas of northwest Tigard on Bull Mountain and Roy Rogers Road are particularly susceptible to landslide.

- Many areas in the southwestern portion of the City are also highly susceptible to damage from landslides.
- The two eastbound lanes of State Highway 99W may be at risk for closure or damage due to a landslide.
- Subdivisions from State Highway 99W from the City of Sherwood and King City to the City of Tigard can be blocked due to landslides.
- The intersection of State Highway 99W and SW Gaarde Street can be impacted by landslides.
- Per DOGAMI, there are 635 buildings with a total value of $228,061,000 at high susceptibility and 8,352 buildings with a total value of $2,608,886,000 at moderate susceptibility to landslide exposure.[500] Additionally, a community risk profile completed by DOGAMI shows 2,005 residents could be displaced due to a very high or high susceptibility landslide event.[501]
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Landslide hazard is ubiquitous in a large percentage of undeveloped land and may present challenges for future planning and mitigation efforts. Awareness of nearby areas of landslide hazard is beneficial for reducing risk for every community in Washington County.

[500] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[501] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.3.7. Volcanic Ash

Volcanic activity is possible from mountains near the County. It is anticipated that ashfall from a volcanic eruption has the potential to impact the City, although the scale and types of impacts and vulnerabilities may differ depending on which volcano erupts, the level of eruption, and the wind direction during and after eruption. Potential impacts of and vulnerabilities to volcanic ash are identified below.

3.3.7.1. Potential Impacts

Though unlikely, the impacts of a significant ashfall can be substantial. Impacts may include:

- Indirect injuries and deaths, such as those sustained during ash cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation. This includes public water systems that rely on outdoor reservoirs.
- The need to shelter individuals to protect them from poor air quality, including houseless persons and persons displaced from their residences due to poor residential air filtration systems.
- Delayed emergency response times due to decreased visibility and increased traffic hazards.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and cleanup activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.7.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to volcanic ash. This includes:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults. This may include those living in or spending time in the City's 20 schools and education administration buildings, 7 medical facilities, the Just Compassion Shelter, and the City of Tigard Senior Center.
- People without access to effective dust masks, eye protection, and drinking water and food uncontaminated by volcanic ash.

- Critical infrastructure and facilities, including 8 city buildings, 14 roads throughout the City, 1 freight rail line, 1 commuter rail line, water infrastructure throughout the City, 1 Clean Water Services Treatment Plant, 3 fire stations, 19 school and education administration buildings, 2 hazardous material sites, 7 medical facilities, 18 religious facilities, 13 private utilities throughout the City, 3 historical properties, 4 cultural sites, 3 natural resources, 1 overnight shelter, 1 shopping center, and 1 office building.
- Other critical infrastructure, including aboveground power lines, communication structures, and emergency generators.
- Essential businesses, including Costco, WinCo Foods, Fred Meyer, Safeway, Walmart, Home Depot, and Lowes.
- Older buildings and infrastructure not built to withstand the weight and impacts from large amounts of volcanic ash. This includes historical structures and properties, manufactured homes and buildings, Tigard City Hall, the Public Works Operations Building, and the Highway 99W viaduct over downtown and a heavily trafficked rail line.
- Drinking water sources and water treatment infrastructure, food supplies and availability, and access to medical resources or care may also be impacted by volcanic ash and can cause health impacts on a large scale.
- Critical transportation infrastructure, including Oregon Highways 99W and 217, Interstate 5, arterial roads, TriMet services, and the Portland & Western Railroad.
- Natural environments located throughout the City.

3.3.8. Wildland Fire

Although the City could experience a wildland–urban interface event, historically it is more likely to be affected by smoke and poor air quality due to wildland fires outside its boundaries. Tigard typically issues burn bans every July through September to reduce the likelihood of an event occurring. Potential impacts of and vulnerabilities to wildland fire and previous significant events are identified below.

3.3.8.1. Significant Events Since Adoption of the 2017 NHMP

The City has not been directly impacted by a wildland fire event since adoption of the 2017 NHMP. However, in September 2020, multiple wildfires occurred concurrently in the county, outside the county, and outside the state, and the City experienced significant smoke from the fires. In addition, on August 13, 2021, wildfire smoke occurred in Tigard due to wildfires outside the City, county, and state. The Occupational Safety and Health Administration (OSHA) distributed hundreds of thousands of respirator masks to construction and contractor crews, and clean air and cooling centers were staffed and stood up for multiple consecutive days within the City.

3.3.8.2. Potential Impacts

The potential impacts from a wildfire event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Exposure to wildfire smoke, which can lead to eye, nose, and throat irritation and the worsening of chronic heart and lung diseases.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to blocked transportation routes and debris, congested transportation routes due to evacuations, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Strain on or loss of water supply due to increased demand.
- Economic impacts to governments, including costs for fire suppression, staff, equipment, supplies, transportation and mobilization of first responders, evacuations, sheltering operations, post-fire recovery, and rebuilding costs associated with government-owned buildings, property, and infrastructure.
- Economic impacts, including loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity. Scoggins Valley Park receives one million visitors a year, most during summer, which is when wildland fires tend to occur.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.

- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property, causing blocked road and rail transportation routes.
- Downed or damaged power lines. This impact may be compounded since powerline failures can lead to additional wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including air and water quality issues. Landslide and erosion issues are common following a wildland fire.

3.3.8.3. Vulnerabilities

Given the dynamic nature of wildland fires, all populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to this hazard. These include:

- People in the City with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults. This may include those living in or spending time in the City's 16 schools and 11 commercial pre-school and/or day care and education administration buildings, 7 medical facilities, the Just Compassion Shelter, and the City of Tigard Senior Center.
- Populations without access to private transportation.
- First responders and other personnel working directly on fire protection, suppression, and patrols or near a wildfire can experience burns, smoke exposure, heat-related impacts such as heat stroke, heat exhaustion, dehydration, physical fatigue, mental health challenges, injuries, and death.
- Critical infrastructure and facilities, including 8 city buildings, 14 roads throughout the City, 1 freight rail line, 1 commuter rail line, water infrastructure throughout the City, 1 Clean Water Services Treatment Plant, 3 fire stations, 19 school and education administration buildings, 2 hazardous material sites, 7 medical facilities, 18 religious facilities, 13 private utilities throughout the City, 3 historical properties, 4 cultural sites, 3 natural resources, 1 overnight shelter, 1 shopping center, and 1 office building.
- Other critical infrastructure, including aboveground power lines, communication structures, and emergency generators.
- Drinking water sources and water treatment infrastructure, food supplies and availability, and access to medical resources or care may also be impacted by wildfire and can cause health impacts on a large scale.
- Critical transportation infrastructure, including Oregon Highways 99W and 217, Interstate 5, arterial roads, TriMet services, and the Portland & Western Railroad.
- Per analysis of the Oregon State University–Extension Service Fire Program and Wildland Fire Associates dataset, there are 33 buildings with a total value of $9,706,000 at high risk of wildland fire, 16 buildings with a total value of $3,304,000 at moderate wildland fire risk, and 1,768

buildings with a total value of $569,993,000 at low wildland fire risk.[502] Additionally, a community risk profile completed by DOGAMI shows 94 residents may be potentially displaced due to a high or moderate risk wildland fire event.[503]

- Homes, businesses, and infrastructure adjacent to the wooded areas near the outskirts of Tigard.
- Areas in the City that are more vulnerable to wildland fire include northwest Tigard on Bull Mountain and Roy Rogers Road, the full length of the Tualatin River east to west, the Cook Park vicinity, the Summer Lake Park vicinity, the southwest Tigard in the vicinity of Royal Villa Senior Living, Bonita Park, and the Wall Street and Fanno Creek Trail area.
- Essential businesses, including Costco, WinCo Foods, Fred Meyer, Albertsons, Safeway, Walmart, Home Depot, and Lowes.
- Natural environments located throughout the City.

[502] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[503] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.3.9. Windstorm, Including Tornado

The City experiences high winds at all elevations. Potential impacts of and vulnerabilities to windstorms are identified below. Potential impacts of and vulnerabilities to windstorm, including tornado, and previous significant events are identified below.

3.3.9.1. Significant Events Since Adoption of the 2017 NHMP

The City identified two previous significant events that impacted the area.

- **April 7, 2017:** Many weather stations across the planning area recorded wind gusts up to 60 to 75 mph. Several trees came down across the area, and personal property throughout the City sustained damage.
- **April 30, 2022:** Significant infrastructure, trees, and personal property damage was sustained throughout the City of Tigard. A short-lived gustnado (a brief, shallow surface-based vortex that forms the downburst emanating from a thunderstorm) at the lowest elevation in the city tore off roofs of dugouts at a youth baseball field during the game.

3.3.9.2. Potential Impacts

The potential impacts from a windstorm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property, causing blocked road and rail transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.9.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to windstorms, including tornadoes. These include:

- Critical infrastructure and facilities, including 8 city buildings, 14 roads throughout the City, 1 freight rail line, 1 commuter rail line, water infrastructure throughout the City, 1 Clean Water Services Treatment Plant, 3 fire stations, 19 school and education administration buildings, 2 hazardous material sites, 7 medical facilities, 18 religious facilities, 13 private utilities throughout the City, 3 historical properties, 4 cultural sites, 3 natural resources, 1 overnight shelter, 1 shopping center, and 1 office building.
- Older buildings and infrastructure not built to withstand high winds. This includes historical structures and properties, manufactured homes and buildings, Tigard City Hall, the Public Works Operations Building, and the Highway 99W viaduct over downtown and a heavily trafficked rail line.
- Critical transportation infrastructure, including Oregon Highways 99W and 217, Interstate 5, arterial roads, TriMet services, and the Portland & Western Railroad. Street signs and traffic lights may also be damaged.
- Other critical infrastructure, including aboveground power lines, communication structures, and emergency generators.
- Essential businesses, including Costco, WinCo Foods, Fred Meyer, Albertson, Safeway, Walmart, Home Depot, and Lowes.
- Natural environments located throughout the City.

3.3.10. Winter Storm

The City has experienced winter storms every year since the 2017 NHMP was adopted. Although the severity of most of the storm events has been low and did not cause significant damage, winter storms occur frequently and have the potential to impact economic activity. Potential impacts of and vulnerabilities to winter storms and previous significant events are identified below.

3.3.10.1. Significant Events Since Adoption of the 2017 NHMP

The City identified three previous significant events that impacted the area.

- **February 18, 2018:** Light snow fell in the City, impacting roads, infrastructure, trees, and power lines.
- **February 8, 2019:** Light snow occurred in the City, impacting roads, infrastructure, trees, and power lines.
- **January 5, 2020:** Many areas in the County received an inch of snow, and areas of the region lost power for up to five days. Within the City, road and water infrastructure was significantly impacted, and trees and power lines were damaged.

3.3.10.2. Potential Impacts

The potential impacts from a winter storm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths, including from carbon monoxide poisoning, falls from slick or icy conditions, frostbite, and hypothermia.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components.
- Stranded travelers due to ice, snow, and transportation impacts.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Increased number of house fires due to unsafe alternate heating methods.
- Significant property damage and loss of water due to frozen or damaged pipes or the thawing of frozen pipes.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property, causing blocked road and rail transportation routes.

- Downed or damaged power lines can lead to wildfires, and tree debris can create fuel load for wildfire.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including flooding.

3.3.10.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the City are vulnerable to winter storms. These include:

- People who do not have access to sufficient heating, insulated clothing, or dry living conditions, including unhoused populations.
- Older adults and infants, people who take certain medications, people who have certain medical conditions, and people who have been drinking alcohol are at increased risk for hypothermia. This may include those living in or spending time in the City's 20 schools and education administration buildings, 7 medical facilities, the Just Compassion Shelter, and the City of Tigard Senior Center.
- People improperly using generators and heating devices.
- Populations with disabilities may be more affected due to mobility issues.
- Critical infrastructure and facilities, including 8 city buildings, 14 roads throughout the City, 1 freight rail line, 1 commuter rail line, water infrastructure throughout the City, 1 Clean Water Services Treatment Plant, 3 fire stations, 19 school and education administration buildings, 2 hazardous material sites, 7 medical facilities, 18 religious facilities, 13 private utilities throughout the City, 3 historical properties, 4 cultural sites, 3 natural resources, 1 overnight shelter, 1 shopping center, and 1 office building.
- Roads within the City that may be especially susceptible to impacts include Bull Mountain Road, SW Gaarde Street, Roy Rogers Road, State Highways 99W and 217. Abandoned vehicles along these roads may restrict the ability to maintain them. Small snow walls that have built up on non-collector streets and downed trees can block streets and cause traffic issues. The City has a combination of county and state roads, which creates a dependency on the county and state for street clearing and maintenance. Additionally, Tigard is surrounded by bridges and overpasses into and out of the City.
- Older buildings and infrastructure not built to withstand the weight and impacts from large amounts of snow and ice. This includes historical structures and properties, manufactured homes and businesses, Tigard City Hall, the Public Works Operations Building, and the Highway 99W viaduct over downtown and a heavily trafficked rail line.
- Other critical infrastructure, including aboveground power lines, communication structures, and emergency generators.
- Essential businesses, including Costco, WinCo Foods, Fred Meyer, Albertsons, Safeway, Walmart, Home Depot, and Lowes.
- Natural environments located throughout the City.

3.4. Historical Events

Hazard events that have affected the entire planning area since adoption of the 2017 NHMP are detailed in Volume I, Section 2. The City has experienced impacts from extreme heat, flooding, windstorm, winter storm, and wildfire smoke events since the 2017 NHMP update.

A City disaster declaration for the COVID-19 pandemic began on March 17, 2020. Although pandemic is not a hazard included in this NHMP, this declaration is noted because FEMA provided support and Hazard Mitigation Grant Program funding during the event.

3.5. Overall Vulnerability

Based on the analysis completed by the Technical Committee, windstorm, including tornado, winter storm, earthquake, wildland fire, and drought present the highest relative risk to the City of Tigard. These hazards can create widespread events, and all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the City can be vulnerable to these hazards.

Areas of greatest vulnerability to these hazards within the City include:

- Populations with higher vulnerability, such as those with preexisting health conditions, older adults, children, and pregnant women. This may include those living in or spending time in the City's 20 schools and education administration buildings, 7 medical facilities, the Just Compassion Shelter, and the City of Tigard Senior Center.
- Populations that are unhoused, do not have access to private transportation, and/or are without access to sufficient heating and clean water.
- Populations with limited income and financial resources.
- Populations whose primary language is not English.
- Industries that can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic impacts to the City, including loss of local revenue due to business and property tax losses, reduced future revenues, reduced recreation and tourism activity, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Critical infrastructure and facilities, including 8 city buildings, 14 roads throughout the City, 1 freight rail line, 1 commuter rail line, water infrastructure throughout the City, 1 Clean Water Services Treatment Plant, 3 fire stations, 19 school and education administration buildings, 2 hazardous material sites, 7 medical facilities, 18 religious facilities, 13 private utilities throughout the City, 3 historical properties, 4 cultural sites, 3 natural resources, 1 overnight shelter, 1 shopping center, and 1 office building.
- Older buildings and infrastructure not built to current building codes or seismic standards, including historical structures and properties, manufactured homes and businesses, Tigard City Hall, the Public Works Operations Building, and the Highway 99W viaduct over downtown and a heavily trafficked rail line.
- Critical transportation infrastructure, including Oregon Highways 99W and 217, Interstate 5, arterial roads, TriMet services, and the Portland & Western Railroad.
    - Roads within the City that may be especially vulnerable to winter storm impacts include Bull Mountain Road, SW Gaarde Street, Roy Rogers Road, State Highways 99W and 217. Additionally, Tigard is surrounded by bridges and overpasses in to and out of the City.

- Other critical infrastructure, including communication structures, emergency generators, and aboveground utility and power lines. Underground infrastructure, such as pipelines and utility lines, buildings, and roads are also vulnerable to damage from liquefaction due to the type of soil in the City.
- Areas in the City that are more vulnerable to wildland, including northwest Tigard on Bull Mountain and Roy Rogers Road, the full length of the Tualatin River east to west, the Cook Park vicinity, the Summer Lake Park vicinity, southwest Tigard in the vicinity of Royal Villa Senior Living, Bonita Park, and the Wall Street and Fanno Creek Trail areas.
- The City's water sources and its three aquifers and three wells.
- Essential businesses, including Costco, WinCo Foods, Fred Meyer, Albertsons, Safeway, Walmart, Home Depot, and Lowes.
- Natural environments located throughout the City.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment and safe growth analysis examine the ability of the City to implement and manage a comprehensive mitigation strategy. Strengths, opportunities, and resources of the jurisdiction are identified to develop an effective hazard mitigation action plan. The capabilities identified in this assessment were evaluated collectively to develop feasible recommendations, which support the implementation of effective mitigation activities.

A capability questionnaire was distributed to the City of Tigard Technical Committee to initiate this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities. The Technical Committee also completed a safe growth analysis to identify potential gaps in growth guidance instruments and improvements that could be made to reduce vulnerability to future development.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances within the City that can prevent and reduce the impacts of hazards.

The City's yearly Capital Improvement Plan and Stormwater System Plan address natural hazards and identify and implement specific mitigation strategies and actions. The City's Capital Improvement Program provides funding for hazard mitigation projects identified in this NHMP and limits expenditures on projects that would encourage development in areas vulnerable to natural hazards. Additionally, the City's infrastructure policies also limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.

The City's Comprehensive Plan addresses natural hazards and grants the authority to prepare mitigation strategies, but it does not identify and cannot be used to implement mitigation projects. It also provides adequate space for expected future growth in areas located outside natural hazard areas. Many of the goals and policies in the City's Comprehensive Plan are related to those in this NHMP and safe growth objectives. The monitoring and implementation section of the NHMP covers these and all other hazard mitigation strategies discussed in the plan. Safety is explicitly included in the Comprehensive Plan's growth and development policies.

The local Emergency Operations Plan contains hazard-specific annexes that include the natural hazards of earthquake, flood, major fire, severe weather, landslides, and volcano. Tigard also has a Continuity of Government (COG) Plan as well as seven department continuity of operations plans that can be used to plan for and mitigate against natural hazard events.

There is not a standalone city economic development plan; however, this topic is addressed in the City's Comprehensive Plan. Additionally, Tigard has multiple transportation plans, but these plans do not address natural hazards. The Regional Disaster Preparedness Organization and Metro is working to revise Emergency Transportation Route maps, and the City is a part of this effort.

The City defers to Tualatin Valley Fire & Rescue for wildfire planning. A Community Resiliency Plan is currently being written and will be a comprehensive community and science-based strategy to bring Tigard to carbon neutrality by 2035, reduce the City's effect on natural resources and the environment, and help the City adapt. It centers people around people, especially historically excluded communities most vulnerable to climate change.

Land use planning and ordinances are adequately administered and enforced and are an effective measure for reducing hazard impacts. These include zoning, subdivision, floodplain, and natural hazard-specific ordinances and the utilization of flood insurance rate maps (FIRMs). The zoning ordinance is effective for reducing some hazard impacts from flooding, landslide, and earthquake, but less effective for other hazards and does not address volcanic ash or windstorms. The subdivision ordinance is older and needs to be updated to better address natural hazards and will be addressed in 2023 and 2024. The floodplain ordinance is currently being updated and should be completed by the end of 2022. The update will include FEMA's Model Code-Coordinated ordinance. FIRMs were updated in 2017. System Development Charge funds may be used to purchase properties for open space and public recreation uses.

The City has zoning ordinances that conform to the Comprehensive Plan in terms of discouraging development or redevelopment within natural hazard areas, including prohibiting development within, or filling of, wetlands, floodways, and floodplains. The ordinance also contains natural hazard overlay zones that set conditions for land use within such hazard zones. Rezoning procedures recognize natural hazard areas as off limits to any zoning changes that would allow for increased activity or development in the area. The City does not have subdivision regulations that restrict the subdivision of land within or adjacent to natural hazard areas, provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources, or allow density transfer where hazard areas exist.

The City has environmental systems that prevent development in natural hazard areas or zones that have been identified and mapped and has policies that maintain and restore protective ecosystems, including land use policies. Additionally, the city council's Community Promise includes embracing sustainability to improve natural resources. The City has a comprehensive Community Resiliency Plan, utilizes carbon responsible community development, and supports the planting of trees on public and private property to maximize the environmental benefit they can provide, even administering a program to provide free trees to the community. The City also has policies that provide incentives to development that is located outside protective ecosystems.

The Building, Planning, and Engineering Departments review all site plans for compliance with state building codes, land use requirements, and accepted engineering practices. The City implements and adequately enforces state building codes, including the 2019 Oregon Structural Specialty Code, 2019 Oregon Mechanical Specialty Code, 2021 Oregon Residential Specialty Code, 2021 Oregon Electrical Specialty Code, and 2021 Oregon Plumbing Specialty Code. Both Tualatin Fire & Rescue stations that service the city have an Insurance Services Office (ISO) Public Protection Classification of 2. The City's building codes also contain provisions to strengthen or elevate construction to withstand hazard forces, and the City has an adopted evacuation and shelter plan to deal with emergencies from natural hazards.

4.1.1. National Flood Insurance Program Compliance

Participation in the National Flood Insurance Program (NFIP) is based on a voluntary agreement between a community and FEMA. For communities that adopt a floodplain management ordinance to reduce flood risks to new construction, federally backed flood insurance is made available to property owners in the community. Compliance with the NFIP, however, extends beyond participation in the program. The three basic components of the NFIP include floodplain identification and mapping risk, responsible floodplain management, and flood insurance.

An RL property is a property insured under the NFIP for which the program has paid at least two claims of more than $1,000 in any 10-year period since 1978, regardless of any change(s) of ownership during that period. As of September 30, 2021, there are two FEMA-identified RL properties in the City.

4.1.1.1. National Flood Insurance Program Details

Insurance Summary

There are currently 127 NFIP policies in the City and $37,270,800 coverage in force. The dollar amount of premiums paid annually was not available at the time this NHMP was published. Identifying this information is an improvement for the next planning cycle.

There have been 12 claims paid for a total amount of $170,962 paid. One substantial damage claim has been paid.

There are 59 structures exposed to 1% (100-year) flood risk within the City.[504]

Staff Resources

There are no barriers to running an effective NFIP program in the City. The City's NFIP Coordinator is not currently certified, and floodplain management is not an auxiliary function. NFIP administration services in the City include building and development permit review to ensure the floodplain is not impacted, education of homeowners and property owners, and staff coordination to certify that capital projects, infrastructure projects, and other City-led projects follow the City's Community Development Code and its floodplain regulations.

Compliance History

The City is in good standing with the NFIP and there are no outstanding compliance issues. The most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC) was in June 2022 and the City passed the program audit.

The City will continue NFIP compliance during the next five years of NHMP implementation by enforcing floodplain management requirements, including active program administration, undertaking any code amendments needed to maintain compliance, and adopting FEMA's Model Code-Coordinated Ordinances within the next two months.

Regulation

The City entered into the NFIP on February 14, 1978, and has both digital and paper FIRMs. The current effective map date is October 19, 2018. Floodplain development regulations either meet or exceed the minimum FEMA and state requirements. No new residential development is allowed in the flood hazard area, and other development within the floodplain is controlled through zoning processes and land use permitting policies.

[504] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

Community Rating System

The City does not participate in the NFIP's Community Rating System.

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions.

The City's Planning Commission is not generally directly involved in mitigation planning; however, Planning Commissioners review land use and transportation policy proposals and advise City Council on updates to the Tigard Comprehensive Plan, Tigard Community Development Code, and Tigard Zoning Map. They also review and decide whether to approve development proposals that are subject to discretionary approval criteria. These plans and codes contain policies and regulations, such as limited development in and access to identified hazard areas, that promote mitigation efforts. The Mitigation Technical Committee works together effectively to update and maintain the NHMP.

The City administers maintenance programs to reduce risk, including tree trimming, clearing drainage systems, and landscape maintenance of open spaces and rights of way. The City also has multiple effective mutual aid agreements and planning partnerships, including intergovernmental agreements and the Managing Oregon Resources Efficiently Mutual Aid Agreement, and partnerships with the Regional Water Providers Consortium, the Oregon Water/Wastewater Agency Response Network, Washington County Emergency Management Cooperative, the Regional Disaster Preparedness Organization, and the Cooperative Public Agencies of Washington County.

Tigard has adequate staffing levels to enforce regulations, staff are trained on hazards and mitigation efforts, and coordination on mitigation initiatives with staff is effective. The chief building official is part of the Community Development Department and is a full-time position. This department also has several other full-time positions, including planners and engineers, and houses subject matter experts on the floodplains and natural resources. The Emergency Management Program is located within the Public Works Department.

City departments like Community Development and Public Works have staff who can support the mitigation strategy, including planners and engineers with an understanding of natural hazards and land development and management practices, engineers and professionals trained in construction practices related to buildings and infrastructure, staff with education or expertise to assess vulnerability to hazards, and GIS staff and coordinators. The City also has an assigned damage assessment team that is trained by the Applied Technology Council in the post-earthquake safety evaluation of buildings and safety evaluation procedures of buildings after windstorms and floods.

Additionally, the City has many technical capabilities that have been used to assess or mitigate risk and could be used in future efforts. Warning systems include CodeRED/Everbridge in partnership with Washington County. Grant writing is completed by individual departments as needed. The City has a robust GIS program that has the ability to create mapping products for all hazards, infrastructure, critical and essential facilities, HAZMAT resources, and Adult Foster Care, and Urgent Care and American Red Cross facilities. Hazard data and information can be pulled from a variety of sources, including historical records and DOGAMI.

4.3. Education and Outreach Assessment

Education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information were assessed to determine the City's capabilities.

Tigard's Community Emergency Response Team (CERT) Program promotes disaster preparedness for hazards and trains members in basic disaster response skills, such as fire safety, light search and rescue, and disaster medical operations. Annually for the past 13 years, the City has partnered with the Church of Jesus Christ of Latter-day Saints to conduct a whole community emergency preparedness fair with an average attendance of 1,000 participants.

The City's Emergency Management Program provides public education in the form of the Take 5 to Survive and the Be Two Weeks Ready programs and school programs. It also provides resources such as emergency preparedness for older adults, people with disabilities, pets; emergency driving tips; extreme heat information and preparedness; and how to pack and storm items to prevent damage from disasters. The City's Public Works Department trains residents on proper tree trimming and vegetation waste disposal. Additionally, Tigard is a Tree City USA and works to maintain landscaping and properties to reduce natural hazards vulnerabilities and impacts.

There are nonprofit organizations and community groups that can assist with implementing future mitigation actions, including The Church of Jesus Christ of Latter-day Saints, the American Red Cross, and other faith-based organizations. The City also participates in the Regional Disaster Preparedness Organization, Washington County Emergency Management Cooperative, Local Emergency Managers group, and the Local Emergency Planning Committee.

4.4. Financial Assessment

The City has access to or is eligible to potentially use the following funding resources for hazard mitigation initiatives:

- Capital improvements project funding
- Taxes levied for specific purposes
- Fees for water, sewer, gas, and/or electric services
- Impact fees for new development
- Stormwater utility fees
- Federal funding sources, including the Community Development Block Grant, Urban Areas Security Initiative, Building Resilient Infrastructure and Communities, and Hazard Mitigation Assistance Grants
- State funding programs, including the State Homeland Security Program and the State Preparedness and Incident Response Equipment grant program
- Public or private partnership funding sources, including Oregon's Seismic Rehabilitation Grant Program

4.5. Capability Expansion and Improvement

Actions that can expand and improve existing authorities, plans, policies, and resources for mitigation include continuing to update City plans as necessary to ensure they are current and reflect the needs of the community; creating and implementing additional public education and outreach offering; and ensuring grant opportunities are capitalized upon to meet goals, as appropriate.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iii), §201.6(c)(3)(iv), and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) directs local mitigation plans describe hazard mitigation actions a community will undertake to lessen the danger from hazards of concern and establish a strategy for implementing those actions. As such, all other requirements for a local hazard mitigation plan lead to and support the mitigation strategy.

5.1. Mitigation Goals

The Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 City of Beaverton NHMP, 2011 Cities of Cornelius and Forest Grove NHMPs, and 2020 State of Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals detailed in Volume I, Section 3. These goals are the basis of this plan and summarize what the Steering Committee will accomplish by implementing this plan.

5.2. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on mitigation plan requirement 44 CFR §201.6(c)(4)(ii), the vulnerability and capabilities assessment for the City was carefully reviewed and considered when developing the mitigation actions for this plan. The City's Technical Committee has established a process by which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into existing local planning strategies.

The committee will coordinate implementation with the responsible parties in the City and with external stakeholders as needed. The primary means for integrating mitigation strategies is through the revision, update, and implementation of current plans and regulations, such as comprehensive plans, capital improvement plans, and land development regulations, as feasible.

The members of the City's Technical Committee are charged with ensuring the goals and strategies of new and updated local planning documents for their jurisdictions and special districts are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.2.1. Comprehensive Plan

The City of Tigard's Comprehensive Plan addresses the hazards identified in this plan and mitigation action items. Once the 2023 NHMP is adopted, these hazard-related portions of the Comprehensive Plan will be updated to reflect any changes, as applicable.

5.2.2. Building and Zoning Codes

The City is enforcing all current building codes and will continue to do so. The current zoning ordinance is effective for reducing hazard impacts from flooding, landslides, and earthquakes, but is less effective in reducing hazard impacts from volcanic ash or winter storm. Updates to these codes will be considered and integrated, as necessary, and appropriate.

5.2.3. Public Engagement, Education, and Outreach

City departments will continue to hold events to educate the public about mitigation planning efforts throughout the year, especially during the five-year NHMP update process, including continuing to host an annual community preparedness fair. City teammates will continue to reach out to established public and private partners, local nongovernmental organizations, and other stakeholders to increase community outreach opportunities.

5.2.4. Day-to-Day Government Functions

The City of Tigard has strong maintenance programs, including park, storm drain, and traffic and transportation maintenance programs. To adapt to current situations, maintenance frequency is being increased for chronic problem catch basins, water retention sites, hillside and stream bank vegetation habitat restoration projects, and hazardous tree inspection locations. These programs will remain flexible and be modified as needed.

5.2.5. Land Development Regulations

Current land development regulation policies ensure there is adequate space for development outside natural hazard areas and restricts development or re-development within these areas. These regulations will continue to be in place and enforced.

5.2.6. Floodplain Management Program and/or National Flood Insurance Program

The City's floodplain management program and NFIP administration meet FEMA and state standards. FEMA's Model Code-Coordinated Ordinances will be adopted by the City in the next two months. Flood hazard area restrictions will continue to be in place and enforced, including not allowing any new residential development in flood hazard areas.

5.2.7. Stormwater Management Plans and Procedures

The City's current Stormwater System Plan has natural hazards identified as well as mitigation action items and strategies that address erosion, water quality, and flooding. When the plan goes through a regular update, additional details about hazard mitigation will be added, as applicable.

5.2.8. Emergency Plans That Address Evacuation and Sheltering

Evacuation and sheltering are addressed in the City's Emergency Operations Plan, and the City works with Washington County on sheltering efforts as needed.

5.2.9. Enforcement of Existing Policies

The City will continue to enforce current policies, which includes not allowing residential or commercial development in identified natural hazard areas.

5.2.10. Funding Opportunities

The City of Tigard will continue to review annual, post-disaster, and stand-alone grant opportunities for potential mitigation project funding opportunities, including, but not limited to, the State Homeland Security Program funding, Building Resilient Infrastructure and Communities funding, and pre-disaster grants.

6. Action Items

The City of Tigard's action items in the 2017 Washington County NHMP were determined by the 2017 planning team. The action items from the previous plan and the status of each action are below in Section 6.1.

Action items for the 2023 NHMP were determined by the City's Technical Committee based on the review of its risk assessment, its existing capabilities, and the status of its previous action items. This comprehensive range of actions includes local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.2 and 6.3. Additional information about how these actions were developed, evaluated, and prioritized is in Volume I, Section 3.

6.1. Status of City of Tigard Action Items from the 2017 Washington County NHMP

Table 238: Status of Action Items from 2017 NHMP

Action Item Number*	Action Item Description	Hazard(s) Addressed	Current Status
Priority #1	Protect existing development in landslide prone areas.	Landslide	Ongoing with significant progress
Priority #2	Improve local capabilities to perform earthquake building safety evaluations and to record and manage building inventory data.	Earthquake	Ongoing with significant progress
Priority #3	Integrate the goals and action items from the Tigard Natural Hazard Mitigation Plan Addendum into existing regulatory documents and programs, where appropriate.	Multi-Hazard	Ongoing with significant progress
Priority #4	Maintain public and private drainage systems.	Landslide	Ongoing with significant progress
Priority #5	Inventory and map alternative firefighting water sources and encourage the development of additional sources.	Wildfire	Ongoing with some progress

Action Item Number*	Action Item Description	Hazard(s) Addressed	Current Status
Priority #6	Adopt the Tualatin Valley Fire & Rescue Wildfire Hazard Map and implement the Wildfire Mitigation section of the Oregon Residential Specialty Code.	Wildfire	Ongoing with some progress
Priority #7	Increase technical knowledge of natural hazards and mitigation strategies in Tigard and implement policies and programs on the basis of that knowledge.	Multi-Hazard	Ongoing with significant progress
Priority #8	Identify critical public infrastructure and facilities located in flood hazard areas and highlight those facilities as a focus for mitigation and preparedness measures.	Flood	Complete
1	Improve network of communications during a disaster.	Multi-Hazard	Ongoing with significant progress
2	Develop inventories of at-risk buildings and infrastructure and prioritize mitigation projects based on those providing the most benefit (at the least cost) to city residents.	Multi-Hazard	Ongoing
3	Develop, enhance, and implement information and education programs aimed at mitigating natural hazards and reducing the risk to citizens, public agencies, private property owners, businesses, and schools.	Multi-Hazard	Ongoing with some progress
4	Identify and pursue funding opportunities to develop and implement mitigation activities.	Multi-Hazard	Ongoing with some progress
5	Identify funding sources to retrofit existing public facilities and services to contemporary standards that are identified as seismically vulnerable.	Earthquake	Ongoing with some progress
6	Expand earthquake hazard mapping in Tigard and improve technical analysis of earthquake hazards.	Earthquake	Ongoing with some progress
7	Enforce the current building code standards to ensure only the appropriate land uses are allowed in high seismic hazard areas.	Earthquake	Ongoing with significant progress
8	Continue to maintain eligibility for the National Flood Insurance Program.	Flood	Ongoing with significant progress
9	Update Storm Water Management Master Plan and identify appropriate mitigation strategies.	Flood	Complete

Action Item Number*	Action Item Description	Hazard(s) Addressed	Current Status
10	Improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in those areas.	Landslide	Ongoing with some progress
11	Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm and severe winter storm events.	Severe Weather**	Ongoing with some progress
12	Coordinate and encourage electrical utilities to use underground construction practices wherever possible to reduce power outages from severe weather storms.	Severe Weather**	Ongoing with significant progress
13	Develop and implement or enhance strategies for debris management for windstorm and severe winter storm events.	Severe Weather**	Ongoing with significant progress
14	Identify critical facilities and industries that may be affected by ashfall and assist them in emergency response plan development.	Volcanic Ash	Ongoing with significant progress
15	Work with the Tualatin Valley Fire & Rescue Community Safety Program to provide information and education about wildland-urban interface to Tigard citizens.	Wildfire	Ongoing with some progress

* Number given to action item in the 2017 Washington County NHMP
** Not a hazard in the 2023 Washington County NHMP

6.2. City of Tigard Action Items: 2023 Washington County NHMP

Table 239: City of Tigard Action Items

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
1	Offer GIS hazard mapping online for residents and design professionals. More accurately map problem areas to educate residents about unanticipated risks. Upgrading maps provides a truer measure of risks to a community. Educate property owners in high-risk areas about mitigation options. Educate the public about risks, preparedness measures, and evacuation procedures.	Dam Failure	Low
2	Educate K–12 students about water conservation. Install low-flow water fixtures in schools and public facilities. Plant drought-resistant xeriscape gardens and landscapes. Capture rainwater in cisterns and rain barrels for future use on gardens, trees, and other planted areas.	Drought	Low
3	Conduct seismic evaluations on identified community assets (including shelters and critical and essential facilities) and “high risk” school and emergency service buildings, and implement appropriate structural and non-structural upgrades as mitigation strategies.	Earthquake	Low
4	Adopt future required seismic building code revisions as they become introduced. Enforce the current building code standards to ensure only the appropriate land uses are allowed, especially in high hazard areas.	Earthquake	Medium
5	Develop a technical assistance information program for homeowners. Teaching homeowners how to seismically strengthen their houses can be an effective mitigation activity. The program can include providing local government building departments with copies of existing strengthening and repair information for distribution.	Earthquake	High
6	Require minimum temperatures in housing/landlord codes. Encourage utility companies to offer special arrangements for paying cooling bills, if not already required by state law. Create a database to track those individuals at high risk of death, such as the older adults, physically fragile, and unhoused.	Extreme Heat	Medium

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
7	Adopt codes and regulations that incentivize the installation of green roofs, solar panels, and solar parking area covers, which provide shade and remove heat from roof and paving surfaces and surrounding air. Incentivize and encourage cool roofing products such as white roofs that reflect sunlight and heat away from a building. Increase tree plantings around buildings to shade parking lots and along public rights-of-way.	Extreme Heat	High
8	Educate citizens regarding the dangers of extreme heat and the steps they can take to protect themselves when extreme temperatures occur. Conduct an outreach campaign, partnering with Tigard CERT, FBOs, and other CBOs.	Extreme Heat	High
9	Heighten awareness of flood risk. Incorporate the procedures for tracking high-water marks following a flood into emergency response plans	Flood	Low
10	Create partnerships and facilitate riparian habitat restoration projects in flood or erosion-prone areas, especially along the Tualatin River, Summer Lake, and Fanno Creek.	Flood	Medium
11	Study areas where riparian landslides may occur. Complete an inventory of locations where critical facilities, other buildings, and infrastructure are vulnerable to landslides. Continue monitoring of all forested slopes cleared for housing developments. Assess vegetation in landslide-prone areas to prevent landslides and encourage plants with strong root systems.	Landslide	Medium
12	Regulate development in landslide hazard areas.	Landslide	Medium
13	Identify critical facilities and industries that may be affected by ashfall and assist them in emergency response plan development.	Volcanic Ash	Low
14	Collaborate with the Washington County Environmental Health Program for immediate warnings to communities about degraded air quality following volcanic eruptions, particularly in areas with a high concentration of vulnerable groups (e.g., schools and retirement and assisted living facilities). Work with state agencies, such as National Oceanic and Atmospheric Administration and DOGAMI, who can assist in developing ashfall models for Washington County and Tigard.	Volcanic Ash	Low

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
15	Public education/awareness of wildfire smoke can be improved. Inform the public about wildfire smoke impacts. Produce and distribute family emergency preparedness information about wildfire smoke hazards, including tips to mitigate impacts, such as stay indoors, limit indoor pollution, stay cool, limit driving, wear a mask outdoors, and use an air purifier when possible. Encourage homeowners to install carbon monoxide monitors and alarms.	Wildland Fire (Wildfire Smoke)	Medium
16	Develop and implement defensible space programs to reduce risk to structures and infrastructure.	Wildland Fire	Medium
17	Inform residents of shelter options and evacuation protocols. Educate homeowners on the benefits of wind retrofits. Provide outreach material to property owners on how to properly install temporary window coverings before a storm. Educate design professionals to include wind mitigation during building design. Educate homeowners on larger tree maintenance and management.	Windstorm, Including Tornado	Low
18	Establish and enforce standards for all utilities regarding tree pruning around lines. Bury overhead power lines. Use designed-failure mode for power line design to allow lines to fall or fail in small sections rather than as a complete system to enable faster restoration. Install redundancies and loop feeds.	Winter Storm	Low
19	Produce and distribute family and traveler emergency preparedness information about severe winter weather hazards, including safety strategies for severe weather in driver education classes and materials. Encourage homeowners to install carbon monoxide monitors and alarms. Educate citizens that all fuel-burning equipment should be vented to the outside.	Winter Storm	Low

6.3. Mitigation Action Information Worksheets

Table 240: EQ – Adopt and Enforce Building Codes

Mitigation Action Information			
Title of action	EQ – Adopt and Enforce Building Codes		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Adopt future required seismic building code revisions as they become introduced. Enforce the current building code standards to ensure only the appropriate land uses are allowed, especially in high-hazard areas.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Promoting effective land use planning based on identified hazards. Adopting and enforcing building codes and standards. Buying earthquake insurance to protect personal property and belongings.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	Council Goal 3, Council Promises 1–4		
Alignment with existing plans and policies	Tigard's Comprehensive Plan (Goal 7), current building code, The Disaster Mitigation Act of 2000, Washington County NHMP, State Land Conservation and Development Goal 7 State of Oregon's NHMP		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development and PW Engineering		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low – Less than $50,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 241: EQ – Conduct Seismic Evaluations on Identified Community Infrastructure

Mitigation Action Information			
Title of action	EQ – Conduct Seismic Evaluations on Identified Community Infrastructure		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	Conduct seismic evaluations on identified community assets (shelters, critical and essential facilities) and "high-risk" school and emergency service buildings, and implement appropriate structural and non-structural upgrades mitigation strategies.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	The Disaster Mitigation Act of 2000 requires communities to identify mitigation actions that are being considered by the community to reduce the effect that natural hazards will have on the community. Developing and implementing programs to reduce the potential for earthquakes to cause damage can assist a community in mitigating its overall risk to earthquakes. Pre-disaster mitigation strategies will reduce post-disaster response needs by lessening life loss, injury, damage, and disruption.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Tigard's Community Resiliency Plan, Council Goal 3, Council Promises 1–4		
Alignment with existing plans and policies	Water Master Plan, Wastewater/Storm Master Plan, Comprehensive Plan (Goal 7), The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Community Development, PW Engineering, and Emergency Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Seismic Rehabilitation Grant Program, Hazard Mitigation Assistance Grants	
Estimated Cost	High – More than $100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 242: EQ – Provide Information on Structural and Non-Structural Retrofitting

Mitigation Action Information			
Title of action	EQ – Provide Information on Structural and Non-Structural Retrofitting		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	Developing a technical assistance information program for homeowners. Teaching them how to seismically strengthen their houses can be an effective mitigation activity. The program can include providing local government building departments with copies of existing strengthening and repair information for distribution.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Developing an outreach program to encourage homeowners to secure furnishings, storage cabinets, and utilities to prevent injuries and damage as well as strapping or bolting the structure to the foundation. Examples include anchoring tall bookcases and file cabinets, installing latches on drawers and cabinet doors, restraining desktop computers and appliances, using flexible connections on gas and water lines, mounting framed pictures and mirrors securely, and anchoring and bracing propane tanks and gas cylinders.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	CERT Program, Know Your Neighborhood Program, Council Goal 3, Council Promises 1, 3, and 4		
Alignment with existing plans and policies	Building Code, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Emergency Management, Building Division, Economic Development and Private Sector; Chamber of Commerce; Community Emergency Response Team Program; and Local Builder Association		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund and Non-Profit Program		SHSP Citizen Corps Grant Program UASI Citizen Corp Grant Program	
Estimated Cost	Low – Less than $50,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 243: EH – Reduce Urban Heat Island Effect

Mitigation Action Information			
Title of action	EH – Reduce Urban Heat Island Effect		
Type of action	Plans/regulations ☒	Natural systems protection ☒	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Adopting codes and regulations the incentivize the installation of green roofs, solar panels, and solar parking area covers, which provide shade and remove heat from roofs, paving surfaces, and surrounding air. Incentivizing and encouraging cool roofing products, such as white roofs that reflect sunlight and divert heat away from a building. Increasing tree plantings around buildings to shade parking lots and along public rights-of-way.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☒	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Urban areas develop, and buildings and roads replace open land and vegetation. Urban regions become warmer than their rural surroundings, forming an “island” of heat.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Council Goal 3, Council Promise 2		
Alignment with existing plans and policies	OR OSHA Permanent Heat Rule, City Heat Policy, The Disaster Mitigation Act of 2000, Comprehensive Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Community Development, PW Engineering		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Medium – $50,000–$100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000-$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☒		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 244: EH – Assist Vulnerable Populations

Mitigation Action Information			
Title of action	EH – Assist Vulnerable Populations		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	Requiring minimum temperatures in housing/landlord codes. Encouraging utility companies to offer special arrangements for paying cooling bills, if not already required by state law. Creating a database to track those individuals at high risk of death, such as the elderly, physically fragile and homeless.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☒	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Measures should be taken to ensure vulnerable populations are adequately protected from the impacts of extreme temperatures.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	Council Goal 3, Council Promises 1–4		
Alignment with existing plans and policies	Emergency Operations Plan, OSHA Permanent Heat Rule, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development, City Council, PGE, PH, Emergency Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund and Non-Profit In-Kind match		Not Applicable	
Estimated Cost	Medium – $50,000–$100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000-$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Table 245: EH – Increase Awareness of Extreme Temperature Risk and Safety

Mitigation Action Information			
Title of action	EH – Increase Awareness of Extreme Temperature Risk and Safety		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	Educating citizens regarding the dangers of extreme heat and the steps they can take to protect themselves when extreme temperatures occur. Conduct outreach campaign partnering with Tigard CERT, FBOs, and other CBOs.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☒	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	The impacts of extreme temperatures on public health can be lessened if citizens know how to prepare and protect themselves.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	Council Goal 3, Council Promises 1, 2, and 4		
Alignment with existing plans and policies	Know Your Neighborhood and Annual Community Preparedness Fair, OSHA Heat Rule, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Community Engagement, Emergency Management, Risk Management, Meals on Wheels		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund and Non-Profit In-Kind match		Not Applicable	
Estimated Cost	Low – Less than $50,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property		$300,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 246: FL – Foster Partnerships and Create Restoration Project

Mitigation Action Information			
Title of action	FL – Foster Partnerships and Create Restoration Project		
Type of action	Plans/regulations ☐		Natural systems protection ☒
	Structure and infrastructure project ☐		Public education/awareness ☐
Action description	Create partnerships and facilitate riparian habitat restoration projects in flood- or erosion-prone areas, especially along the Tualatin River, Summer Lake, and Fanno Creek.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Riparian habitat restoration projects will protect and maintain ecosystem functions, reduce erosion and sedimentation, and strengthen flood-prone areas. Restoration projects that involve planting trees in riparian areas can both improve the habitat and prevent damage to parkland during flood events. Strengthening partnerships in the county will increase the likelihood that natural hazard mitigation will remain an active element within the community. Partnerships that can facilitate habitat restoration include working with the Oregon Department of Fish and Wildlife, Oregon Parks and Recreation, local watershed councils, and other organizations that can assist in habitat restoration.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☒	
Integration into other initiatives	Council Goal 3, Council Promises 2 and 4		
Alignment with existing plans and policies	Park System Master Plan, Sani/Sewer Master Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development, PW Engineering, and Local Volunteers		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	High – More than $100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property Environment		$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 247: FL – Improve Flood Risk Assessment

Mitigation Action Information			
Title of action	FL – Improve Flood Risk Assessment		
Type of action	Plans/regulations ☒		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☐
Action description	Heighten awareness of flood risk. Incorporating the procedures for tracking high water marks following a flood into emergency response plans. Incorporating the procedures for tracking high water marks following a flood into emergency response plans.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Conducting cumulative impact analyses for multiple development projects within the same watershed using GIS to map areas that are at risk of flooding. Obtaining depth grid data and using it to illustrate flood risk to citizens. Incorporating digital floodplain and topographic data into GIS systems, in conjunction with Hazus, to assess risk.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	Council Goal 3, Council Promise 2		
Alignment with existing plans and policies	Flood Plain Management, Comprehensive Plan, Emergency Operations Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	NOAA, OR Water Resource, USGS, Community Development, Tualatin River Keeper, Public Works		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Federal Grant Opportunities	
Estimated Cost	High – More than $100,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property		$600,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 248: LS – Landslide Monitoring Management

Mitigation Action Information			
Title of action	LS – Landslide Monitoring Management		
Type of action	Plans/regulations ☐		Natural systems protection ☒
	Structure and infrastructure project ☐		Public education/awareness ☐
Action description	Study areas where riparian landslides may occur. Completing an inventory of locations where critical facilities, other buildings, and infrastructure are vulnerable to landslides. Continue monitoring of all forested slopes cleared for housing developments. Assess vegetation in landslide prone areas to prevent landslides and encourage plants with strong root systems.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☒	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Depending on the type, location, severity, and area affected, severe property damage, injury, and loss of life can be caused by landslide hazards. Landslides can also damage or temporarily disrupt utility services, roads, and other transportation/communication systems, including emergency response, fire, medical, police, etc.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Council Goal 3, Council Promises 2 and 3		
Alignment with existing plans and policies	Building Code and Comprehensive Plan Goal 7, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development, PW Engineering, DLCD, Environmental Services		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	High – More than $100,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property		$600,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 249: LS – Manage Development in Landslide Prone Areas

Mitigation Action Information			
Title of action	LS – Manage Development in Landslide Prone Areas		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Landslide risk can be mitigated by regulating development in landslide hazard areas.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☐ Landslide ☒ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identify current or future risks and vulnerabilities?	Create a plan to implement reinforcement measures in high-risk areas. Create guidelines for regulating new development in steep-slope/high-risk areas. Create or increase setback limits on parcels near high-risk areas. Locating utilities outside of landslide areas to decrease the risk of service disruption. Restrict or limit industrial activity that would strip slopes of essential topsoil. Incorporating economic development activity restrictions in high-risk areas.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☒ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Council Goal 3, Council Promises 2 and 3		
Alignment with existing plans and policies	Building Code and Comprehensive Plan Goal 7, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Community Development, PW Engineering, DLCD, Environmental Services		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	High – More than $100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 250: WS – Increase Windstorm Risk Awareness

Mitigation Action Information			
Title of action	WS – Increase Windstorm Risk Awareness		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	Inform residents of shelter options and evacuation protocols. Educate homeowners on the benefits of wind retrofits Provide outreach material to property owners on how to properly install temporary window coverings before a storm. Educate design professionals to include wind mitigation during building design. Educate homeowners on larger tree maintenance and management.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm ☒
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Severe wind can occur alone, such as during straight-line wind events and derechos, or it can accompany other natural hazards, including hurricanes and severe thunderstorms. Severe wind poses a threat to lives, property, and vital utilities primarily because of flying debris or downed trees and power lines. Severe wind will typically cause the greatest damage to structures of light construction, particularly manufactured homes.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	Council Goal 1 and 3, Council Promises 1–4		
Alignment with existing plans and policies	Comprehensive Plan Goal 7, Emergency Operations Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Community Development, PW Operations Arborist, Community Engagement		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Federal Grant opportunities	
Estimated Cost	Medium – $50,000–$100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000-$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 251: WS – Protect Power Lines

Mitigation Action Information			
Title of action	WS – Protect Power Lines		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	Establish and enforce standards for all utilities regarding tree pruning around lines. Burying overhead power lines. Use designed-failure mode for power line design to allow lines to fall or fail in small sections rather than as a complete system to enable faster restoration. Install redundancies and loop feeds.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☒
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Power lines can be protected from the impacts of winter storms. Severe winter weather can down trees, cause widespread power outages, damage property, and cause fatalities and injuries. By taking the three steps above, the impacts can be lessened.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Council Goal 3, Council Promises 1–4		
Alignment with existing plans and policies	Building Code, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	PGE, Developers Association, Community Development, PW Engineering		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC	
Estimated Cost	High – More than $100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 252: WS – Conduct Winter Weather Risk Awareness Activities

Mitigation Action Information			
Title of action	WS – Conduct Winter Weather Risk Awareness Activities		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	Produce and distribute family and traveler emergency preparedness information about severe winter weather hazards. Including safety strategies for severe weather in driver education classes and materials. Encourage homeowners to install carbon monoxide monitors and alarms. Educate citizens that all fuel-burning equipment should be vented to the outside.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☒
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Severe winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Public awareness of severe winter storms can be improved Inform the public about severe winter weather impacts.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	Council Goal 3, Council Promise 4		
Alignment with existing plans and policies	Emergency Operations Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	OSFM, TVFR, Tigard-Tualatin School District, Emergency Management and Tigard CERT, ODOT, WC LUT, Design and Communications		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund and Non-Profit In-Kind Volunteers		Not Applicable	
Estimated Cost	Medium – $50,000–$100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000-$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 253: WF Smoke – Public Education/Awareness of Wildfire Smoke

Mitigation Action Information			
Title of action	WF Smoke – Public Education/Awareness of Wildfire Smoke		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐		Natural systems protection ☐ Public education/awareness ☒
Action description	Public education/awareness of wildfire smoke can be improved. Inform the public about wildfire smoke impacts. Produce and distribute family emergency preparedness information about wildfire smoke hazards, including tips to mitigate impacts such as: Stay indoors, limit indoor pollution, stay cool, limit driving, wear a mask outdoors, and use an air purifier when possible. Encourage homeowners to install carbon monoxide monitors and alarms.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildfire smoke ☒	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identify current or future risks and vulnerabilities?	Larger and more frequent and intense wildfires are a growing public health problem, contributing to reduced air quality for people living near or downwind of fire. Health problems related to wildfire smoke exposure can be as mild as eye and respiratory tract irritation and as serious as worsening of heart and lung disease, including asthma, and even premature death.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐ Goal 2 ☐ Goal 3 ☒	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Council Goal 1 and 3, Council Promises 1, 2, and 4		
Alignment with existing plans and policies	U.S. EPA: Wildfire Smoke Guide for Public Officials U.S. EPA: Smoke Ready Toolbox City Smoke/AQI Policy, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	OHA, NOAA, WC Public Health, Risk and Emergency Management, OSFM, Fire Defense Board, ODF, and Tigard CERT		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low–Medium (Low – Less than $50,000; Medium – $50,000 – $100,000)		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000-$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 254: WF – Develop and Implement Defensible Space Program

Mitigation Action Information			
Title of action	WF – Develop and Implement Defensible Space Program		
Type of action	Plans/regulations ☒		Natural systems protection ☒
	Structure and infrastructure project ☐		Public education/awareness ☐
Action description	Develop and implement defensible space programs to reduce risk to structures and infrastructure.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildfire ☒	
How does the action address identify current or future risks and vulnerabilities?	Create buffers around residential and non-residential structures through the removal or reduction of flammable vegetation, including vertical clearance of tree branches. Replace flammable vegetation with less flammable species. Create defensible zones around power lines, oil and gas lines, and other infrastructure systems. Regulate new development in and near natural areas, incorporating design principles that create defensible space.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	Council Goal 3, Council Promises 2 and 4		
Alignment with existing plans and policies	Fire District Wildfire Interface Policy City Smoke/AQI Policy, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	State Fire Marshal, TVFR, Code Enforcement, Risk and Emergency Management, Community Development		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		BRIC	
Estimated Cost	Medium – $50,000–$100,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000-$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 255: Volcanic Ash – 1

Mitigation Action Information			
Title of action	Volcanic Ash – 1		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Identify critical facilities and industries that may be affected by ash fall and assist them in emergency response plan development		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☒ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identify current or future risks and vulnerabilities?	Volcanic ash can lead to respiratory problems for vulnerable sectors of residents such as the elderly and youth. Increasing awareness through public outreach reduces the impact of a volcano on vulnerable groups residing in Tigard.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Council Goal 3, Council Promise 1		
Alignment with existing plans and policies	Tigard Emergency Operations Plan, City Facility Emergency Action Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒ Medium ☐ High ☐		
Lead position, office, department, or division responsible for implementation	USGS-CVO, DOGAMI, Major Industries, City Facility Management		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low–Medium (Low – Less than $50,000; Medium – $50,000–$100,000)		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Protect Life and Property		$300,000-$600,000	

Project Timeline		
Expected Timeline for Completion		
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 256: Volcanic Ash – 2

Mitigation Action Information			
Title of action	Volcanic Ash – 2		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☒
Action description	Collaborate with county environmental health for immediate warnings to communities about degraded air quality following volcanic eruptions, particularly in areas with high concentrations of vulnerable groups (e.g., retirement facilities and schools). Work with state agencies such as NOAA and DOGAMI that can assist in developing ash fall models for Washington County and Tigard.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☒	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	Volcanic ash can lead to respiratory problems for vulnerable sectors of residents, such as the elderly and youth. Increasing awareness through public outreach reduces the impact of a volcano on vulnerable groups residing in Tigard.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	Everbridge ENS, Council Goal 3, Council Promises 1 and 4		
Alignment with existing plans and policies	County Environmental Health, Tigard Emergency Operations Plan, City Facility Emergency Action Plan, Community Outreach Strategies, City GIS, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	USGS-CVO, DOGAMI, County Environmental Health, City Emergency Management, King City, Summer Lake Senior Community, and other vulnerable populations		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low–Medium (Low – Less than $50,000; Medium – $50,000–$100,000)		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000-$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 257: Drought

Mitigation Action Information			
Title of action	Drought		
Type of action	Plans/regulations ☐	Natural systems protection ☒	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	Educate K–12 students about water conservation. Install low-flow water fixtures in schools and public facilities. Plant drought-resistant “xeriscape” garden and landscape. Capture rainwater in cisterns and rain barrels for future use on gardens, trees, and other planted areas.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☒	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Partner with EarthWISE and local schools to implement water conservation strategies to maximize water use in schools and home.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	Council Goal 3, Council Promises 2 and 4		
Alignment with existing plans and policies	Comprehensive Plan Goal 7, Water Conservation Plan, Drainage Maintenance Program, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Public Works, Tigard/Tualatin Schools District, Design and Communications, USDA, ODOA, OSU Extension and Soil/Water Conservation		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund, Non-Profit In-Kind support		Potential Federal Grant opportunity, BRIC	
Estimated Cost	Low–Medium (Low – Less than $50,000; Medium – $50,000–$100,000)		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000-$600,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 258: Dam Failure – Provide Information on High-Risk Areas

Mitigation Action Information			
Title of action	Dam Failure – Provide Information on High-Risk Areas		
Type of action	Plans/regulations ☐	Natural systems protection ☒	
	Structure and infrastructure project ☒	Public education/awareness ☒	
Action description	Offering GIS hazard mapping online for residents and design professionals. More accurately mapping problem areas to educate residents about unanticipated risks. Upgrading maps provides a truer measure of risks to a community. Educating property owners in high-risk areas about mitigation options. Educating the public about risks, preparedness measures, and evacuation procedures.		
Hazard(s) addressed	Dam failure ☒	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identify current or future risks and vulnerabilities?	A high-volume water surge upstream from a catastrophic Scoggins Dam failure can cause the rise of downstream tributaries anywhere from 4 feet to 5 feet. High water surges can be devastating, causing flooding, severe bank erosion, and property damage along the immediate tributary. Furthermore, water can rise very rapidly due to the surge, posing a serious threat to people remaining in lower-lying inundation areas.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	Council Goal 3 and Council Promises 2 and 4		
Alignment with existing plans and policies	Statewide Planning Goal 7, Comprehensive Plan Goal 7, Emergency Operations Plan, The Disaster Mitigation Act of 2000		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Community Development, PW Engineering, Army Corp of Engineers, Bureau of Reclamation		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Fund		Not Applicable	
Estimated Cost	Low – Less than $50,000		

Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Protect Life and Property		$300,000
Project Timeline		
Expected Timeline for Completion		
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Clean Water Services

Annex H
Clean Water Services

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1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for Clean Water Services[1] (CWS) was the Senior Water Resources Program Manager.

1.2. Annex Organization

This annex has six sections that satisfy mitigation requirements in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

This annex applies to maintaining the business continuity of CWS operations to provide wastewater and stormwater management services in the event of a natural hazard. The information provided in this annex is for CWS alone. All pertinent information that is not identified in this annex is identified in other sections of this NHMP or within the respective appendices.

1.3. NHMP Adoption Process

Once the Washington County NHMP receives the designation “Approvable Pending Local Adoption” from the Federal Emergency Management Agency (FEMA), CWS will present the plan to the Board of Directors for final public comment and adoption. A copy of the resolution will be inserted into the NHMP and held on file at CWS and Washington County.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that

[1] Clean Water Services is an ORS 451 county service district that provides urban wastewater treatment, stormwater management, and related water resources management services in the Tualatin River Watershed.

communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

CWS recognizes the benefits of having a long-term, all-hazards approach to mitigating natural hazards that could impact the provision of wastewater conveyance and treatment and stormwater management services. This approach has been implemented through the NHMP and five-year NHMP updates as required by law. This planning will improve the business continuity of CWS operations in the event of hazard-associated impacts by building on risk reduction measures in subsequent iterations of the NHMP. (In previous NHMP efforts, CWS did not participate as an independent jurisdiction with specific risk reduction measures.) The involvement of CWS in the Washington County NHMP represents the collective efforts of the NHMP Steering Committee members, Clean Water Services' Technical Committee members, the public, and stakeholders.

CWS developed this annex in accordance with 44 CFR §201.6(c)(5) as referenced in the Disaster Mitigation Act of 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in the CWS service area.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP annex as part of the overall NHMP. An open involvement process was established for the public and all stakeholders through the Emergency Management Cooperative of Washington County as well as the Clean Water Services Advisory Commission, which provided an opportunity for those groups to be involved in the planning process and make their views known.

Two teams worked simultaneously throughout the development of this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of points of contact from each plan participant. The group met to discuss countywide topics, including hazards and mitigation strategies. The points of contact were the leads of each local Technical Committee.
2. **Local Technical Committee:** Each plan participant had a Technical Committee that consisted of the Steering Committee representative for that jurisdiction or special district as well as designated representatives from within the organization. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. Clean Water Services Technical Committee

The CWS annex of the overall NHMP was developed by the CWS local Technical Committee with support from IEM, a consulting firm hired to support the planning process. The efforts of the committee were led by the CWS Senior Water Resources Program Manager throughout 2022 and 2023.

Table 1: Clean Water Services Technical Committee Members for the 2023 NHMP

Job Title and Department	Role in Committee and Planning Process
Senior Water Resources Program Manager, CWS Natural Systems Enhancement & Stewardship	General oversight, hazard identification, and plan development
Strategic Risk Manager, CWS Strategy Development & Enterprise Performance Management	Leadership oversight; hazard identification and plan development
Field Operations Division Manager, CWS Utility Operations & Services	Hazard identification and plan development
Development Services Division Manager, CWS Regional Utility Services	Hazard identification and plan development
GIS Analyst, CWS Regional Utility Services	Hazard identification and plan development
Plant Superintendent 3, CWS Utility Operations & Services	Hazard identification and plan development
Business Practice Leader 1 Integrated Planning, CWS Strategy Development & Enterprise Performance Management	Hazard identification and plan development
Water Resources Analyst, CWS Water Resource Recovery Operations & Services	Hazard identification and plan development
Public Involvement Coordinator, CWS Communications and Community Engagement	Hazard identification and plan development
Systems Planning Division Manager, CWS Regional Utility Services	Hazard identification and plan development

IEM also supported or led the following activities associated with the development, approval, and adoption of the plan:

1. Facilitated the NHMP update process.
2. Based on committee direction and stakeholder and community input, prepared the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.
3. Submitting the proposed plan to the State of Oregon Department of Emergency Management (OEM) and FEMA for review and approval and completed edits or revisions requested by these organizations.
4. Coordinating the plan adoption processes with OEM and FEMA.

2.3. Public Participation

Public participation is an important component of the NHMP and also a required element as outlined in 44 CFR §201.6(c)(5), FEMA's mitigation planning guidance. In addition to FEMA's public participation requirement, Oregon's land use system addresses the need for public participation in Statewide Land Use Planning Goal 1, Citizen Involvement, which ensures the opportunity for the community to be involved in the planning process.

As described in the base report, plan participants used a survey to collect information about community perceptions of natural hazards and priorities. The Steering and Technical Committees used the results to inform their risk assessments and mitigation strategies. Community members were also provided an

opportunity to comment on a draft of the NHMP through the Emergency Management Cooperative of Washington County's website. These NHMP sections were further reviewed by the Clean Water Services Advisory Commission (CWAC) representing environmental, business, agricultural, and service area representatives. CWAC provides specific policy, programs, and budget input to CWS and the Clean Water Services Board of Directors. The plan was also reviewed by the Clean Water Services Board of Directors, whose members also serve as the Washington County Board of Commissioners. A public notice was issued via multiple social media accounts for a two-week open public comment period coordinated through the Emergency Management Cooperative of Washington County. Appendix B in the base plan contains notices and additional information about the survey and opportunities for public comment. CWS will take the NHMP to its Board for adoption after FEMA approval.

As CWS implements the mitigation actions identified in this annex, there will be additional opportunities for public participation.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist CWS in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards to maintain business continuity in the provision of wastewater and stormwater management services in urbanized Washington County and other adjacent urban areas served.

3.1. Clean Water Services Profile

This section provides information on CWS-specific characteristics. Additional community characteristics of the planning area are in Appendix A.

The Unified Sewerage Agency (USA) was formed in 1970 by public vote to consolidate into one agency the responsibility to correct the significant pollution problems in local area creeks caused by multiple poorly operating wastewater treatment plants discharging partially treated sewage. USA formed a surface water utility in 1990 to provide stormwater management services to meet new regulatory compliance requirements. In 2001, the organization's name was changed to Clean Water Services (CWS).

CWS is an ORS 451 county service district that provides wastewater conveyance and treatment and stormwater management services to urbanized Washington County. CWS provides innovative wastewater and stormwater management services with a watershed-based approach to regulatory compliance by investing in nature-based solutions with partners to meet the regulatory requirements for the utility while providing improved environmental and ecological outcomes with its project investments.

Clean Water Services provides regional services for wastewater and stormwater management for all customers in the service area (Figure 1). CWS works with the cities of Hillsboro, Beaverton, Forest Grove, Cornelius, Tualatin, Tigard, and Sherwood, which provide the local sewer and storm drainage services to their communities. Within its service area, CWS also provides the local sewer and storm drainage services for unincorporated Washington County and the cities of Banks, North Plains, Durham, Gaston (wastewater only), and King City. Finally, Clean Water Services provides regional wastewater services to small portions of Lake Oswego, Portland, and portions of unincorporated Clackamas and Multnomah counties. CWS cleans an average of 66 million gallons of wastewater each day from residents of these communities.

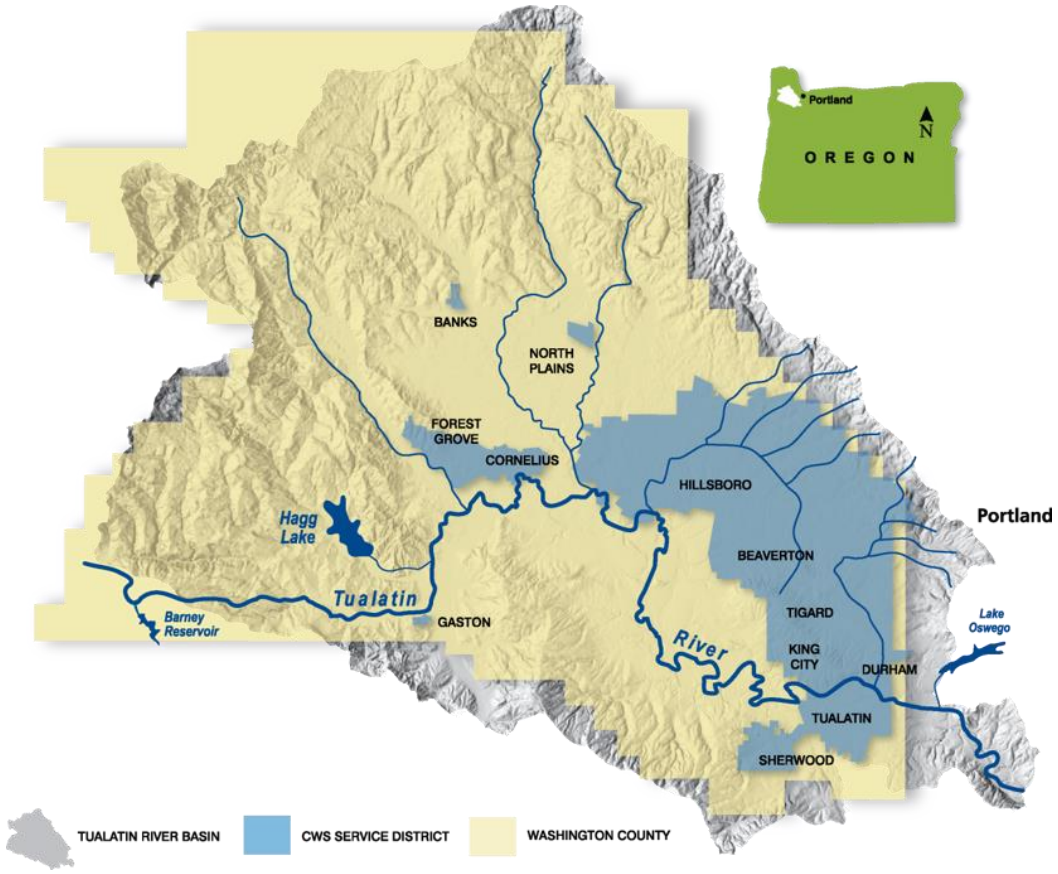


Figure 1: Clean Water Services Service Area

During fiscal year 2021–2022, CWS transformed the region's wastewater into nearly 15 million kilowatts of renewable energy and more than 24 billion gallons of clean water.[2] Additionally, CWS contributed about 75% of the Tualatin River's summer flow by releasing clean water from reservoirs and treatment facilities and released 83% of the Hagg Lake water and 100% of the Barney Reservoir water allocated for stream and river flow restoration.[3]

CWS is responsible for 875 miles of the nearly 1,900 miles of public sewer pipes within the CWS service area and 44 pump stations routed to one of its four water resource recovery/wastewater treatment facilities at Durham (located in Tigard), Rock Creek (located in Hillsboro), Hillsboro, and Forest Grove. These pipelines are divided into the "Regional" system of larger diameter lines, pump stations and associated force mains, and siphons under the Tualatin River, and the "Local" system of smaller diameter lines and related infrastructure outside of the larger cities as described above.[4] CWS also owns and manages a Field Operations office, research and laboratory facility, materials handling yard, and Administrative Building Complex.[5]

CWS holds the National Pollutant Discharge Elimination System (NPDES) stormwater permit for urban Washington County, with Washington County and city partners as co-implementers. As part of the

[2] Clean Water Services. (2022, September). At a Glance. https://cleanwaterservices.org/wp-content/uploads/2022/09/clean-water-services-at-a-glance.pdf
[3] Clean Water Services. (2022 September). At a Glance. https://cleanwaterservices.org/wp-content/uploads/2022/09/clean-water-services-at-a-glance.pdf
[4] Clean Water Services. (2022). Locations. https://cleanwaterservices.org/a(bout/locations/
[5] Clean Water Services. (2022). Locations. https://cleanwaterservices.org/about/locations/

requirements of this permit, CWS owns and is responsible for maintenance of at least 536 miles of public drainage pipelines, 18,284 catch basins, and nearly 2,000 public stormwater detention and water quality facilities for unincorporated Washington County and the cities of Banks, North Plains, Durham, and King City.[6]

CWS nature-based solutions as part of the watershed-based approach to regulatory compliance include nearly 100 miles of revegetated riparian corridors that provide stream shade to meet regulatory compliance requirements to offset thermal loads from the water resource recovery facilities, over 7,000 acres of wetland and stream corridor enhancement and floodplain reconnection project investments to improve the function of streams receiving urban runoff, the Fernhill Natural Treatment System, and portions of the Jackson Bottom Wetlands site in conjunction with the City of Hillsboro, Oregon. CWS also partners with the U.S. Fish & Wildlife Service to support the restoration of large complexes like the Wapato and Chicken Creek sites on the Tualatin River National Wildlife Refuge to improve water quality and stream function. These nature-based solutions can help mitigate several natural hazards. For instance, they moderate flooding impacts by providing flood storage or slowing runoff, reduce extreme heat impacts by providing shade, and locally stabilize steep slopes to reduce the risk of landslides.

Many of the characteristics of CWS investments in built and natural infrastructure can affect how natural hazards impact the CWS service area, facilities, underground infrastructure and project investments. It is important for CWS to plan for natural hazard mitigation to reduce the risk of damage that impacts the operations and business continuity of providing wastewater and stormwater management services. Considering these specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

The critical and vulnerable facilities listed below in Tables 2 and 3, noncritical facilities such as local wastewater conveyance and stormwater management facilities, and the nature-based solutions described above are in hazard areas for all or some of the hazards identified in the CWS service area. Table 2 includes infrastructure or facilities other than pump stations. Pump stations are listed in Table 3. A complete and current inventory of all CWS facilities is maintained in our enterprise GIS system. More detail regarding specific CWS-maintained engineered assets is maintained in our Lucity-based asset management system, while information on nature-based investments is maintained in our TerraTrak system.

[6] Other cities within the CWS service area own and are responsible for similar stormwater infrastructure within their jurisdictions, although CWS performs basin-scale public education and outreach, water quality monitoring, compliance services and other actions across the service district as required by the permit. This infrastructure is not considered “critical,” but may be locally important in specific events.

Table 2: Critical Facility and Asset Inventory, Not Including Pump Stations

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Forest Grove Water Resource Recovery Facility	Infrastructure or Facility	1345 SW Fern Hill Road, Forest Grove	Not vulnerable to drought, landslide, or wildfire.
Hillsboro Water Resource Recovery Facility	Infrastructure or Facility	770 S First Avenue, Hillsboro	Not vulnerable to drought, landslide, or wildfire
Rock Creek Water Resource Recovery Facility	Infrastructure or Facility	3235 SE River Road, Hillsboro	Not vulnerable to drought, landslide, or wildfire.
Durham Water Resource Recovery Facility	Infrastructure or Facility	16060 SW 85th Avenue, Tigard	Not vulnerable to dam failure, drought, or wildfire.
Fernhill Natural Treatment System	Infrastructure or Facility and natural and cultural resource	1399 Fern Hill Road, Forest Grove	Not vulnerable to landslide or wildfire.
Wastewater lines (interceptors, trunk lines, force mains, gravity mains) greater than or equal to 24 inches in diameter	Infrastructure or Facility	Various locations	Not vulnerable to dam failure (except adjacent to Tualatin River upstream of Highway 99W), drought, extreme heat, flooding (except in stream corridors), volcanic ash, or wildfire. Includes related wastewater infrastructure (e.g., manholes, flow meters) and buried infrastructure (e.g., fiber optic lines).
Wastewater siphons	Infrastructure or Facility	45.396, -122.777; 45.396, -122.790; 45.393, -122.804	Not vulnerable to drought, extreme heat, volcanic ash, or wildfire. May be susceptible to streambank erosion during floods or dam failure, though the assets are protected and set back through emplacement with horizontal directional drilling.
Wastewater lines less than 24 inches in diameter that comprise the “Local” system in unincorporated Washington County and the cities of Banks, North Plains, Durham, Gaston, and King City	Infrastructure or Facility	Various locations	Not vulnerable to dam failure (except adjacent to Tualatin River upstream of Highway 99W), drought, extreme heat, flooding (except in stream corridors), volcanic ash, or wildfire. Includes related infrastructure (e.g., manholes, flow meters).

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Administrative Building Complex	Infrastructure or Facility	2550 SW Hillsboro Highway, Hillsboro	Not vulnerable to drought, extreme heat, or landslide. Primary emergency operations center.
Field Operations Center	Infrastructure or Facility	2025 SW Merlo Court, Beaverton	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire. Backup location of emergency operations center.
Springer Facility	Infrastructure or Facility	3395 NE Springer Street, Hillsboro	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire. Potential location of a future emergency operations center.
Material Handling Yard	Infrastructure or Facility	3990 & 3910 NE 33rd, Hillsboro	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire. Repository for debris.
ripl (Research + Innovation + Partnerships + Laboratory)	Infrastructure or Facility	1585 Poplar Street, Forest Grove	Not vulnerable to drought, extreme heat, flooding, landslide, or wildfire. Site of future water quality laboratory facilities.
CWS Water Quality Laboratory at ABC	Infrastructure or Facility	2550 Hillsboro Highway, Hillsboro	Not vulnerable to drought, extreme heat, flooding, landslide, or wildfire. Increased vulnerability to winter storms due to the lack of a backup power source.
Scoggins Dam and Hagg Lake	Infrastructure or Facility	45.471, -123.200	Not vulnerable to extreme heat, landslide, volcanic ash, windstorms, or winter storms. Provides water supply for water quality flows. Bureau of Reclamation facility with CWS water rights.
Barney Dam and Reservoir	Infrastructure or Facility	45°26'34.59", -123°22'50.70"	Not vulnerable to extreme heat, landslide, volcanic ash, windstorms, or winter storms. Provides water supply for water quality flows. CWS has a minor ownership interest to assure water rights.
Tualatin River Farm	Infrastructure or Facility and Natural Resource	4490 SW Minter Bridge Road, Hillsboro	Not vulnerable to flooding or wildfire.
Emergency communications facilities	Infrastructure or Facility	4475 SW Fern Hill Road, Forest Grove 45.438 -122.723	Not vulnerable to dam failure or flood (Nansen summit facility only), landslide.

Table 3: Critical Facility and Asset Inventory – Pump Stations

Name of Pump Station (No.)	Type of Asset	Address	Comments
Alderbrook (8397)	Infrastructure or Facility	1601 NW 9th Avenue, Hillsboro	Not vulnerable to dam failure, drought, extreme heat, landslide, or wildfire.
Aloha 3 (1561)	Infrastructure or Facility	4850 SW 209th Avenue, Beaverton	Not vulnerable to dam failure, drought, extreme heat, landslide, or wildfire.
B Street (1229)	Infrastructure or Facility	1527 B Street, Forest Grove	Not vulnerable to dam failure, drought, extreme heat, landslide, or wildfire.
Banks (1881)	Infrastructure or Facility	42660 NW Cedar Canyon Road, Banks	Not vulnerable to dam failure, drought, extreme heat, landslide, volcanic ash, or wildfire.
Beaverton (185)	Infrastructure or Facility	4150 SW Watson Avenue, Beaverton	Not vulnerable to dam failure, drought, extreme heat, landslide, or wildfire.
Borland (1867)	Infrastructure or Facility	4600 SW Borland Road, Tualatin	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
Brighton (1208)	Infrastructure or Facility	14802 NW Cornell Road, Portland	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
Broad Oak (134)	Infrastructure or Facility	6313 SW Broad Oak Drive, Beaverton	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
Bull Mtn. (1151)	Infrastructure or Facility	14385 SW Beef Bend Road, Tigard	Not vulnerable to dam failure, drought, extreme heat, or wildfire.
Butternut (6554)	Infrastructure or Facility	4622 SW 229th Avenue, Hillsboro	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
Cedar Street (4521)	Infrastructure or Facility	1065 Cedar Street, Forest Grove	Not vulnerable to dam failure drought, extreme heat, landslide, or wildfire.
Childs (6387)	Infrastructure or Facility	6500 Childs Road, Lake Oswego	Not vulnerable to drought, extreme heat, landslide, or wildfire.
Cipole (1868)	Infrastructure or Facility	19400 SW Cipole Road, Tualatin	Not vulnerable to drought, extreme heat, landslide, or wildfire.
Cornelius (6054)	Infrastructure or Facility	788 S. Linden Street, Cornelius	Not vulnerable to drought, extreme heat, flooding, landslide, or wildfire.

Name of Pump Station (No.)	Type of Asset	Address	Comments
Country Haven (1499)	Infrastructure or Facility	23585 NW Jacobson Road, Hillsboro	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
Cross Creek (4890)	Infrastructure or Facility	6400 SW 209th Avenue, Beaverton	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire. To be decommissioned.
Dawson Creek (6389)	Infrastructure or Facility	1199 NE Brookwood Parkway, Hillsboro	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
Fir Grove (8650)	Infrastructure or Facility	1505 SE Duke Drive, Hillsboro	Not vulnerable to dam failure, drought, extreme heat, landslide, or wildfire.
Fox Hill (1869)	Infrastructure or Facility	5698 SW Nyberg Lane, Tualatin	Not vulnerable to dam failure, drought, extreme heat, or wildfire.
Gaston (994)	Infrastructure or Facility	44329 East Gaston Road, Gaston	Not vulnerable to drought, extreme heat, landslide, or wildfire.
Laurel Woods (9864)	Infrastructure or Facility	2525 South Jasper Drive, Cornelius	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
Lower Tualatin (6187)	Infrastructure or Facility	8549 SW Tualatin Road, Tualatin	Not vulnerable to drought, extreme heat, landslide, or wildfire.
Meyers Farm (8435)	Infrastructure or Facility	16399 SW Bray Lane, Tigard	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
North Hillsboro Industrial	Infrastructure or Facility	5832 NE Sewell Avenue, Hillsboro	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
North Plains (6387)	Infrastructure or Facility	9835 NW 307th Avenue, North Plains	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
Nyberg (6070)	Infrastructure or Facility	6500 SW Nyberg Lane, Tualatin	Not vulnerable to drought, extreme heat, landslide, or wildfire.
Oak Village (4753)	Infrastructure or Facility	42230 NW Oak Way, Banks	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
Orchard Hills (1873)	Infrastructure or Facility	4561 SW Natchez Court, Tualatin	Not vulnerable to drought, extreme heat, or wildfire.

Name of Pump Station (No.)	Type of Asset	Address	Comments
Pine Lodge (876)	Infrastructure or Facility	4450 Pacific Avenue, Forest Grove	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
Pleasant View (1885)	Infrastructure or Facility	4450 Pacific Avenue, Forest Grove	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
Polygon (8848)	Infrastructure or Facility	800 NW 185th Avenue, Beaverton	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
River Road (6060)	Infrastructure or Facility	4195 SW Davis Road, Hillsboro	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
River Terrace North (6631)	Infrastructure or Facility	17480 SW Clementine Street, Tigard	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
River Terrace South (6827)	Infrastructure or Facility	17158 SW Roy Rogers Road, Sherwood	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
Rock Creek Ranch (239)	Infrastructure or Facility	4960 NW Salishan Drive, Portland	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
Rock Creek Ranch #3 (1356)	Infrastructure or Facility	20410 NW West Union Road, Portland	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
Saum Creek (1874)	Infrastructure or Facility	20455 SW 65th Avenue, Tualatin	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
Scholls Country (4165)	Infrastructure or Facility	16381 SW Gearin Court, Tigard	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
Sherwood (26)	Infrastructure or Facility	19035 SW Pacific Highway, Sherwood	Not vulnerable to drought, extreme heat, landslide, or wildfire.
Sunset Terrace (6689)	Infrastructure or Facility	32435 NW Wascoe Street, North Plains	Not vulnerable to dam failure, drought, extreme heat, flooding, landslide, or wildfire.
Tektronix (8294)	Infrastructure or Facility	3555 SW Hocken Avenue, Beaverton	Not vulnerable to dam failure, drought, extreme heat, or wildfire.

Name of Pump Station (No.)	Type of Asset	Address	Comments
Victoria Woods (4424)	Infrastructure or Facility	22960 SW Miami Place, Tualatin	Not vulnerable to dam failure, drought, extreme heat, flooding, or wildfire.
Westmark (8493)	Infrastructure or Facility	22650 NW West Union Road, Hillsboro	Not vulnerable to dam failure, drought, extreme heat, landslide, or wildfire.

3.2. Natural Hazard Profiles

The Technical Committee for CWS utilized the OEM's hazard analysis methodology to examine hazard vulnerability and probability by collecting information about history, probability, vulnerability, and maximum threat for each hazard that impacts CWS. The Technical Committee focused on evaluating the hazards and potential vulnerabilities relative to staff, facilities, and the ability to recover the level of service to those within the CWS service area. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants.

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Section 2 of the base plan.

All natural hazards included in the NHMP have the potential to impact CWS. The scores for each hazard that impacts CWS are presented below.

Table 4: Natural Hazard Risk Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	Low	Low	Medium	Low	98
Drought	Medium	Medium	Medium	High	165
Earthquake: Cascadia (3–5-minute event)	Low	Medium	High	Low	148
Earthquake: Crustal (1-minute event)	Low	High	High	Low	155
Extreme heat	High	Medium	Medium	High	152
Flooding, including channel migration and streambed erosion	High	Medium	High	High	189
Landslide	Medium	Low	Low	Medium	96
Volcanic ash	Low	Low	Medium	Low	86
Wildland fire	Medium	Medium	Medium	Medium	127
Windstorm, including tornado	High	Low	Medium	High	147
Winter storm	High	Low	Medium	High	142

Full descriptions of each hazard are provided in Section 2 of the base plan. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description in this annex and in Section 2 of the base plan.

The time frame of data collected during the planning process for CWS was from as far back as available to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the CWS Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events, if applicable, and potential impacts and vulnerabilities. Potential impacts and vulnerabilities are focused on those directly related to CWS-owned or managed gray and green infrastructure; nature-based solution investments, on CWS staff, contractors and visitors that may be on premises; and on customers affected loss of CWS-provided services. For impacts to residents and businesses of urban Washington County, see the annexes provided by the County and by individual participating cities in this NHMP. (Note that the City of Tualatin has participated in the Clackamas County NHMP.)

3.2.1. Dam Failure

CWS could be directly impacted by dam failure. The Bureau of Reclamation owns Scoggins Dam and Hagg Lake, which provide water supply for agricultural irrigation, municipal drinking water supply, and water quality flows for the Tualatin River. CWS has an allocation of 16,900 acre-feet that can be used to maintain water quality in the main stem of the Tualatin or to supplement flows in select tributaries. Barney Reservoir is owned and operated by the Barney Joint Ownership Commission, organized under ORS 225.050. CWS' share of this venture is 10%, granting it access to 1,654 acre-feet of stored water from the reservoir every summer. Potential impacts of and vulnerabilities to dam failure are identified below.

3.2.1.1. Potential Impacts

The potential impacts of a dam failure event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event.

- Water quality infrastructure—both green and gray—adjacent to the Tualatin River upstream of Highway 99W could be inundated or subject to flood-related erosion. This includes the Forest Grove Water Resource Recovery Facility and adjacent Fernhill Natural Treatment System wetlands and parts of the Hillsboro Water Resource Recovery Facility. Portions of the Durham Water Resource Recovery Facility campus may also be inundated. Finally, several pump stations could be inundated.
- Should the Barney Dam and Reservoir or Scoggins Dam and Hagg Lake fail, it would impact the ability of CWS to meet instream water quality targets, as this area and the Scoggins Dam area provide water quality flows to augment summer low water flows, mitigating water quality impacts of discharges from the CWS water resource recovery facilities.

3.2.1.2. Vulnerabilities

Public wastewater and stormwater infrastructure and CWS investments in nature-based solutions can have vulnerabilities to a dam failure event from Scoggins Dam that may include:

- The CWS Forest Grove and Hillsboro treatment facilities are in the potential dam failure impact area. These facilities provide wastewater treatment for the cities of Gaston, North Plains, Banks, Cornelius, Forest Grove, and the western region of Hillsboro. The facilities together clean approximately 8.5 million gallons of wastewater on an average winter day; the Hillsboro facility typically operates only during the winter months.[7]

[7] Clean Water Services. (2022). Locations. https://cleanwaterservices.org/about/locations/

- While it is likely that there would be adequate warning of dam failure to allow evacuation of staffed CWS facilities, workers in those facilities would be at risk until the evacuation is complete. Field staff, particularly those working in the vicinity of Gaston, Forest Grove, and Cornelius, are less likely to receive timely alerts and may have more difficulty moving to higher ground; consequently, they are potentially more vulnerable.
- Interties between Forest Grove, Hillsboro, and Rock Creek mean that there might be little economic loss from damage to the Forest Grove and Hillsboro water resource recovery facilities other than that associated with direct damage to CWS infrastructure in those facilities. Damage to storm sewer outfalls for these facilities could occur from erosion during the flood wave. If the dam failure occurs during a moderate or heavier rainstorm, localized flooding beyond the area of direct inundation could occur if stormwater outfalls are submerged deeply enough or long enough to restrict upland drainage.
- Multiple pump stations (see Table 3) could be inundated and therefore temporarily compromised to move sewage from specific neighborhoods to the interceptor lines feeding the water resource recovery facilities. Damage to storm sewer outfalls that discharge directly to the main stem of the Tualatin River could occur from streambank erosion.
- Fernhill and Wapato Lake areas would likely be inundated with the flood wave. While this should not damage the vegetation as long as the inundated areas are allowed to drain, incidental damage from inundation or erosion could occur. Riparian plantings along the main stem of the Tualatin River and the lower reaches of major tributaries upstream of Rock Creek (including those acting as offsets for thermal loads from the water resource recovery facilities) could be inundated for several days. Again, while this is not likely to cause widespread vegetation loss, some may occur. The most likely damage to these areas would be from streambank erosion.

With respect to CWS facilities and operations, failure of Barney Dam would reduce the availability of supplemental summer flows that would otherwise be diverted to the Tualatin River. The CWS flow allocation from Barney Reservoir represents about 10% of the water available to CWS for this purpose.

3.2.2. Drought

Drought typically occurs as a regional event and often affects more than one jurisdiction simultaneously. Potential impacts of and vulnerabilities to public wastewater and storm drainage infrastructure and CWS investments in nature-based solutions from drought events are identified below.

3.2.2.1. Potential Impacts

The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts from a drought may include:

- Inadequate reservoir rainfall fill volume could reduce the CWS water supply available for stream flow augmentation to meet regulatory permit requirements.
- Vegetation used in the CWS nature-based solution investments in natural areas could be so affected as to require replanting.
- High potential would exist for concurrent hazards, including extreme heat, wildfire, when under severe and prolonged drought conditions.
- Inadequate drinking water supply could reduce water usage and result in secondary impacts to CWS by reducing sewage flows that require conveyance and treatment. This could reduce rate revenues.

- Loss of power or reduced availability of electricity due to concurrent hazards such as wildfire and extreme heat that require electrical grid pre-emptive shutdowns could impact CWS operations.
- CWS property and infrastructure could be damaged in areas with expansive soils, which are clay-based soils that expand and contract based on the amount of moisture in the soil.

3.2.2.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in Washington County are vulnerable to drought. Vulnerabilities specific to CWS operations are identified below.

- CWS may incur additional costs (e.g., for chemicals, energy, or staff) associated with operational changes needed to manage drought conditions.
- Need to increase revegetation efforts at CWS nature-based solution sites including riparian zones and floodplain restoration sites to increase riparian shading of streams and respond to plant mortality.
- Landscaping in and around CWS facilities (e.g., the green roof on the Field Operations building) may be damaged and require additional maintenance or replanting.
- Streams and vegetation in riparian corridors in the Tualatin River Watershed are vulnerable to dewatering (with related water quality impacts for temperature and dissolved oxygen) and drought stress.

3.2.3. Earthquake

CWS facilities could experience earthquakes that originate from the Cascadia Subduction Zone (CSZ), or crustal earthquakes originating in the Portland Hills Fault Zone, the Gales Creek Fault Zone, or other faults within or near the Tualatin Basin. (Regionally, the 1993 Scotts Mill or 2001 Nisqually events are examples of crustal earthquakes.) CWS facilities could also be affected by liquefaction and co-seismic landslides as the result of an earthquake. The risk score assigned to earthquake by the CWS Technical Committee was 148 for a CSZ earthquake and 155 for a crustal earthquake. These scores are not significantly different but reflect the fact that there are many possible faults that could be activated during a crustal zone earthquake and that shaking locally could be more severe than would occur with a CSZ earthquake. Potential impacts of and vulnerabilities to earthquake are identified below.

3.2.3.1. Potential Impacts

The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts from an earthquake event may include:

- Injuries, deaths, or access impacting availability of the workforce.
- Mental health impacts, including post-traumatic stress disorder, impacting capability of workforce.
- Public health hazards resulting from disruption of drinking water and wastewater systems.
- Need for CWS resources to support countywide debris removal operations.
- Displaced residents in need of shelter may require temporary sewage and drainage infrastructure solutions.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles impacting operations.

- Economic impacts, including reduced future revenues from changes in number of customers, housing patterns, population, or business activity; increased costs resulting from response activities; and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment, reducing the need for CWS services.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance could make it difficult to pay utility bills.
- Damage to aboveground and underground utilities and transportation systems causing operational problems.
- Disruption of essential infrastructure systems such as power systems, public utilities, and telecommunications causing operational problems.
- Blocked roads and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction, causing operational problems.
- Downed or damaged power lines that can lead to wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to facility damage.
- Loss of habitat and vegetation, impacting CWS nature-based solution investments.
- Change in water flows, including paths of rivers and streams.
- Concurrent hazards initiated by an earthquake, including flooding resulting from dam failure, wildland fire, and landslides.

3.2.3.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the CWS service area are vulnerable to earthquakes. Vulnerabilities specific to CWS are identified below.

- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property. Such damage is reduced with distance from an earthquake epicenter. Structures and facilities in the western half of the CWS service area are more vulnerable in the event of a CSZ earthquake than those in the eastern half of the CWS service area. Less dependent on distance to an epicenter, floodplain areas or other areas of high soil moisture could experience liquefaction.
- Buildings with very high or high collapse potential include buildings constructed prior to 1990 that have not been retrofitted to improve seismic resilience (e.g., Hillsboro Water Resource Recovery Facility).
- CWS employees, contractors, and visitors could be vulnerable in an earthquake should structures collapse. In the event that CWS cannot provide sanitation services from one or more of the wastewater treatment facilities, affected residents would need to provide personal sanitation.
- Economic losses to CWS would be substantial (hundreds of millions) if wastewater treatment facilities suffered significant damage. Damage to collection pipes from liquefaction or other ground movement could also be costly. Finally, damage to riparian and wetland enhancement projects could occur if those areas become living space for residents whose living quarters are rendered unsuitable.

- All CWS structures could be damaged by a sufficiently large or proximal earthquake. Recent retrofits, such as those currently ongoing at the Forest Grove Water Resource Recovery Facility, and improved seismic resilience of new construction, such as that occurring at the Durham Water Resource Recovery Facility, incrementally reduce the vulnerability of CWS facilities. Buildings such as the Administrative Building Complex, Field Operations and associated structures (Springer facility and Material Handling Yard), and the Research+Innovation+Partners+Labs (ripl) facility would also be vulnerable. Vulnerability of green infrastructure facilities—planted stormwater treatment or flow management facilities, such as stream corridor or wetland enhancement projects—is expected to be low. A substantial portion of the underground pipes in the wastewater collection system and stormwater drainage system is expected to be subject to liquefaction in moderate to large earthquakes, potentially leading to line breakage. In steep portions of the CWS service area, these pipes could also be affected by co-seismic landslides.
- Ecosystem disturbance is an inherent process, particularly in geologically active ecoregions such as those in Washington County. Ground movement in areas of steep topography or liquefaction could disrupt vegetation with attendant modifications to wildlife use patterns. The extent of damage to ecosystem functions and values would depend on the amount of area disrupted and whether the disruption reduces ecosystem connectivity. CWS-owned property or natural resource restoration investments could be damaged as county residents seek to set up temporary shelter in these areas.

3.2.4. Extreme Heat

Due to a recent rise in frequency, severity, and impacts of extreme heat events, the NHMP Steering Committee chose to include this hazard for the first time in the Washington County NHMP. Potential impacts of and vulnerabilities to extreme heat are identified below.

3.2.4.1. Potential Impacts

The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts of an extreme heat event may include:

- Injuries or deaths impacting workforce availability.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, heat stroke, and death impacting workforce.
- Disruption of biologically-mediated processes requiring modifications of operations at CWS' water resource recovery facilities.
- Impact on industries resulting in reduction in use of services and associated revenue loss to CWS.
- Economic losses from decreased worker efficiency and effectiveness and time lost on the job when workers take more frequent or longer breaks to avoid overheating.
- Property damage, such as roof expansions, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding.
- Disruption of essential infrastructure systems from overheated and damaged utilities.
- Damage to vegetation, such as scorch and sunscald of new foliage, branches or tops of trees dying, and significant stress and die-off of native trees, particularly Douglas-fir and Western red cedar. These impacts are intensified if drought is also occurring.
- Concurrent hazards include drought and wildland fire.

3.2.4.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the CWS service area are vulnerable to extreme heat.

Populations substantially vulnerable to extreme heat include:

- Staff and contractors who work or spend a sufficient amount of time outdoors, including those in construction, inspection, landscaping, and field data collection.
- Staff, contractors, and visitors who work in buildings without air conditioning or cooling equipment.

Additional vulnerabilities to extreme heat include:

- Costs associated with:
  - Setting up and providing cooling centers in CWS facilities for the workforce.
  - Additional energy and maintenance staff costs to sustain air conditioning.
  - Replacement of heat-damaged plants in green infrastructure maintained by CWS.

3.2.5. Flooding, Including Channel Migration and Erosion

Some degree of flooding is not uncommon in Washington County, and riverine flooding events typically occur from October through April. Potential impacts of and vulnerabilities to flooding are identified below.

3.2.5.1. Potential Impacts

The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts of a flooding event include:

- Injuries or deaths impacting available workforce.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Displaced residents in need of shelter and temporary sewer and drainage services.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment, reducing the need for CWS services and associated revenue loss.
- Damage and destruction of aboveground and underground infrastructure.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Loss of habitat and vegetation, impacting CWS nature-based solution investments.

3.2.5.2. Vulnerabilities

Population, economic, built environment, critical facility, infrastructure, and natural environment vulnerabilities to changes in CWS services resulting from a flooding event, or changes in these features that influence the ability of CWS to perform services, include:

- Staff and contractors unable to report for work or visitors unable to access CWS services due to flood-related access limitations (e.g., closure of Highway 219, limiting access to the CWS Administration Building Complex).
- Costs of repair for damages to CWS facilities, and revenue lost due to service interruptions.
- Inundation of water resource recovery facilities and associated facilities (e.g., Fernhill Natural Treatment System) or pump stations, and damage to outfall structures as a result of stream erosion.
- Stream channel (bed and/or bank) erosion resulting in damage, including potentially broken wastewater lines or damage to stormwater outfalls.
- Flooding and stream channel (bed and/or bank) erosion or channel migration resulting in damage to CWS investments in nature-based solutions.

3.2.6. Landslide

CWS operations could be directly impacted by landslides, though the likelihood of geographically widespread impacts is low because landslides themselves are geographically limited and major CWS facilities are not located in zones of high or very high landslide susceptibility. Potential impacts of and vulnerabilities to landslides are identified below.

3.2.6.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a landslide event are identified below. The type, magnitude, and extent of these can vary based on the scale of the event.

- Most large CWS facilities are not at substantial risk of landslides. However, several—including Durham and Rock Creek water resource recovery facilities and the Tualatin River Farm, as well as multiple pump stations—are located at the top of locally steep slopes. If landslides develop on these slopes, individual components of these larger facilities could be damaged if the headscarp migrates upward before the land is stabilized.
- In the event of a severe or intense and widespread rainfall event that produces a large number of landslides (e.g., such as occurred during the February 1996 storms), the potential for landslide impact locations in the CWS service area could be numerous. Blocked roads could hamper access to its facilities. Landslides could potentially damage the wastewater collection pipes or storm drainage pipes, outfalls, and adjacent water quality or quantity facilities. The geographic extent of individual landslides and related service impairment is expected to be limited; however, a few pump stations are at the top of slopes that could experience landslides.
- Areas at high or very high risk of landslides are ubiquitous in a notable percentage of under-developed land, particularly where slopes are steep (greater than 20% to 25%) and may present challenges for future planning and mitigation efforts. Awareness of nearby areas vulnerable to landslides is beneficial for reducing risk for every community in Washington County.
- Populations affected by landslide hazards related to CWS facilities and activities include residents with service “up-system” of damaged pipes that may be asked to moderate water use during an initial period of repair, or staff, contractors, or visitors unable to reach CWS facilities due to access limitations.

- Economic impacts are primarily the cost of repair of damaged facilities but could include the provision of alternative sanitary facilities (e.g., porta-potties) to affected residents immediately after damage and during the initial stages of repair.
- Landslides following wildfire in the drainages upstream of Hagg Lake and Barney Reservoir could mobilize sufficient sediment to reduce capacity of these reservoirs. This could have long-term implications for the ability to use CWS' allocated water to support water quality needs.
- Landslides are an inherent element of ecosystems developed on steeper slopes in the Pacific Northwest, although urban land use can alter the frequency, size, or geographic distribution of occurrence. Landslides may result in temporary loss of vegetation and associated habitat in the affected area. If landslide debris reaches watercourses, it would likely result in elevated dominantly suspended sediment loads and could temporarily block passage of aquatic organisms (e.g., fish). Landslides are not likely to be extensive enough to result in loss of species from urban Washington County, however, and may facilitate habitat improvement by adding complexity to instream and floodplain habitat through the introduction of large wood or rock and gravel.

3.2.7. Volcanic Ash

Volcanic activity is possible from mountains near Washington County. Based on late Holocene eruptive history, the most likely eruptions would originate from Mount St. Helens, Mount Hood, and Mount Rainier. It is anticipated that ashfall from a volcanic eruption has the potential to impact CWS, although the scale and types of impacts and vulnerabilities may differ depending on which volcano erupts, the level of eruption, and the wind direction during and after eruption. Potential impacts of and vulnerabilities to volcanic ash are identified below.

3.2.7.1. Potential Impacts

Though unlikely, the impacts of a significant ashfall can be substantial, including:

- Short-term health effects, including respiratory effects, impacting the workforce.
- The need to shelter the workforce to protect them from poor air quality.
- Delayed emergency response times due to decreased visibility and increased traffic hazards.
- Extended operational hours for staff and resources needed for response to the event.
- Economic impacts, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and cleanup activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment, reducing the need for CWS services.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance could make it difficult to pay utility bills.
- Damage to aboveground and underground infrastructure from interference with mechanical systems.
- Damage to stormwater infrastructure and creek water quality due to increased fine sediment load.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Damage to nature-based solution investments.

3.2.7.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the CWS service area are vulnerable to volcanic ash. This includes:

- Staff, contractors, and visitors with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults.
- Staff, contractors, and visitors without access to effective dust masks, eye protection, and drinking water and food uncontaminated by ash.
- Economic impacts to CWS could result from damages to mechanical, airflow, and electrical systems at CWS water resource recovery facilities, pump stations, and buildings. While not likely an issue, loading of volcanic ash on the roofs of CWS buildings, including pump stations, could cause structural damage.
- Ash could damage outlet structures of stormwater detention ponds, particularly those fitted with real-time controls.

3.2.8. Wildland Fire

CWS could be affected by fire at the wildland-urban interface, an area where urban and ex-urban development occurs in close proximity to wildland vegetation, due to the extent of its service area. However, it is more likely to be affected by smoke and poor air quality due to wildland fires outside its boundaries. Potential impacts of and vulnerabilities to wildland fire are identified below.

3.2.8.1. Significant Events

In September 2020, wildfires within Washington County and nearby Cascade and Coastal ranges produced hazardous air quality resulting in the closure of all CWS offices, minimum staffing of water resource recovery facilities, and the suspension of outdoor work (e.g., revegetation planting, construction inspection, stormwater facility maintenance).

3.2.8.2. Potential Impacts

The potential impacts of a wildfire event are identified below. The type, magnitude, and extent of impacts can vary based on the scale and location of the event. Nearly all of the CWS service area is well away from the wildland–urban interface. This reduces the probability of an urban wildfire. Therefore, regional smoke impacts dominate those that CWS would respond to.

- Injuries or deaths resulting in reduction of available workforce.
- Exposure to wildfire smoke, which can lead to eye, nose, and throat irritation and the worsening of chronic heart and lung diseases impacting the workforce
- Public health issues stemming from failing or damaged infrastructure, such as lack of sanitation, should fire encroach on and damage CWS infrastructure.
- Delayed emergency response times due to blocked transportation routes and debris, congested transportation routes due to evacuations, and damaged infrastructure and vehicles.
- Extended operational hours of CWS staff and resources needed for response to the event.
- Strain on or loss of water supply that impacts operations and use of services.
- Economic impacts including loss of local revenue due to decline in use of service.

- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment, reducing the need for CWS services.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance could make it difficult to pay utility bills.
- Damage and destruction to the built environment, including aboveground and underground infrastructure.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes impacting CWS operations
- Debris from trees and damaged property, causing blocked road and rail transportation routes and impacting operations.
- Downed or damaged power lines. This impact may be compounded since power line failures can lead to additional wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Loss of habitat and vegetation, impacting CWS nature-based solution investments.
- Concurrent hazards, including air and water quality issues. Landslide and erosion issues are common following a wildland fire.

3.2.8.3. Vulnerabilities

Given the dynamic nature of wildland fires, all populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the CWS service area are vulnerable to this hazard. This may include:

- Staff, contractors, and visitors with chronic lung problems and other preexisting health conditions, who are not otherwise able to shelter in a place that allows them to remain safe and continue to perform assigned duties.
- The primary economic impact to CWS from wildfires is related to disruption of work activities due to limitations placed on staff to limit exposure to excessive smoke and air particulates.
- Longer term accelerated erosion of the watersheds upstream of Hagg Lake and Barney Reservoir as a result of fire-related vegetation loss could further reduce the volume of water available for downstream releases to support attainment of instream water quality targets. These impacts would be compounded by drought or extreme heat conditions.
- Facilities (including shallow buried plastic piping) at the western edge of the CWS service area, including those associated with Hagg Lake, Barney Reservoir, and portions of the Tualatin River National Wildlife Refuge, are located within the wildland–urban interface and may be at direct risk of wildfire damage.
- Impacts to wildlife could arise as animals move into urban environments as a strategy during wildland fires; these could include increased mortality due to stress or vehicle collisions. Impacts from smoke on wildlife are not well understood but can also be significant. Impacts to plants are not likely to be detectable unless conditions persist for an entire season, in which case reduced growth and vigor due to reduced photosynthetic activity could occur.

- Ash and erosion from wildfires can impair water quality. Observations following recent wildland fires in Oregon found short-term elevated temperatures, turbidity, specific conductance, and dissolved organic matter.[8] These parameters may periodically be elevated due to vegetation loss.
- Vegetation associated with nature-based solutions infrastructure, particularly west of the CWS service area, are directly vulnerable to wildfire impacts, including direct combustion or damage from post-fire landslides or stream dynamics.

3.2.9. Windstorm, Including Tornado

CWS has multiple facilities that can be affected by windstorms. Potential impacts of and vulnerabilities to windstorms are identified below.

3.2.9.1. Potential Impacts

The type, magnitude, and extent of windstorm impacts can vary based on the scale of the event.

- Injuries or deaths impacting workforce.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles impacting operations.
- Extended operational hours of CWS staff and resources needed for response to the event.
- Economic impacts, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment, reducing the need for CWS services.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance could make it difficult to pay utility bills.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked road and rail transportation routes.
- Downed or damaged power lines can lead to wildfires.
- Power outages.
- Loss of habitat and vegetation, impacting CWS nature-based solution investments.

[8] U.S. Geological Survey. (2021, January 5). USGS Measures the Effect of Recent Wildfires on Water Quality in Oregon. https://www.usgs.gov/news/usgs-measures-effect-recent-wildfires-water-quality-oregon

3.2.9.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and historical properties and cultural resources in the CWS service area are vulnerable to windstorms, including tornadoes. Because windstorms are a natural part of the ecosystem disturbance regime in the Pacific Northwest, natural environments are not considered vulnerable to harm from windstorms. Vulnerabilities specific to CWS include:

- Older buildings and infrastructure not built to withstand high winds.
- Aboveground utility and power lines impacting operations.
- Staff, contractors, and visitors working outside (particularly in forested areas) or affected by toppled trees.
- CWS economic impacts from extensive windstorms are likely to be restricted to damage to CWS buildings and related facilities (e.g., communications facility on Nansen Summit, Lake Oswego), particularly from downed trees. Less likely, CWS would incur costs to replant trees that were uprooted in riparian forests located within enhancement project areas.

3.2.10. Winter Storm

CWS has facilities at various elevations throughout its service area and can be affected by winter storms. Potential impacts of and vulnerabilities to winter storms are identified below.

3.2.10.1. Potential Impacts

The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts of a winter storm event may include:

- Injuries or deaths, including from carbon monoxide poisoning, falls from slick or icy conditions, frostbite, and hypothermia impacting the workforce.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components impacting operations.
- Employees stranded due to ice, snow, and transportation impacts.
- Extended operational hours of staff and resources needed to respond to the event.
- Economic impacts, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment, reducing the need for CWS services.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance could make it difficult to pay utility bills.
- Damage and destruction to the aboveground infrastructure.
- Significant property damage and loss of water due to frozen or damaged pipes or the thawing of frozen pipes.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes, impacting operations.

- Debris from trees and damaged property causing blocked road and rail transportation routes impacting operations.
- Downed or damaged power lines can lead to wildfires, and tree debris can create fuel load for wildfire.
- Power outages disrupting operations.
- Loss of habitat and vegetation, impacting CWS nature-based solution investments.
- Concurrent hazards, including flooding.

3.2.10.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the CWS service area are vulnerable to winter storms. Vulnerabilities specific to CWS include:

- Buildings and infrastructure not built to withstand the weight and impacts of the storm-related amounts of snow and ice.
- Outdoor workers who are unable to return to shelter and who do not have enough heating, sufficiently insulated clothing, or dry conditions available to them in the moment.
- Economic damages are expected to be those associated with repairs to buildings or surface infrastructure, such as stormwater treatment facilities and additional staff resources needed to manage storm impacts. It is unlikely that the storm would prevent adequate staff from being able to operate the wastewater treatment facilities, though should that happen there may be losses associated with lack of service revenue.
- Winter storms are part of the disturbance regime in the Pacific Northwest. While damage to vegetation occurs, it is not likely to fundamentally alter ecosystems in the short run. More frequent periods of low temperatures could impair vigor of native broad-leafed evergreens, over time altering plant communities and changing the mix of wildlife.

3.3. Historical Events

Hazard events that have affected the entire planning area are detailed in Section 2 of the base plan. CWS has experienced impacts of drought, extreme heat, flood, landslide, windstorm, winter storm, and wildfire smoke events. Specific impacts to CWS from the 1980 eruption of Mount St. Helens, if any, were not recorded.

3.4. Overall Vulnerability

Based on the analysis completed by the Technical Committee, flooding, drought, crustal earthquake, extreme heat, and windstorm, including tornado, present the highest relative and recurring risks to CWS operations. These hazards can create widespread events, and all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the CWS service area can be vulnerable. Areas of greatest vulnerability to these hazards for CWS include:

- Staff and contractors unable to report for work or visitors unable to access CWS services due to flood-related access limitations (e.g., closure of Highway 219, limiting access to the CWS Administration Building Complex).
- Costs of repair for damages to CWS facilities, and revenue lost due to service interruptions.
- Inundation of water resource recovery facilities and associated facilities (e.g., Fernhill Natural Treatment System) or pump stations from flooding, and damage to outfall structures as a result of stream erosion.

- Stream channel (bed and/or bank) erosion resulting in damage to the collection system, including broken wastewater lines or damage to stormwater outfalls.
- Stream channel erosion that damages or eliminates riparian vegetation, beyond that normal for dynamic stream processes and impacts CWS investments in restoration.
- CWS may incur additional costs (e.g., for chemicals, energy, or staff) associated with operational changes needed to manage drought conditions, including reduced releases from Hagg Lake and/or Barney Reservoir. CWS also may need to increase revegetation efforts at publicly maintained stormwater treatment facilities or riparian plantings to maintain project functionality. Customers of the CWS water reuse program could incur losses if CWS is unable to supply expected water volumes at expected times in the year.
- Landscaping in and around CWS facilities (e.g., the green roof on the Field Operations building) may be damaged and require additional maintenance or replanting in the event of drought or extreme heat.
- Streams and vegetation in vegetated corridors regulated by CWS or within areas of CWS nature-based investments are vulnerable to dewatering from stream channel erosion and drought stress.
- Damage to all buildings, infrastructure, facilities, and property as a result of a moderate to severe earthquake. Such damage is reduced with distance from an earthquake epicenter. Structures and facilities in the western half of the CWS service area are more vulnerable in the event of a CSZ earthquake than those in the eastern half of the service area. Less dependent on distance to an epicenter, floodplain areas or other areas of high soil moisture could experience liquefaction.
- Buildings with very high or high collapse potential include buildings constructed prior to 1990 that have not been retrofitted to improve seismic resilience (e.g., Hillsboro Water Resource Recovery Facility).
- CWS employees, contractors, and visitors could be vulnerable in an earthquake should structures collapse. If CWS cannot provide sanitation services from one or more of the water resource recovery facilities, affected residents would need to provide personal sanitation.
- Economic losses to CWS would be substantial (hundreds of millions) should water resource recovery facilities suffer significant damage. Damage to sewer pipes from liquefaction or other ground movement could also be costly. Finally, damage to riparian and wetland enhancement projects could occur should those areas become living space for residents whose living quarters are rendered unsuitable.
- All CWS structures could be damaged by a sufficiently large or proximal earthquake. Recent retrofits, such as those ongoing at the Forest Grove Water Resource Recovery Facility, and improved seismic resilience of new construction, such as that occurring at the Durham Water Resource Recovery Facility, incrementally reduce the vulnerability of CWS facilities. Buildings such as the Administrative Building Complex, Field Operations, and associated structures (Springer facility and Material Handling Yard), and the Research+Innovation+Partners+Labs (ripl) facility would also be vulnerable. Vulnerability of green infrastructure facilities—planted stormwater treatment or flow management facilities, such as stream corridor or wetland enhancement projects—is expected to be low. A substantial portion of the underground pipes in the wastewater collection system and stormwater drainage system is expected to be subject to liquefaction in moderate to large earthquakes, potentially leading to line breakage. In steep portions of the CWS service area, these pipes could also be affected by co-seismic landslides.
- Ecosystem disturbance is an inherent process, particularly in geologically active ecoregions such as those in Washington County. Ground movement in areas of steep topography or liquefaction could disrupt vegetation with attendant modifications to wildlife use patterns. The extent of damage to ecosystem functions and values would depend on the amount of area disrupted and whether the disruption reduces ecosystem connectivity. This could impact the CWS investment in nature-based solutions.

- Populations substantially vulnerable to extreme heat include:
  - Staff and contractors who work or spend a significant amount of time outdoors, including those in construction, inspection, facility maintenance, vegetation management, and field data collection.
  - Staff, contractors, and visitors who work in buildings without air conditioning or cooling equipment.
- Additional vulnerabilities to extreme heat include costs associated with:
  - Setting up and providing cooling centers in CWS facilities for the workforce.
  - Additional energy and maintenance staff costs to sustain air conditioning.
  - Replacement of heat-damaged plants in green infrastructure maintained by CWS.
  - Accelerated aging of CWS buildings.
  - Damage to vegetation in green infrastructure.
- CWS economic impacts from extensive windstorms are likely to be restricted to damage to CWS buildings and related facilities (e.g., communications facility on Nansen Summit, Lake Oswego), particularly from downed trees. CWS operations could be indirectly affected by damage to aboveground utility and power lines. Staff, contractors, and visitors working outside (particularly in forested areas) may be affected by toppled trees. Less likely, CWS would incur costs to replant trees that were uprooted in riparian forests located within enhancement project areas.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment examines the ability of CWS to implement and manage a comprehensive mitigation strategy. Strengths, opportunities, and resources of the CWS service area are identified to develop an effective hazard mitigation action plan. The capabilities identified in this assessment were evaluated collectively to develop feasible recommendations, which support the implementation of effective mitigation activities.

A capability questionnaire was distributed to the CWS Technical Committee to initiate this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances within the CWS service area that can prevent and reduce the impacts of hazards.

CWS operates under a watershed-based NPDES and Municipal Separate Storm Sewer Systems (MS4) permit that regulates discharges to surface water from water resource recovery facilities and the network of stormwater drainage pipes and stormwater management facilities within urban Washington County. Regulatory compliance is predicated on the continuity of operations of these facilities within permit requirements.

Master plans for the wastewater collection system, operational documents for the water resource recovery facilities (e.g., Temperature Management Plan, Mercury Minimization Plan, Total Maximum Daily Load Implementation Plan), and a Stormwater Management Plan aid in documenting the actions necessary to guide facility management. CWS has Design and Construction Standards and Performance Standards (adopted as a Resolution and Order [R&O] by the CWS Board of Directors) that address a range of topics, including the design, construction, and maintenance of public wastewater and stormwater management systems, erosion control methods, and natural resources protection.[9]

Within the past several years, CWS has conducted the following as examples of hazard mitigation actions:

- Performed seismic retrofits at the Rock Creek Water Resource Recovery Facility (completed) and Forest Grove Water Resource Recovery Facility (in progress).
- Supported the Tualatin Watershed Enhancement Collaborative pilot effort in the Cedar Mill–North Johnson watershed to evaluate potential flood risk reduction capital and outreach projects with advanced hydrologic and hydraulic modeling. This was recently completed through the efforts of CWS, Washington County Department of Land Use and Transportation, the cities of Beaverton and Portland, Tualatin Hills Park & Recreation District, the Tualatin Soil and Water Conservation District, and several nonprofit partners.
- Developed the Watershed Navigator website with the Tualatin Soil and Water Conservation District to connect Washington County communities to place-based resources, learning opportunities, and natural resource information. Applied for a FEMA grant with the Tualatin Soil and Water Conservation District and Tualatin River Watershed Council to support hiring a Watershed Navigator staff position for the watershed council.
- Began development of a CWS Climate Action Roadmap. Evaluated changes in plant species to use for “climate ready” riparian habitat enhancements. Facilitated the development of a Wildfire Protection Plan and work with the Joint Water Commission (Hillsboro), Tualatin Soil and Water Conservation District, and Tualatin River Watershed Council to evaluate wildfire risk in watersheds upstream of Hagg Lake and Barney Reservoir and propose suitable mitigation actions.

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions.

The CWS Technical Committee will become a mitigation planning committee that includes members from many sections of the organization.

Field Operations personnel perform Local Maintenance Program activities on the public storm drainage and wastewater systems serving the unincorporated area and the cities of Banks, Durham, Gaston (wastewater only), King City, and North Plains. These activities include emergency response, cleaning and performing CCTV inspection of public storm and wastewater pipes, cleaning catch basins and water quality maintenance holes, sweeping streets, maintaining water quality facilities, repairing damaged or deteriorated infrastructure, constructing short line replacements, installing catch basins and inlets, and enhancing stream corridors. This program also includes handling debris collected from catch basins and street sweeping functions. The group also maintains ditches and performs limited culvert repairs on roads within the Urban Road Maintenance District under an annual contract with Washington County.

The Field Operations staff members also perform Regional Maintenance Program activities throughout the entire service area and large cities for regional wastewater and stormwater infrastructure. These

[9] Clean Water Services. (2022). Design & Construction Standards. https://cleanwaterservices.org/development/dnc/view-the-standards/

activities include managing and maintaining the systemwide flow monitoring and rain gauge network, chemical root control, rehabilitating maintenance holes to reduce inflow and infiltration, maintaining and replacing the large diameter (24-inch and larger) wastewater system, and maintaining and reconstructing regional water quality facilities serving multiple lots.[10]

CWS has a robust staff that includes the following personnel across many departments:

- Planners and engineers with knowledge of land development and land management practices.
- Engineers and professionals trained in construction practices related to CWS infrastructure.
- Planners and engineers with an understanding of natural hazards.
- Scientists and engineers with an understanding of natural area management.
- Staff with education and expertise to assess vulnerability to hazards.
- Geographic information system (GIS) coordinators.

Additionally, CWS has many technical capabilities that have been used to assess or mitigate risk and could be used in future efforts. Warning systems include Everbridge and OR-Alert in partnership with Washington County and the Barney Reservoir earthquake monitoring system. Grant writing is completed by staff in individual departments as needed. A strong GIS program is available to create mapping products for specific projects and needs, and hazard data and information can be pulled from a variety of sources, including historical records and the Oregon Department of Geology and Mineral Industries (DOGAMI).

4.3. Education and Outreach Assessment

Education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information were assessed to determine CWS capabilities. CWS has a comprehensive social footprint and uses it to educate the public. This includes the organization's Communications & Community Engagement section, which enables CWS to reach its strategic outcomes by amplifying its values and nurturing positive behaviors including promoting and advocating for mitigation efforts.[11]

4.4. Financial Assessment

The Finance & Accounting section of CWS manages budget planning, development, and administration, capital improvement program development and project accounting, and bond issuance and debt management. Finance & Accounting works closely with the Strategy Development team on cost of services analysis, rate and fee setting, and financial forecasting.[12]

4.5. Capability Expansion and Improvement

Actions that can expand and improve existing authorities, plans, policies, and resources for mitigation include continuing to update organizational plans as necessary to ensure they are current and reflect the needs of CWS, its partners, and customers; further development of warning systems and messaging; increasing dedicated grant writing staff; creating and implementing additional public education and

[10] Clean Water Services. (2022). Utility Operations & Services. https://cleanwaterservices.org/about/leadership-departments/uops/
[11] Clean Water Services. (2022). Business Services. https://cleanwaterservices.org/about/leadership-departments/business-services/
[12] Clean Water Services. (2022). Business Services. https://cleanwaterservices.org/about/leadership-departments/business-services/

outreach offerings and increasing the volume of translated materials; and ensuring grant opportunities are capitalized upon to meet CWS goals.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iii), §201.6(c)(3)(iv), and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) directs local mitigation plans to describe hazard mitigation actions and establish a strategy to implement those actions. Therefore, all other requirements for a local mitigation plan lead to and support the mitigation strategy.

5.1. Mitigation Goals

The Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 City of Beaverton NHMP, 2011 Cities of Cornelius and Forest Grove NHMPs, and 2020 State of Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals detailed in Section 3.4 of the base plan. These goals are the basis of this plan and summarize what the Steering Committee will accomplish by implementing this plan.

5.2. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on mitigation plan requirement 44 CFR §201.6(c)(4)(ii), the vulnerabilities and capabilities assessment for CWS were carefully reviewed and considered when developing the mitigation actions for this plan. The CWS Technical Committee will establish a process in which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into the existing local planning strategies.

Once the plan is adopted, the committee will coordinate implementation with the responsible parties in the CWS service area and with external stakeholders as needed. The primary means for integrating mitigation strategies will be through the revision, update, and implementation of plans and regulations, such as comprehensive plans, capital improvement plans, and land development regulations, as feasible.

The members of the CWS Technical Committee will remain charged with ensuring the goals and strategies of new and updated local planning documents for their jurisdictions and special districts are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.2.1. Public Engagement, Education, and Outreach

CWS will work with community partners, including building and strengthening community partnerships that engage the public. Staff will direct particular attention with respect to natural hazard mitigation targeted at supporting the value of nature-based solution investments to help in the mitigation of natural hazard events.

5.2.2. Day-to-Day CWS Functions

CWS will continue to perform Local and Regional Maintenance Program activities and update them as required to fit the needs of CWS, its partner cities, and its customers.

5.2.3. Stormwater Management Plans and Procedures

CWS is a Phase 1 Municipal Separate Storm Sewer System (MS4) permittee, with cities and Washington County as co-implementers. These provisions are included as part of the CWS watershed-wide NPDES permit. As such, CWS provides the local stormwater management program that includes sweeping public streets, responding to flooding from the stormwater drainage system and water pollution, and water quality investigation and spill response in unincorporated Washington County and the cities of Banks, North Plains, Durham, and King City. In addition, CWS addresses stormwater management in its Stormwater Management Plan, Design and Construction Standards, and Performance Standards.[13]

5.2.4. Enforcement of Existing Policies

CWS will continue to operate the water resource recovery facilities as required by the NPDES permit. In addition, CWS will enforce the Design and Construction Standards, Performance Standards, and Stormwater Management Plan used by the organization and update them as needed to fit requirements of CWS, its partner cities, and its customers.

5.2.5. Funding Opportunities

CWS will continue to review annual, post-disaster, and stand-alone grant openings for potential mitigation project funding opportunities.

[13] Clean Water Services. (2022). Design & Construction Standards. https://cleanwaterservices.org/development/dnc/view-the-standards/

6. Action Items

Action items for the 2023 NHMP were determined by the Technical Committee of CWS based on the review of its risk assessment and its existing capabilities. This comprehensive range of actions includes modifications to local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.1 and 6.2 below. Additional information about how these actions were developed, evaluated, and prioritized is in Section 3 of the base plan.

6.1. Clean Water Services Action Items: 2023 Washington County NHMP

Table 5: Clean Water Services Action Items

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
WN1	With regional partners, CWS would facilitate the establishment of a Watershed Navigator to assist (primarily urban) basin residents with strategies for living in a floodplain or other area with urban drainage and related erosion issues.	• Drought • Extreme heat • Flooding	High
WF1	CWS would support the Tualatin Soil and Water Conservation District forestry plan for forest thinning, debris flow mitigation, and Tualatin River Watershed Council efforts on stream corridor and floodplain enhancement. Provide CWS staff expertise at a minimum, along with potential support for grant applications.	• Drought • Flooding • Landslide • Wildland fire	High
WF2	CWS would continue to support current efforts for joint wildfire planning to protect sites where CWS has invested in natural assets for temperature management	• Drought • Flooding • Wildland fire	High
WF4	CWS facilities located near the Wildland–Urban Interface (particularly the Banks pump station) don't have alternative power sources that can be easily reconfigured to provide electricity in the event of a planned shutoff. This action item would develop a strategy for the management of PGE shutoffs for wildfire at Banks pump station.	• Wildland fire	High
WF6	Develop management strategy for planning, constructing, and maintaining capital projects and other enhancement projects within stream corridors and wetlands in the face of elevated wildfire risk.	• Drought • Flooding • Wildland fire	Medium
WF7	Support Washington County, Tualatin Valley Water District, Tualatin Valley Irrigation District, Tualatin River Watershed Council, and the Tualatin Soil and Water Conservation District to develop a risk assessment for and best practices to mitigate the risk of or from post-wildfire debris flows.	• Drought • Flooding • Landslide • Wildland fire	Medium

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
C4	Develop a strategy to improve the climate resiliency opportunities of real-time controls for detention pond outlets. Move beyond the current approach for managing winter flows to one also managing summer or nonpeak flows to increase resilience of riparian vegetation.	• Dam failure • Flooding	Medium
D1	Improve CWS resilience to harm from dam failure during period of implementation of the Bureau of Reclamation's Safety of Dams project at Scoggins Dam through staff training and development of temporary floodproofing strategies.	• Dam failure • Flooding	Medium
D3	Federal funding for the project design and construction is anticipated to come with programmatic funding available under the Bureau of Reclamation Safety of Dams Program. This action item relates to efforts to ensure the project receives necessary federal funding under the Safety of Dams Program, including federal dollars to support the Endangered Species Act and other fish and wildlife benefits.	• Dam failure • Earthquake	High
F2	Identify and further prioritize sites of wastewater mains and public laterals at high-risk due to potential stream erosion into Capital Improvement Program and begin work to confirm and secure access for risk-reduction activities.	• Flooding • Landslide	Medium
F4	Pluvial flooding, with or without adjacent riverine flooding, presents the most frequent flooding risk to most CWS ratepayers. This action item would increase outreach (e.g., organizing a neighborhood "clean-up" day) to particularly flood-prone neighborhoods, leveraging the existing "rake the grate" outreach and leaf collection events that occur across the CWS service area annually.	• Flooding	Medium
G1	Support Washington County and other partner jurisdictions in managing cross-entity education and response activities undertaken by the Emergency Management Cooperative of Washington County to the extent that they are relevant to CWS facilities or staff safety or actions.	• Dam failure • Drought • Earthquake • Extreme heat • Flooding • Landslide • Volcanic ash • Wildland fire • Windstorm, inc. tornado • Winter storm	Medium
V1	Evaluate critical wet, dry ash loading values for CWS-owned facilities; develop response plans based on ashfall depth. Evaluate potential for interference in mechanical systems from suspended ash particles. Develop appropriate procedures for staff to reduce impacts to health.	• Volcanic Ash	Medium

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
H3	Evaluate participation in PGE dispatchable generation program - pump station power (i.e., at Dawson Creek and North Plains pump stations). Look at additional incorporation of renewables, and need for participation in this program at other sites (e.g., Durham, Rock Creek facilities).	• Extreme heat	High
H4	Develop strategy to assess and repair heat damage to green infrastructure (including vegetated stormwater facilities) from extreme heat events.	• Extreme heat • Wildland fire	Medium
E1	Refine the strategy for earthquake preparedness training for CWS staff into a program that is repeated frequently.	• Earthquake	Medium
E2	Participate in regional strategies for cooperative sharing of trained and capable staff across Portland metro region based on staff mobility and access (e.g., considering that staff ability to travel from home to work may be limited) in the event of a natural disaster.	• Earthquake	Medium
E3	More widely distribute emergency toilet information to be used in the event of earthquake or other major interruption of wastewater service. Develop strategy with other partners to distribute or make available at reasonable cost the supplies (e.g., two 5-gallon buckets, seats) needed to provide for emergency sanitation.	• Earthquake	Low
E5	Incorporate into wastewater conveyance system design the "safe fail" strategy to manage the large geographic area of elevated liquification risk with a dominantly gravity sewer system. A strategy of “safe fail” has been incorporated into the recent West Basin Master Plan master plan design concept whereby weaker portions of pipe that would be the locus of failure are placed in areas where a pipe fracture can be easily managed, contained, and repaired.	• Earthquake	Medium
E8	Incorporate recommended seismic upgrades during budgeted facility improvements at the CWS Field Operations Merlo Road facility. This will help ensure Utility Operations & Services can meet CWS’ desired level of service during emergencies and disaster situations and improve facility resiliency.	• Earthquake	High
E12	Develop strategy for easement acquisitions for CWS collection system projects implementing “safe-fail” design approach to managing liquefaction hazard. Increase operational resilience of collection system, recognizing that it is impossible to avoid all areas of moderate or high liquefaction or ground motion risk in upgrading or building the collection system.	• Earthquake	Medium

6.2. Mitigation Action Information Worksheets

Table 6: Watershed Navigator Program

Mitigation Action Information			
Title of action	WN-1: Facilitate Establishment of a Watershed Navigator Program		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	With regional partners Tualatin River Watershed Council and Tualatin Soil and Water Conservation District, CWS would facilitate the establishment of a Watershed Navigator program to assist (primarily urban) basin residents with strategies for living in a floodplain or other area with urban drainage and related erosion issues. This program would consider the expected conditions of climate change: increased summer drought and more intense winter rains. Strategies could include vegetation selection and management related to flooding and wildfires, beaver management, approaches for maintaining stable stream banks, response in the event of a dam break, and community engagement and education. The program would include staff resources (e.g., a position) to extend the reach of the existing web resource. Staff could also work with HOAs to address hazard response in natural areas, including wildfire risk reduction, storm debris management, and vegetation response to drought or extreme heat. In addition, prior work has found that members of under-represented communities are relatively unlikely to call for information or assistance on these issues; outreach coordinated by the Watershed Navigator would help reduce the disparities in service.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☒	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☒	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Questions from basin residents are frequently addressed to multiple organizations and jurisdictions with specific and often limited authorities or missions and complex boundaries and regulatory environments. As a result, residents often don't get the "best" answer. In addition, organizational/agency staff are required to spend a great deal of time coordinating a response.		
Area of action impact	Throughout the CWS service area at a minimum, with potential for outreach to the remainder of Washington County.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives	CWS Climate Action Roadmap; Washington County Climate Change Adaptation Plan; Oregon Natural Hazard Mitigation Plan		

Alignment with existing plans and policies	NPDES permit (public education and outreach requirements) Stormwater management, floodplain management, and transportation components of comprehensive plans of partner jurisdictions.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Stewardship division in Natural Systems Enhancement & Stewardship department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Communications & Community Engagement	Tualatin River Watershed Council, Tualatin Soil and Water Conservation District, Washington County and cities with floodplain management and stormwater management responsibilities

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS, Tualatin Soil and Water Conservation District operating budgets	FEMA (grant application submitted to Oregon Office of Emergency Management)
Estimated Cost	$150,000/year for staff, benefits (CWS share)

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
One central source for residents in the CWS service area to connect them with resources and provide them with information.	• Awareness by residents and commercial interests. • Support for developing capital projects (public and private) that maintain systemwide resilience in drainage management.	Unknown

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	July 2023	After July 2026

Implementation Benchmarks: How Will Success Be Measured?

- Securing funding for initial grant period.
- Developing stable long-term funding source.
- Hiring and training staff.
- Identification of outreach strategies to underserved communities and neighborhoods
- Number of education and outreach events
- Number of field visits, follow-up contacts in proportion to initial inquiries

Potential Challenges to Implementation
• Securing ongoing funding for maintenance of communications networks, response to issues arising from community.
Resources and References, if Applicable
• Watershed Navigator Website, https://watershednavigator.org/

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action	$0	Continued challenging coordination between organizations operating in the County around communicating with residents and businesses.
Alternative #2	Standing coordinating council with community partners	At least $20,000/year in staff time	Hard to prioritize given current staffing levels in the absence of a new disaster. Some ability to respond will remain with partners even as CWS focuses on stormwater management.
Alternative #3	Increase content detail on Watershed Navigator website only	Ongoing – $5,000–$10,000	Doesn't provide site-specific information, awareness, or options. Also, not able to respond in real-time to specific disasters.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 7: Support Tualatin Soil and Water Conservation District Forestry Plan and Tualatin River Watershed Council Stream Corridor Conservation

Mitigation Action Information	
Title of action	WF1: Support Tualatin Soil and Water Conservation District Forestry Plan and Tualatin River Watershed Council Stream Corridor Conservation
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	CWS would support the Tualatin Soil and Water Conservation District forestry plan for forest thinning, debris flow mitigation, and Tualatin River Watershed Council efforts on stream corridor and floodplain enhancement. Provide CWS staff expertise at a minimum, along with potential support for grant applications.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☐ Drought ☒ Landslide ☒ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Risk of wildfire is expected to increase with projected temperature trends, while overall vegetation vigor may decline. Precipitation events are expected to be more extreme, increasing flooding risks. This action item affirms the need to coordinate and support the efforts of these partners with respect to watershed management activities that will make uplands and stream corridors more resilient to expected changes in temperature and moisture regime.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☒ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	Specifically, integration with Tualatin Soil and Water Conservation District outreach to small woodlot owners (particularly tributary to Hagg Lake and Barney Reservoir) and with urban conservation program. Actions undertaken to support Action Item WF-2 Strategic Climate Action Roadmap and Natural Systems Enhancement & Stewardship department Roadmap
Alignment with existing plans and policies	Asset management for water supply within these reservoirs and for stream corridors, including those enrolled in the CWS thermal mitigation (aka “shade”) program.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Stewardship division in Natural Systems Enhancement & Stewardship department

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Operating budget, OWEB	USDA, FEMA pre-disaster mitigation
Estimated Cost	$10,000/year
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Over long term, reduced wildfire risk in portions of the watershed is key to meeting water quality requirements under NPDES permit and TMDLs	Unknown
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☐ Long-term ☐ Ongoing ☒	

Table 8: WF2: Joint Wildfire Planning with Joint Water Commission and Tualatin Soil and Water Conservation District

Mitigation Action Information			
Title of action	WF2: Joint Wildfire Planning with Joint Water Commission, Tualatin Soil and Water Conservation District, and Tualatin Valley Irrigation District to protect CWS temperature management assets		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	CWS would continue to support current efforts for joint wildfire planning to protect sites where CWS has invested in natural assets for temperature management. Facilitate wildfire planning to protect other water infrastructure in partnership with others (e.g., Joint Water Commission and Tualatin Soil and Water Conservation District). Provide staff support for joint planning and implementation, including procuring grant funding.		
Hazard(s) addressed	Dam failure ☐	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☒	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	Risk of wildfire is expected to increase with projected temperature trends, while overall vegetation vigor may decline. Precipitation events are expected to be more extreme, increasing flooding risks and placing riparian vegetation—which provides needed shade—at risk. This action item affirms the need to coordinate and support efforts of these partners with respect to watershed management activities that will enhance resiliency in light of expected changes in temperature and moisture regime.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	State of Oregon NHMP Actions undertaken to support Action Item WF-1 Watershed Navigator Upcoming update to County's Wildfire Protection Plan CWS Climate Action Roadmap		
Alignment with existing plans and policies	NPDES permit Tualatin Basin Quantitative Wildfire Risk Assessment and Recommendations (2021)		

Mitigation Action Implementation Plan		
Priority	Low ☐ Medium ☐ High ☒	
Lead position, office, department, or division responsible for implementation	Stewardship division in Natural Systems Enhancement & Stewardship department	
Potential Funding Sources		
Non-Federal Funding Sources		**Federal Funding Sources**
CWS Operating budget OWEB grant program for implementation actions		USDA, FEMA pre-disaster mitigation
Estimated Cost	$5,000–10,000/year	
Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Over long term, reduced wildfire risk in portions of the watershed is key to meeting water quality requirements under NPDES permit and TMDLs.		Unknown
Project Timeline		
Expected Timeline for Completion		
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☒		

Table 9: Alternatives to Electrical Grid for Pump Stations

Mitigation Action Information			
Title of action	WF4: Alternatives to Electrical Grid for Pump Stations		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	In 2022, PGE de-powered a portion of the Washington County grid for the first time as a wildfire prevention measure, following the experience of the California and Oregon Labor Day 2020 fires. CWS facilities located near the Wildland–Urban Interface (particularly the Banks pump station) don't have alternative power sources that can be easily reconfigured to provide electricity. This action item would develop a strategy for management of PGE shutoffs for wildfire at Banks pump station. CWS would coordinate planning and alerts with PGE and would integrate alert information into the provision of both fuel and non-fuel (e.g., solar with battery) alternative electricity sources. CWS and PGE could also evaluate the applicability of this strategy to other pump stations and with respect to other hazards (e.g., windstorm or winter storm). The action item would include developing an agreement document and documenting any changes in CWS operational guidance.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	Loss of pump stations from unplanned power interruptions could result in wastewater overflows. This action item would develop a coordinated alerting process from PGE (potentially ahead of the general public, particularly with respect to the actual power shutoff) as well as provide a process for coordinated action by CWS staff (e.g., to ascertain that backup system is functioning as needed).		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☒	
Integration into other initiatives	Any Wildfire Prevention Plan updates		
Alignment with existing plans and policies	NPDES permit (facility performance, prevention/reporting of wastewater overflows, pump station operational guidance)		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Water Resource Recovery Operations & Services department		

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Operating budget	N/A
Estimated Cost	$5,000–10,000
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Improve operational resilience of CWS pump station facilities during wildfire emergencies	Unknown; at a minimum, avoided cost of one wastewater overflow complex cleanup (one two-person crew for 8 hours, plus vehicles, and subsequent reporting; approx. $3,000)
Project Timeline	
Expected Timeline for Completion	
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	

Table 10: Develop Wildfire-Risk Aware Strategy for Capital Projects Within Stream Corridors and Wetlands

Mitigation Action Information	
Title of action	WF6: Develop Wildfire-Risk Aware Strategy for Capital Projects Within Stream Corridors and Wetlands
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Develop management strategy for planning, constructing, and maintaining capital projects and other enhancement projects within stream corridors and wetlands in the face of elevated wildfire risk. Evaluate design approaches that address site access, approach to maintaining soil moisture, plant selection and planting design strategies, and implementation and maintenance best practices. Goal is to reduce wildfire risk to any adjacent infrastructure while providing the intended ancillary benefits (e.g., increased flood storage, water quality improvement, habitat values) of revegetation scheme. Action item would include elements of public education and outreach.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☐ Drought ☒ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Vegetation is an important component of green infrastructure (water quality facilities, stream corridor enhancement of thermal load mitigation riparian planting sites) and site stabilization for traditional gray infrastructure projects (e.g., conveyance pipes). Healthy riparian zones are more resistant to wildfires than uplands. Adding a “hazard reduction” lens to project implementation would potentially reduce harm and would explicitly address potential conflicts between this and other project goals.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	Any Wildfire Prevention Plan updates Climate-ready planting (CWS internal initiative) and CWS Climate Action Roadmap
Alignment with existing plans and policies	Integrated Project Delivery policies and procedures NPDES permit and project-specific natural resource and land use permits
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Field Operations division in Utility Operations & Services department Stewardship division in Natural Systems Enhancement & Stewardship department

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Operating budget Partner contributions (e.g., Metro, Tualatin Soil and Water Conservation District)	N/A
Estimated Cost	$20,000–40,000
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Projects would be more resilient to future climate conditions.	Unknown
Project Timeline	
Expected Timeline for Completion	
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	

Table 11: Support Development of Strategy to Respond to, and Mitigate Risk From, Post-Wildfire Debris Flows

Mitigation Action Information	
Title of action	WF7: Support development of a strategy to respond to, and mitigate risk from, post-wildfire debris flows
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Support Washington County, Tualatin Valley Water District, Tualatin Valley Irrigation District, Tualatin River Watershed Council, and Tualatin Soil and Water Conservation District to develop a risk assessment for and best practices to mitigate risk of or from post-wildfire debris flows. Contribute staff expertise, grant management, and/or convening services. Support development of a management strategy for planning, constructing, and maintaining capital projects undertaken in response to debris flow potential. Evaluate design approaches that address site access, approach to maintaining soil moisture, plant selection and planting design strategies, implementation and maintenance best practices. The goals are to retain sediment within the stream corridor, promote revegetation of runout and source areas by others, protect adjacent infrastructure, and provide the intended ancillary benefits (e.g., increased flood storage, water quality improvement, habitat values) of revegetation scheme. Action item should include an element of public education and outreach.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, inc. tornado ☐ Drought ☒ Landslide ☒ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Debris flows resulting from landslides associated with post-wildfire processes are an anticipated risk. Excess sediment from these debris flows has the potential to reduce reservoir capacity in Hagg Lake or Barney Reservoir, potentially reducing available water for water quality flows needed for CWS to support permit and TMDL compliance. Greater variability in future water supply suggests maintaining existing water storage capacity is regionally important. Elsewhere in the Tualatin Basin, debris flows following wildfire have the potential to degrade water quality and destabilize streams, thus endangering CWS' plantings for instream temperature management.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	Any Wildfire Prevention Plan updates Climate-ready planting (CWS internal initiative) Washington County Climate Adaptation Plan CWS Climate Action Roadmap

Alignment with existing plans and policies	CWS Integrated Project Delivery policies and procedures NPDES permit, TMDL Implementation Plan, and project-specific natural resource and land use permits
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Field Operations division in Utility Operations & Services department Stewardship division in Natural Systems Enhancement and Stewardship department
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Operating budget CWS Capital Budget (if tied to a specific project) Partner contributions (e.g., Metro, Tualatin Soil and Water Conservation District)	N/A
Estimated cost	$30,000-50,000
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Projects would be more resilient specifically to wildfires, which are expected to be more frequent in the Coast Range until forest stand replacement has occurred. This action item would promote long-term climate resiliency as a result.	Unknown
Project Timeline	
Expected Timeline for Completion	
Short term ☐ Mid term ☒ Long term ☐ Ongoing ☐	

Table 12: Develop Approach to Using Real-Time Controls on Detention Ponds as a Climate Adaptation Tool

Mitigation Action Information	
Title of action	C4: Develop approach to using real-time controls on detention ponds as a climate adaptation tool
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Develop strategy to improve the climate resiliency opportunities of real-time controls for detention pond outlets. Move beyond current approach for managing winter flows to one managing summer or non-peak flows to increase resilience of riparian vegetation.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, inc. tornado ☐ Drought ☒ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Real-time controls represent a potentially significant tool for managing urban runoff volumes that can lead to channel erosion and flood inundation on a somewhat smaller footprint than detention that would provide the same flow-duration matching performance. The use of real-time controls is expected to be more significant in the future as storm intensity increases and urban environments become more impervious. Real-time controls have not yet been evaluated as a mechanism for maintaining streamflow during the summer dry season; such flows can be locally crucial to maintaining riparian vegetation that in turn supports stream channel stability and provides shade to improve instream temperature conditions.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☒ Goal 7 ☐ Goal 2 ☒ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	CWS Climate Action Roadmap, Resilient Stream Corridors
Alignment with existing plans and policies	NPDES permit, local comprehensive plans

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Utility Operations & Services department Engineering Technical Services		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
CWS Operating, Capital budgets			
Estimated cost	$30,000 - $50,000		
Estimated Benefit			
Primary Benefit(s)		**Financial Benefit(s)**	
Building on analysis of business case for real-time controls, this would provide pathway for taking this tool to scale in support of new development or redevelopment.		Unknown, but could free developable land	
Project Timeline			
Expected Timeline for Completion			
Short term ☐ Mid term ☒ Long term ☐ Ongoing ☐			

Table 73: Implement Measures to Improve Resilience of CWS Staff and Infrastructure in the Event of Dam Failure

Mitigation Action Information	
Title of action	D1: Implement measures to improve resilience of CWS staff and infrastructure in the event of dam failure
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Improve CWS resilience to harm from dam failure during period of implementation of the Bureau of Reclamation Safety of Dams project at Scoggins Dam through staff training and development of temporary floodproofing strategies. Deliver to CWS staff information on dam failure drills and exercises as identified in the recent update to Bureau of Reclamation's Emergency Action Plan. Train staff on procedures that would be used to notify them of impending dam failure, and when to act without receiving such notification. Provide them with information on escape routes and strategies, along with procedures for check-in. Coordinate activities with the Emergency Management Cooperative of Washington County and Bureau of Reclamation. Along with staff training, develop interim strategies for floodproofing (based on predicted dam break flood elevation) at Forest Grove Water Resource Recovery Facility and Gaston force main and pump station until the Safety of Dams project is complete. Include actions needed to prepare for initial recovery following flooding.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	The upper basin facilities where staff are most vulnerable are located at or below the predicted inundation depth in the event of dam failure at Scoggins Dam. Risk of dam failure is expected to be much reduced after the Bureau of Reclamation's Safety of Dams upgrades to Scoggins Dam, which are in initial stages of implementation, are complete. For this reason, some floodproofing may be more temporary or deployable in the event of observed failure or failure precursors. CWS staff could be working within the predicted inundation zone for failure of Scoggins Dam, or need to respond to damage to CWS facilities within this zone. Including this element, while unlikely, would increase employee safety until the Scoggins Dam Safety of Dams project is completed.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	Onboarding education for new employees regarding health and safety policies Emergency Management Cooperative of Washington County emergency response planning

Alignment with existing plans and policies	Updated Emergency Action Plan, CWS health and safety training Bureau of Reclamation Safety of Dams / Scoggins Dam project
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Risk Management in Business Services department
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Operating budget CWS Operating, Capital budgets State Clean Water Revolving Loan fund	FEMA BRIC grant for floodproofing implementation
Estimated cost	$30,000-$40,000 if training is included in broader training/ notification of facility-specific and CWS Emergency Action Plan updates. Costs for floodproofing to be determined.
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Increase workforce safety, facility resilience, and effectiveness of response to flooding in the event of dam failure	Unknown
Project Timeline	
Expected Timeline for Completion	
Short term ☒ Mid term ☐ Long term ☐ Ongoing ☐	

Table 84: Finalize Funding Strategy to Advance Bureau of Reclamation Scoggins Safety of Dams Project

Mitigation Action Information	
Title of action	D3: Finalize funding strategy to provide CWS' share of local match for Bureau of Reclamation's Scoggins Safety of Dams project
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	The Bureau of Reclamation's Scoggins Safety of Dams project is currently in design. Federal funding for the project design and construction is anticipated to come from programmatic funding available under the Bureau of Reclamation Safety of Dams Program. That programmatic funding was increased as a result of the Bipartisan Infrastructure Law. Local repayment partners, including Clean Water Services, will be responsible for 15% of the total project cost. Once the project design is complete, the total amount of the 15% local obligation and CWS' share of the local obligation will be determined. CWS' obligation will be finalized and payable through a long-term repayment contract once the project is substantially complete. This action item relates to efforts to ensure the project receives necessary federal funding under the Safety of Dams Program, including federal dollars to support the Endangered Species Act and other fish and wildlife benefits.
Hazard(s) addressed	Dam failure ☒ Flood ☐ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Clean Water Services depends on releases from Hagg Lake and Barney Reservoir to meet instream permit conditions related to discharges from CWS water resource recovery facilities. Reducing the risk of dam failure provides additional resilience to the package of actions undertaken by CWS to maintain the option for releases from Hagg Lake to facilitate water quality improvements in the main stem of the Tualatin River.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☐ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	Cooperation with local repayment partners (Joint Water Commission, Tualatin Valley Irrigation District)
Alignment with existing plans and policies	NPDES permit, water reuse program

Mitigation Action Implementation Plan		
Priority	Low ☐ Medium ☐ High ☒	
Lead position, office, department, or division responsible for implementation	Finance & Accounting in Business Services department	
Potential Funding Sources		
Non-Federal Funding Sources	**Federal Funding Sources**	
CWS Capital budget	Primarily a federal project funded by Bureau of Reclamation	
Estimated cost	To be determined	
Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Reduce risk of loss of source for water quality flows.		Unknown
Project Timeline		
Expected Timeline for Completion		
Short term ☐ Mid term ☒ Long term ☐ Ongoing ☐		

Table 9: Retrofit High-Risk Public Wastewater Line Locations

Mitigation Action Information	
Title of action	F2: Retrofit high-risk public wastewater line locations
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Identify and further prioritize sites of wastewater mains and public laterals as high-risk due to potential stream erosion, incorporate their stabilization into the Capital Improvement Program, and begin work to confirm or secure access. Document risk conditions.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☒ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	CWS has repaired a number of sewer lines within stream corridors in recent years, usually as the line becomes exposed. This action would accelerate retrofits to occur for at-risk locations ahead of exposure so that line exposure, and related failure risk, would not occur.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	Subbasin planning and stream corridor enhancement/ resilient stream corridors
Alignment with existing plans and policies	Capacity, Management, Operations and Maintenance (CMOM) asset management for collection system. CWS Integrated Plan.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Regional Utility Services department Systems Planning division for CIP development Utility Operations & Services department for wastewater line work Project Delivery division in Natural Systems Enhancement & Stewardship department for stream corridor enhancement.

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Capital budget to develop projects State Clean Water Revolving Fund available for retrofit projects, capitalizing on additional green infrastructure add-on funding where suitable. This is a loan rather than grant program. Green infrastructure projects typically have favorable loan rates and repayment terms.	
Estimated cost	$150,000 to develop projects sufficient for inclusion in CIP. Costs to implement capital projects to be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Primary benefit would be protection of the existing wastewater collection system infrastructure, providing more reliable service to ratepayers. Secondarily could provide opportunities to improve stream corridor resilience, address capacity issues (if any).	Unknown

Project Timeline
Expected Timeline for Completion
Short term ☐ Mid term ☐ Long term ☒ Ongoing ☐

Table 10: Support Ratepayers to Reduce Flooding From Clogged Stormwater Drainage Within the Public Stormwater Drainage System

Mitigation Action Information	
Title of action	F4: Support ratepayers to reduce flooding from clogged stormwater drainage within the public stormwater drainage system
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Help ratepayers fix storm drainage issues associated with the public stormwater drainage system and improve maintenance in adjacent public storm infrastructure.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Pluvial flooding, with or without adjacent riverine flooding, presents the most frequent flooding risk to most CWS ratepayers. This is particularly an issue in low-lying parts of the urban Tualatin Basin that were developed in the 1970s or earlier. This flooding pattern arises most commonly in the fall when higher-intensity storms occur at the same time that leaves are falling. This leads to plugging of inlet grates or other parts of the public drainage infrastructure. This action item would increase outreach (e.g., organizing a neighborhood clean-up day) to particularly flood-prone neighborhoods, leveraging the existing “rake the grate” outreach and leaf collection events that occur annually throughout the CWS service area. With predicted increases in high-intensity rainfall events occurring earlier in the season, the need for this activity is expected to increase.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☐ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	Integrate with Watershed Navigator program, leaf collection events, “rake the grate” social media posts CWS Climate Action Roadmap
Alignment with existing plans and policies	NPDES permit: Field Operations policy is to respond to flooding where the storm drainage system might be impaired.

Mitigation Action Implementation Plan		
Priority	Low ☐ Medium ☒ High ☐	
Lead position, office, department, or division responsible for implementation	Field Operations division in Utility Operations & Services department	
Potential Funding Sources		
Non-Federal Funding Sources		**Federal Funding Sources**
CWS Operating budget		
Estimated cost	$25,000 initial, $5,000/year	
Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Field Operations will respond during flood emergencies to situations arising from the public stormwater system. Prevention would allow Field Operations to concentrate on public infrastructure issues that are beyond the scope of individual residents.		Unknown
Project Timeline		
Expected Timeline for Completion		
Short term ☐ Mid term ☐ Long term ☐ Ongoing ☒		

Table 11: In Cooperation With Project Partners, Evaluate CWS Floodplain Facilities for Flood Storage Opportunities

Mitigation Action Information	
Title of action	F5: In cooperation with project partners, evaluate CWS floodplain facilities for flood storage opportunities
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	CWS owns multiple floodplain parcels that provide winter flood storage. As opportunities and need arise, under this action item CWS would help project partners acquire (or acquire easements to) floodplain parcels, continue building or preserving wetlands to maintain or improve flood storage in addition to providing other ecological benefits of interest to CWS. Flood storage benefit would be documented where suitable on riparian and wetland parcels managed or enhanced by CWS. For sites with flood storage opportunities, partners and CWS would assess feasibility of implementing any site modifications to protect CWS infrastructure and optimize flood storage.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Particularly within the urban basin, where runoff is flashy and the time between peak rainfall and peak runoff is less than a few hours, preserving existing flood storage is currently important. Doing so will likely become more important in the future as storm intensity is predicted to increase. CWS actions can support non-encroachment into regulated floodplains and drainage hazard areas, and support the preservation of “pockets” of flood storage. This could reduce both inundation and erosion damage.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☒ Goal 7 ☐ Goal 2 ☒ Goal 5 ☒ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	CWS Climate Action Roadmap. Also consider as part of regional conservation strategy.
Alignment with existing plans and policies	Integrate with vegetated corridor program, regulations and floodplain management requirements of individual jurisdictions; CWS integrated planning. CIP for collection system, shade program, and resilient stream corridors.

Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Regional Utility Services and Natural Systems Enhancement & Services departments
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Operating budget Metro Nature In Neighborhoods grants Tualatin Soil and Water Conservation District TREE grants	FEMA BRIC program pre-disaster mitigation grant
Estimated cost	To be determined
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Increase stream corridor resilience to erosion and potentially decrease risk of inundation either by direct flooding or by reducing the drainage efficiency of existing stormwater infrastructure.	Unknown
Project Timeline	
Expected Timeline for Completion	
Short term ☐ Mid term ☐ Long term ☐ Ongoing ☒	

Table 12: Support Activities of the Emergency Management Cooperative of Washington County That Are Relevant to CWS

Mitigation Action Information	
Title of action	G1: Support activities of the Emergency Management Cooperative of Washington County that are relevant to CWS.
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Support Washington County and other partner jurisdictions in managing cross-entity education and response activities undertaken by the Emergency Management Cooperative of Washington County to the extent that they are relevant to CWS facilities or staff safety or actions. An example activity would be developing plans to coordinate re-establishing access to critical CWS facilities in the event of a natural disaster. This entity would also support implementation of warning systems (e.g., U.S. Geological Survey Shake Alert) disaster response drills, including dam failure, and hazard communication to residents and businesses.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, inc. tornado ☒ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Clean Water Services depends on other jurisdictions to maintain road access to CWS facilities or other infrastructure on which these facilities depend; such access can be impaired in the event of flooding and storms. One element of this action would build on strategies developed for regional disasters (e.g., earthquakes) to provide operational response in the event of shorter term or more geographically limited disasters.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	Jurisdiction-specific emergency management staff, infrastructure, and administrative structures; Oregon Climate Adaptation Plan; Washington County NHMP Action Item #20 (this plan)
Alignment with existing plans and policies	CWS facility-specific Emergency Response Plans; NPDES permit; Oregon Natural Hazard Mitigation Plan

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☐ High ☒		
Lead position, office, department, or division responsible for implementation	Risk Management in Business Services department		
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
CWS Operating budget			
Estimated cost	$20,000		
Estimated Benefit			
Primary Benefit(s)			**Financial Benefit(s)**
Increase coordination of emergency response between CWS and partner entities			Unknown
Project Timeline			
Expected Timeline for Completion			
Short term ☒ Mid term ☐ Long term ☐ Ongoing ☐			

Table 18: Assess Vulnerability to Volcanic Ash Loading at CWS Facilities and Develop Response Strategy

Mitigation Action Information	
Title of action	V1: Assess vulnerability to volcanic ash loading at CWS facilities and develop response strategy
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Evaluate critical wet, dry ash loading values for CWS-owned facilities; develop response plans based on ashfall depth. Evaluate potential for interference in mechanical systems from suspended ash particles. Develop appropriate procedures for staff to reduce impacts to health.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☒ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Vulnerability to volcanic ash loading for CWS buildings is not understood. Action item would evaluate as-built plans and basis-of-design reports for buildings and define wet and dry ash depth thresholds for maintenance actions as appropriate. Action item would also document procedures to be taken to reduce health risk to employees. Resulting strategies would be documented in facility-specific Emergency Response plans.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Emergency Management Cooperative of Washington County
Alignment with existing plans and policies	Facilities asset management, Emergency Response plans
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Facilities division in Enterprise Asset & Technical Services department

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Operating budget	
Estimated cost	$50,000 to assess vulnerability. Any retrofit costs are not included.
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Understand and manage CWS vulnerability to volcanic ashfall	Unknown
Project Timeline	
Expected Timeline for Completion	
Short term ☐ Mid term ☒ Long term ☐ Ongoing ☐	

Table 13: Participate in Dispatchable Generation Program for CWS Facilities

Mitigation Action Information	
Title of action	H3: Participate in dispatchable generation program for CWS facilities
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Evaluate participation in PGE dispatchable generation program - pump station power (i.e., at Dawson Creek and North Plains pump stations). Look at additional incorporation of renewables and need for participation in this program at other sites (e.g., Durham, Rock Creek facilities).
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☒ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Because the power grid is vulnerable during extreme heat events due to increased usage for cooling, having alternative power sources available on short notice may be useful to maintain system function. One option to investigate is dispatchable generation, which is offered by PGE, the local power utility.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☒ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Emergency Management Cooperative of Washington County
Alignment with existing plans and policies	Facility-specific Emergency Response Plans; Oregon Natural Hazard Mitigation Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Water Resource Recovery Operations & Services department

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Operating budget	
Estimated cost	<$10,000
Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Increase facility resilience in the face of extreme heat events	Unknown
Project Timeline	
Expected Timeline for Completion	
Short term ☒ Mid term ☐ Long term ☐ Ongoing ☐	

Table 20: Manage Impacts to Green Infrastructure From Extreme Heat Events

Mitigation Action Information	
Title of action	H4: Evaluate and manage impacts to green infrastructure from extreme heat events
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Develop strategy to assess and repair heat damage to green infrastructure (including vegetated stormwater facilities) from extreme heat events. Develop assessment approach through use of drone surveys or other remote sensing resources. Develop methods for determining urgency of vegetation repair and contracting/ revegetation strategies for responding in a timely manner.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Functionality of CWS' green infrastructure—whether its purpose is stormwater management, shade provision, or at natural resource enhancement—depends on appropriate vegetation and cover. Stormwater management facilities and natural resource enhancement sites require vegetation to maintain structural integrity through winter storms beginning in October, while summer is the critical season for sites in the shade program and other sites requiring healthy riparian vegetation. There is currently no mechanism for systematically assessing the impact of extreme heat events at these sites, which typically have no or limited irrigation infrastructure, and replacing vegetation in a timely manner as needed to maintain key functionality.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	Regional conservation strategy; Metro Titles 3, 13; CWS Climate Action Roadmap
Alignment with existing plans and policies	NPDES permit

Mitigation Action Implementation Plan		
Priority	Low ☐ Medium ☒ High ☐	
Lead position, office, department, or division responsible for implementation	Natural Systems Enhancement & Stewardship department	
Potential Funding Sources		
Non-Federal Funding Sources	**Federal Funding Sources**	
CWS Operating budget		
Estimated cost	$25,000 - $35,000	
Estimated Benefit		
Primary Benefit(s)	**Financial Benefit(s)**	
Increase responsive revegetation in the event of heat-related vegetation loss	Unknown	
Project Timeline		
Expected Timeline for Completion		
Short term ☐ Mid term ☒ Long term ☐ Ongoing ☐		

Table 21: Refine Earthquake Preparedness Training for CWS Staff

Mitigation Action Information	
Title of action	E1: Refine earthquake preparedness training for CWS staff
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Refine the strategy for earthquake preparedness training for CWS staff into a program that is repeated frequently. Program should include participation in the "Great American Shake Out" as an element of the CWS' employee health and safety plan. Develop a strategy to set repeat intervals (if not annually) as a part of recurring training of staff. Incorporate information about new seismic risk information, as available, and "Shake Alert" warning system. Document process to update internal leads and contact info for external emergency managers, and awareness for staff at the front desk and answering service. Provide guidelines for employees to return to work.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	"Disaster amnesia" affects nearly everyone. Consistent (every one to three years) participation in this event, along with others in the community, reinforces behaviors in the event of an earthquake and provides an opportunity for updated information and training on this and other related hazards that staff may experience in the workplace and at home, in the community, or recreating.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	Emergency Management Cooperative of Washington County
Alignment with existing plans and policies	Employee health and safety plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Risk Management, with support from Communications & Community Engagement in Business Services department

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Operating budget	
Estimated cost	$5,000 - $10,000 for initial strategy development; additional cost to be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Increase staff awareness of earthquake hazards including immediate response. Decrease time to operational recovery for CWS-provided services.	Unknown

Project Timeline
Expected Timeline for Completion
Short term ☒ Mid term ☐ Long term ☐ Ongoing ☐

Table 22: Participate in Regional Staff Sharing and Exchange Program for Certified and Highly Trained Staff

Mitigation Action Information	
Title of action	E2: Participate in regional staff sharing and exchange program for certified and highly trained staff
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Participate in regional strategies for cooperative sharing of trained and capable staff across Portland metro region based on staff mobility and access (e.g., considering that staff ability to travel from home to work may be limited) in the event of a natural disaster.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	In the event of a regional-scale emergency such as an earthquake, specifically trained personnel are needed to manage and staff many CWS facilities (e.g., water resource recovery facilities, water quality lab, digital infrastructure) or to staff emergency operations center(s). Similar situations occur at many jurisdictions across the Portland metro region. However, a major seismic event is expected to make bridges across the Willamette River impossible. A regional strategy for specialized staff sharing would have workers report to an available similar facility if they are unable to reach CWS (and vice versa).
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Emergency Management Cooperative of Washington County; City of Portland Basic Earthquake Emergency Communication Nodes, Emergency mutual aid agreements.
Alignment with existing plans and policies	NPDES permit
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Risk Management in Business Services department

Potential Funding Sources		
Non-Federal Funding Sources		**Federal Funding Sources**
CWS Operating budget		
Estimated cost	To be determined	
Estimated Benefit		
Primary Benefit(s)		**Financial Benefit(s)**
Improve likelihood that service interruptions due to lack of trained workers will be minimized.		Unknown
Project Timeline		
Expected Timeline for Completion		
Short term ☐ Mid term ☒ Long term ☐ Ongoing ☐		

Table 23: Emergency Sanitation Outreach

Mitigation Action Information	
Title of action	E3: Emergency sanitation outreach
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	More widely distribute emergency toilet information to be used in the event of earthquake or other major interruption of wastewater service. Develop strategy with partners to distribute or make available at reasonable cost the supplies (e.g., two 5-gallon buckets, seats) needed to provide for emergency sanitation.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Because the CWS wastewater collection system cannot avoid areas with moderate or greater liquefaction risk, and other facilities are vulnerable in the event of extensive loss of electrical power, it is likely that a major earthquake will result in service disruptions that are too geographically extensive to repair or provide a temporary work-around in the first several weeks post-event. This action would show residents how to provide for their sanitation needs.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	Potential to integrate with Watershed Navigator
Alignment with existing plans and policies	Align with Washington County Emergency Management Cooperative efforts
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	Communications & Community Engagement in Business Services department
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Operating budget	
Estimated cost	$10,000

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Protect human health by providing community with 5-gallon buckets to use (with instructions) to prepare in case of emergency and lack of access to sewer services.	Unknown
Project Timeline	
Expected Timeline for Completion	
Short term ☐ Mid term ☐ Long term ☒ Ongoing ☐	

Table 24: Develop Strategy for Conveyance System Design in Response to Geographic Distribution of Liquefaction Hazard

Mitigation Action Information	
Title of action	E5: Develop strategy for conveyance system design in response to geographic distribution of liquefaction hazard
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Incorporate into wastewater conveyance system design the "safe fail" strategy to manage the large geographic area of elevated liquification risk with a dominantly gravity sewer system. Applying construction methods to entire pipeline length that would withstand liquefaction is too expensive. This strategy has been incorporated into the recent West Basin Master Plan design concept whereby weaker portions of pipe that would be the locus of failure are placed in areas where a pipe fracture can be easily managed, contained, and repaired. This action item would seek to incorporate such a design strategy into subsequent conveyance pipe projects to the extent practicable.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	CWS will be upgrading many miles of wastewater conveyance pipes over the next decade. Across much of this length, liquefaction hazard is moderate or higher. High hazard areas cannot be avoided with a dominantly gravity system. Nor can pipes be made to be failure-proof at any reasonable costs. This action would employ a strategy of managed pipe failure.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☒ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Emergency Management Cooperative of Washington County
Alignment with existing plans and policies	NPDES permit (asset management); Oregon Natural Hazard Mitigation Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Conveyance Engineering in Utility Operations & Services department

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Capital budget Clean Water State Revolving Fund	FEMA BRIC grant for mitigation actions
Estimated cost	To be determined; can be incorporated into collection system design relatively easily, but construction costs would be project-specific

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Reduce risk of wastewater reaching surface waters in the event of a pipe break caused by liquefaction during a seismic event.	Unknown

Project Timeline
Expected Timeline for Completion
Short term ☐ Mid term ☒ Long term ☐ Ongoing ☐

Table 25: Perform Seismic Upgrades at Field Operations Merlo Road Facility

Mitigation Action Information	
Title of action	E8: Perform seismic upgrades at Field Operations Merlo Road facility
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	This action item would incorporate recommended seismic upgrades during budgeted facility improvements at the CWS Field Operations Merlo Road facility. This will help ensure Utility Operations & Services can meet CWS' desired level of service during emergencies and disaster situations and improve facility resiliency. A seismic evaluation of the building as well as other resiliency improvements are included in the scope of work.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and	The Merlo Road facility is a major component of CWS' emergency response capability. Having it remain functional during a seismic event will aid in delivery of emergency services, including command center, throughout the CWS service area.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☒ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Emergency Management Cooperative of Washington County,
Alignment with existing plans and policies	Emergency Action Plan, Capital Improvement Plan; Oregon Natural Hazard Mitigation Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Field Operations division in Utility Operations & Services department
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Capital budget	
Estimated cost	$6.1 million, included in 2022-2026 CIP for all upgrades. Seismic component not broken out separately.

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Help ensure CWS can meet its desired level of service during emergencies and disaster situations and improve facility resiliency.	Unknown
Project Timeline	
Expected Timeline for Completion	
Short term ☐ Mid term ☒ Long term ☐ Ongoing ☐	

Table 26: Develop Strategy for Easement Acquisitions for CWS Collection System Projects Implementing "Safe-Fail" Design Approach

Mitigation Action Information	
Title of action	E12: Develop strategy for easement acquisitions for CWS collection system projects implementing "safe-fail" design approach
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Develop strategy and begin to acquire easements to support "safe fail" design approach for wastewater collection system. Determine selection criteria for a location of allowable pipeline "failure"
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, inc. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Increase operational resilience of collection system, recognizing that it is impossible to avoid all areas of moderate or high liquefaction or ground motion risk in upgrading or building the collection system. Because this design approach could require land in specific locations that would extend beyond the typical pipeline easement, acquiring easements prior to development would provide available land when needed prior to construction.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☒ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Emergency Management Cooperative of Washington County
Alignment with existing plans and policies	NPDES permit (asset management), capital improvement plan; Oregon Natural Hazards Mitigation Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Conveyance Engineering in Utility Operations & Services department
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
CWS Capital budget	
Estimated cost	$25,000 for strategy development; easement acquisition costs to be determined

Estimated Benefit	
Primary Benefit(s)	**Financial Benefit(s)**
Ensure land availability for design approach to reduce risk of wastewater reaching surface waters in the event of a pipe break caused by seismic event.	Unknown
Project Timeline	
Expected Timeline for Completion	
Short term ☐ Mid term ☒ Long term ☐ Ongoing ☐	

Annex I: Tualatin Hills Park & Recreation District

1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for the Tualatin Hills Park & Recreation District (THPRD) was the Safety Services Manager.

1.2. Annex Organization

This annex has six sections that satisfy mitigation requirements in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

The information provided in this annex applies to THPRD (the District) alone. All pertinent information that is not identified in this annex is identified in other sections of this NHMP or within the respective appendices.

1.3. NHMP Adoption Process

Once the Washington County NHMP has received the designation “Approvable Pending Local Adoption” from the Federal Emergency Management Agency (FEMA), the District will take the plan to its Board of Directors for final public comment and local adoption. A copy of the resolution will be inserted into the NHMP and held on file in Washington County and the headquarters of THPRD.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

While THPRD historically has implemented measures to reduce vulnerability to some hazards, passage of the Disaster Mitigation Act of 2000 (DMA 2000) helped District officials recognize the benefits of having a long-term, all-hazards approach to mitigation. This approach is achieved by a gradual decrease of hazard-associated impacts through the implementation of an NHMP. The District's involvement in the Washington County NHMP represents the collective efforts of the NHMP Steering Committee members, all participating local Technical Committee members, the public, and stakeholders.

The District developed this annex in accordance with guidance outlined in 44 CFR §201.6(c)(5) of DMA 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in the geographical region of the District.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP. An open involvement process was established for the public and all stakeholders, which provided an opportunity for everyone to be involved in the planning process and make their views known.

Two teams worked simultaneously on this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of points of contact from each planning participant. The group met to discuss countywide topics, including hazards and mitigation strategies. The points of contact were the leads of their local Technical Committee.
2. **Local Technical Committee:** Each plan participant created a Technical Committee that consisted of the Steering Committee representative for that jurisdiction or special district as well as designated representatives from within the organization. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. Tualatin Hills Park & Recreation District's Technical Committee

This annex within the NHMP was developed by the local THPRD Technical Committee with support from consulting firm IEM. The committee's efforts, which took place throughout 2022, were led by the Safety Services Manager.

Table 259: Tualatin Hills Park & Recreation District Technical Committee Members for the 2023 NHMP

Position	Division	Role in Committee and Planning Process
Safety Services Manager	Communications Division, Safety Services	General oversight, hazard identification, and plan development
Grant Specialist	Finance Services Division	Hazard identification and plan development
Support Services Manager	Park Services Division, Nature & Trails Department	Hazard identification and plan development
Administrative Specialist	Communications Division, Community Events	Hazard identification and plan development

Position	Division	Role in Committee and Planning Process
Web Specialist, Geographic Information System (GIS)	Communications Division, Information Services	Hazard identification and plan development
Nature & Trails Manager	Park Services Division, Nature & Trails Department	Hazard identification and plan development
Risk Manager	Human Resources Division, Risk & Contract Management	Hazard identification and plan development
Information Services Manager	Communications Division, Information Services	Hazard identification and plan development
IS Systems Administrator	Communications Division, Information Services	Hazard identification and plan development
Maintenance Manager	Park Services Division, Maintenance Coordination	Hazard identification and plan development

IEM also supported or led the following activities associated with the development, approval, and adoption of the plan:

1. Prepared, based on committee direction and stakeholder and community input, the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.
2. Submitted the proposed plan to the Oregon Department of Emergency Management (OEM) and FEMA for review and approval and completed edits or revisions requested by these organizations.
3. Coordinated plan adoption processes with the District, OEM, and FEMA.

2.3. Public Participation

Public participation is an important component of this NHMP. Public participation offers community members the chance to voice their ideas, interests, and opinions. In addition to FEMA's public participation requirement, Oregon's land use system addresses the need for public participation in Statewide Land Use Planning Goal 1, Citizen Involvement, which ensures the opportunity for community involvement in the planning process.

A survey regarding community perceptions of natural hazards and priorities was administered, and the results were used to help the Steering and Technical Committees update their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP. See Volume III, Appendix B for additional information about the survey and opportunities for public comment.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist the District in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards.

3.1. Tualatin Hills Park & Recreation District Profile

This section provides information about District-specific characteristics. Additional community characteristics of the planning area are included in Volume III, Appendix A.

Many special District characteristics may affect how natural hazards impact the District and how THPRD chooses to plan for natural hazard mitigation. Considering the District-specific assets during the planning process assisted in identifying appropriate measures for natural hazard mitigation.

The mission of THPRD is to provide high-quality park and recreation facilities, programs, services, and natural areas that meet the needs of the diverse communities it serves. The District is a system of indoor and outdoor resources, including more than 200 park sites, 75 miles of trails, 1,300 acres of natural areas, 27 miles of streams, 3 lakes, 8 swim centers, and 6 recreation centers (see Figure 39). The organization serves a population of 270,297 and has 600 employees over a 50-square-mile area.

The critical and vulnerable facilities listed in Table 260 are in the hazard area for all or some of the hazards identified by the District.

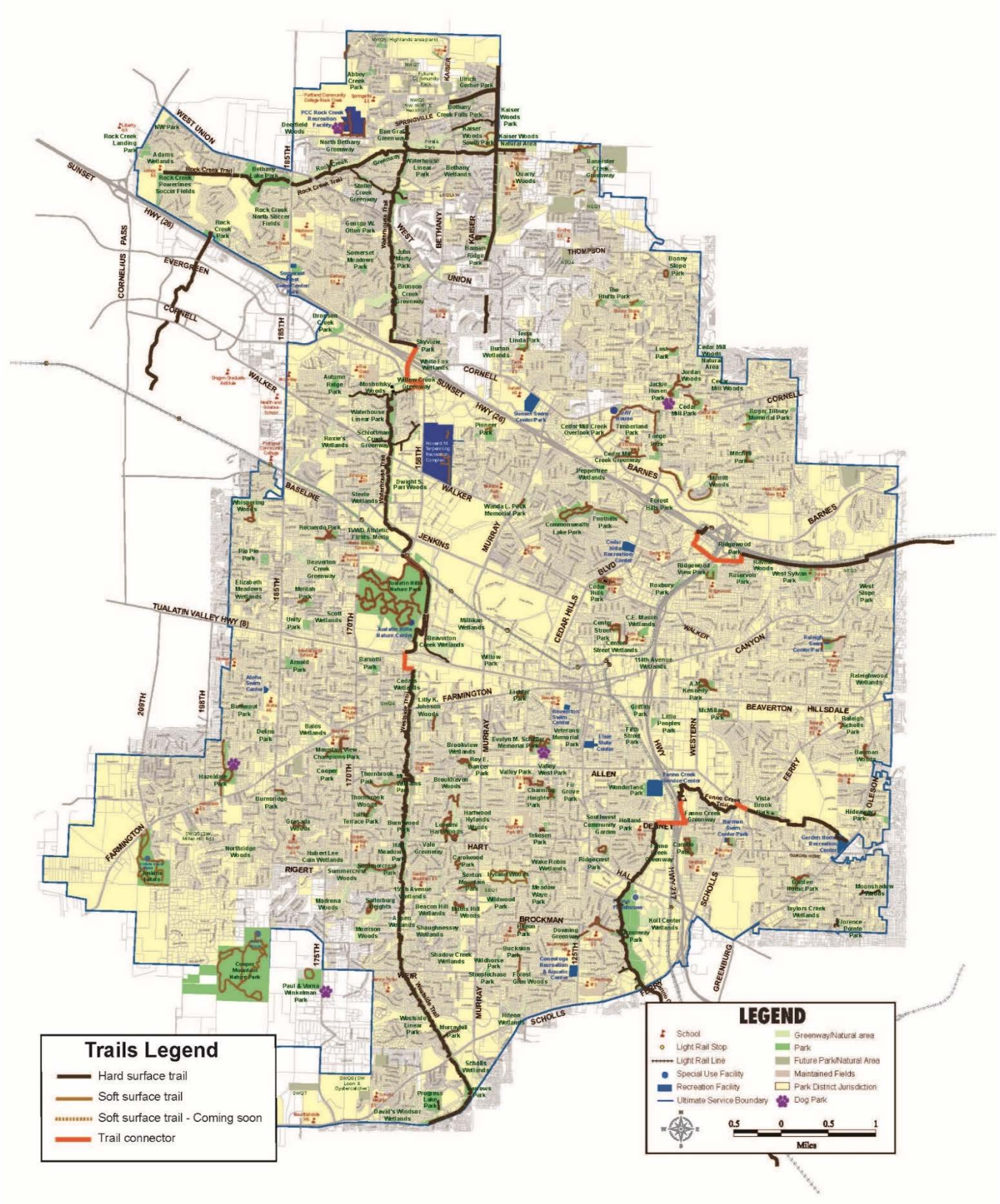


Figure 39: THPRD Parks, Recreation Facilities, Maintained School Grounds, and Natural Area

Table 260: Critical Facility and Asset Inventory

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
114th Avenue Wetlands Natural Area	Natural Resource	S of Center Street between 114th Avenue and Highway 217	45.4927397	-122.793208	Not vulnerable to dam failure or earthquake.
155th Avenue Wetlands Natural Area	Natural Resource	SW corner of Satterburg Road and 155th Avenue	45.458007	-122.836842	Not vulnerable to dam failure or earthquake.
A.M. Kennedy Park	Infrastructure or Facility	10200 SW Kennedy Street	45.4885424	-122.78061	Not vulnerable to dam failure.
Abbey Creek Park	Infrastructure or Facility	7284 NW 170th Avenue	45.57245	-122.852	Not vulnerable to dam failure.
Adams Wetlands Natural Area	Natural Resource	South of Rock Creek Road/East of Wahkeena	45.5590548	-122.895156	Not vulnerable to dam failure or earthquake.
Aloha Swim Center	Infrastructure or Facility	18650 SW Kinnaman Road	45.4860435	-122.869723	Not vulnerable to dam failure or drought.
Arnold Park	Infrastructure or Facility	4155 SW 182nd Avenue	45.4897848	-122.863592	Not vulnerable to dam failure or earthquake.
Aspen Wetlands Natural Area	Natural Resource	Access off Flagstone Drive/W of 155th Avenue	45.4550456	-122.838735	Not vulnerable to dam failure.
Autumn Ridge Park	Infrastructure or Facility	Access off Autumn Ridge Drive and Fall Avenue	45.5286419	-122.857869	Not vulnerable to dam failure.
Bales Wetlands Natural Area	Natural Resource	N of Rosa Road at Farmington Road	45.4792182	-122.860269	Not vulnerable to dam failure or earthquake.
Bannister Creek Greenway	Infrastructure or Facility	NW Laidlaw Road and NW Bannister Drive	45.557301	-122.807364	Not vulnerable to dam failure.
Barlow Square Path	Infrastructure or Facility	S of Barlow Road between 126th Street and Juniper Terrace	45.4696524	-122.806453	Not vulnerable to dam failure.
Barrows Park	Infrastructure or Facility	Intersection of SW Barrows Road and SW Horizon Boulevard	45.430323	-122.828457	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Barsotti Park	Infrastructure or Facility	16610 SW Blanton Street	45.4894018	-122.848021	Not vulnerable to dam failure.
Bauman Woods Natural Area	Natural Resource	Corner of Ames Way and Oleson Road	45.4796285	-122.748804	Not vulnerable to dam failure.
Beacon Hill Wetlands Natural Area	Natural Resource	East of 154th Avenue between Sexton Mountain Drive and Turquoise Loop	45.4566269	-122.833771	
Beaverton Creek Greenway	Natural Resource	175th Avenue and Oakwood Drive	45.501281	-122.856728	Not vulnerable to dam failure.
Beaverton Creek Wetlands Natural Area	Natural Resource	North of Tualatin Valley Highway/W of 153rd Avenue	45.4924571	-122.835927	
Beaverton Swim Center	Infrastructure or Facility	12850 SW Third Street	45.4849028	-122.809182	Not vulnerable to dam failure or drought.
Ben Graf Greenway	Natural Resource	South of Springville Road/East of Sickle Terrace	45.5621204	-122.839827	Not vulnerable to dam failure.
Bethany Creek Greenway	Natural Resource	865 SW Pheasant Drive			Not vulnerable to dam failure.
Bethany Creek Park	Infrastructure or Facility	E of Greenway between Hall Boulevard and SW Scholls Ferry Road			Not vulnerable to dam failure.
Bethany Lake Park	Natural Resource	Access off Neakahnie Avenue and 185th Avenue	45.5567056	-122.873385	Not vulnerable to dam failure.
Bethany Wetlands Natural Area	Natural Resource	5391 NW Kaiser Road	45.5583585	-122.833639	Not vulnerable to dam failure.
Bonny Slope Park	Infrastructure or Facility	Access off Thompson Road and South Road	45.5454804	-122.79136	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Bronson Creek Greenway	Natural Resource	NE corner of Bethany Boulevard and West Union Road	45.5440223	-122.840663	Not vulnerable to dam failure.
Bronson Creek Park	Natural Resource	Access off Cornell Road between Evergreen Street and 173rd Avenue	45.536346	-122.857887	Not vulnerable to dam failure.
Brookhaven Woods Natural Area	Natural Resource	Access off Daphne Street, Ivy Glen Street, Kilchis Street, and Barcelona Way	45.4712431	-122.829769	Not vulnerable to dam failure.
Brookview Wetlands Natural Area	Natural Resource	NE corner of 150th Avenue and Glenbrook Road	45.4780377	-122.831492	Not vulnerable to dam failure.
Buckskin Park	Infrastructure or Facility	Access off SW Buckskin Terrace/S of SW Harness Lane	45.452368	-122.809596	Not vulnerable to dam failure.
Burnsridge Park	Infrastructure or Facility	E of SW 185th between SW Broad Oak Boulevard and SW Monte Verdi Boulevard	45.4718712	-122.866309	Not vulnerable to dam failure.
Burntwood Park	Infrastructure or Facility	North of SW Burntwood Way between SW 158th Avenue and SW 160th Avenue	45.4675827	-122.840934	Not vulnerable to dam failure.
Burton Wetlands Natural Area	Natural Resource	Access off NW Wheatfield Way/S of NW Burton Street	45.5345083	-122.822336	Not vulnerable to dam failure.
Butternut Park	Infrastructure or Facility	SW corner of SW 192nd Avenue and SW Butternut Street	45.4835157	-122.873593	Not vulnerable to dam failure.
C.E. Mason Wetlands Natural Area	Natural Resource	Access North of SW Sunnyhill Lane/West of Highway 217	45.4969532	-122.79276	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Camille Park	Infrastructure or Facility	Access at west end of SW Marjorie Lane/S end of SW 105th Avenue	45.4657908	-122.783653	Not vulnerable to dam failure.
Carolwood Park	Infrastructure or Facility	East of SW 149th Avenue between SW Hart Road and SW Vulcan Court	45.4625285	-122.8297	Not vulnerable to dam failure.
Cedar Hills Park	Infrastructure or Facility	2300 SW Cedar Hills Boulevard	45.502031	-122.802386	Not vulnerable to dam failure. Property includes restrooms and concessions.
Cedar Hills Recreation Center	Infrastructure or Facility	11640 SW Park Way	45.5073781	-122.797622	Not vulnerable to dam failure or drought. Recreation facility with outdoor park and fields. Designated shelter site.
Cedar Mill Creek Greenway	Infrastructure or Facility	NW Cornell Road at NW 114th Avenue	45.5251537	-122.800509	Not vulnerable to dam failure.
Cedar Mill Creek Overlook Park	Infrastructure or Facility	Stone Mountain Lane	45.5234879	-122.8013	Not vulnerable to dam failure.
Cedar Mill Park	Infrastructure or Facility	10385 NW Cornell Road	45.5275223	-122.784461	Not vulnerable to dam failure.
Cedar Mill Woods Natural Area	Natural Resource	Access off NW Priscilla Court/E of NW 102nd Avenue	45.5300979	-122.781657	Not vulnerable to dam failure.
Cedar Park Tennis Courts	Infrastructure or Facility	11100 SW Park Way	45.5066305	-122.795878	Not vulnerable to dam failure.
Cedars Wetlands Natural Area	Natural Resource	Access off SW Shelton Street, West of 162nd Place	45.4867767	-122.844071	Not vulnerable to dam failure.
Center Street Park	Infrastructure or Facility	11895 SW Center Street	45.4960817	-122.799697	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Center Street Wetlands	Natural Resource	Access North of SW Center Street			Not vulnerable to dam failure.
Channing Heights Park	Infrastructure or Facility	Access off SW Hyland Way/SSW of Valley Circle	45.4740569	-122.814137	Not vulnerable to dam failure.
Commonwealth Lake Park	Infrastructure or Facility	SW Foothill Drive and SW Huntington Avenue	45.5118792	-122.808931	Not vulnerable to dam failure.
Conestoga Recreation and Aquatic Center	Infrastructure or Facility	9985 SW 125th Avenue	45.4484469	-122.80637	Not vulnerable to dam failure or drought. Recreation and aquatic facility with an outdoor park area and restrooms. Designated shelter site.
Conestoga Tennis Courts	Infrastructure or Facility	12250 SW Conestoga Drive	45.4464968	-122.804878	Not vulnerable to dam failure.
Cooper Mountain Nature Park	Infrastructure or Facility	18892 SW Kemmer Road	45.447871	-122.8727	Not vulnerable to dam failure. Park has extensive number of buildings and trails.
Cooper Park	Infrastructure or Facility	Access off SW Oak Street between 172nd Avenue and 176th Avenue	45.4750701	-122.856017	Not vulnerable to dam failure.
David's Windsor Wetlands Natural Area	Natural Resource	Access off SW Harlequin Drive, E of SW Sheldrake Way	45.4287907	-122.837764	Not vulnerable to dam failure.
Deerfield Woods Natural Area	Natural Resource	18079 NW Chemetka Lane	45.5624525	-122.862981	Not vulnerable to dam failure.
Deline Park	Infrastructure or Facility	Southeast corner of SW Deline Street and SW 187th Avenue	45.4796599	-122.869654	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Downing Greenway	Natural Resource	Access off SW 125th Avenue between SW Greenway and SW Longhorn Lane	45.45345	-122.804087	Not vulnerable to dam failure.
Dwight S. Parr Woods Natural Area	Natural Resource	16000 SW Regatta Lane	45.5164909	-122.842217	Not vulnerable to dam failure.
Eichler Park	Infrastructure or Facility	13710 SW Farmington Road	45.4863952	-122.817994	Not vulnerable to dam failure.
Elizabeth Meadows Wetlands Natural Area	Natural Resource	No Access	45.4980082	-122.873646	Not vulnerable to dam failure.
Elsie Stuhr Center	Infrastructure or Facility	5550 SW Hall Boulevard	45.4798178	-122.804157	Not vulnerable to dam failure or drought. Designated shelter site.
Fanno Creek Greenway	Infrastructure or Facility	Access off SW Denney Road	45.4629935	-122.792359	Not vulnerable to dam failure.
Fanno Creek Service Center	Infrastructure or Facility	6220 SW 112th Avenue	45.474145	-122.790788	Not vulnerable to dam failure or drought. Emergency Operations Center.
Fanno Farmhouse	Historical Property	8405 SW Creekside Place	45.4588719	-122.793476	Not vulnerable to dam failure or drought.
Fifth Street Park	Infrastructure or Facility	Southwest corner of SW 5th Street and SW Alger Avenue	45.4826282	-122.797148	Not vulnerable to dam failure.
Fir Grove Park	Infrastructure or Facility	Northwest corner of SW 22nd Street and SW 130th Avenue	45.4728946	-122.811417	Not vulnerable to dam failure.
Five Oaks Tennis Courts	Infrastructure or Facility	1600 NW 173rd Avenue	45.5312079	-122.84947	Not vulnerable to dam failure.
Florence Pointe Park	Infrastructure or Facility	7484 SW Florence Lane	45.4560712	-122.753467	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Foege Park	Infrastructure or Facility	11320 NW Cornell Road	45.5197522	-122.792826	Not vulnerable to dam failure.
Foothills Park	Infrastructure or Facility	Southeast corner of SW Lanewood Street and SW Huntington Avenue	45.5116761	-122.801445	Not vulnerable to dam failure.
Forest Glen Woods Natural Area	Natural Resource	Access off SW Weir Road and SW 130th Avenue	45.4470229	-122.811391	Not vulnerable to dam failure.
Forest Hills Park	Infrastructure or Facility	Access off SW Portola Avenue, S of NW Sunset Highway at Cedar Hills Boulevard	45.5125916	-122.792911	Not vulnerable to dam failure.
Future Community Park	Infrastructure or Facility	18110 SW Farmington Road, 6255 SW 179th Avenue	45.4762475	-122.862839	Not vulnerable to dam failure.
Future North Bethany East Community Park	Infrastructure or Facility				Not vulnerable to dam failure.
Future North Bethany Neighborhood Park	Infrastructure or Facility				Not vulnerable to dam failure.
Future Neighborhood Park Northeast Quadrant	Infrastructure or Facility				Not vulnerable to dam failure.
Future Neighborhood Park Southwest Quadrant	Natural Resource				Not vulnerable to dam failure.
Future Park South Cooper Mountain – Gorman	Infrastructure or Facility				Not vulnerable to dam failure.
Garden Home Park	Infrastructure or Facility	8020 SW 83rd Avenue	45.4612949	-122.761628	Not vulnerable to dam failure.
Garden Home Recreation Center	Infrastructure or Facility	7475 SW Oleson Road	45.4672921	-122.752878	Not vulnerable to dam failure or drought. Designated shelter site.
George W. Otten Park	Infrastructure or Facility	Northeast corner of NW Laidlaw Road and NW Emerald Canyon Drive	45.5505854	-122.853869	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Granada Woods Natural Area	Natural Resource	Northwest corner of SW Bany Road and SW 179th Avenue	45.4674106	-122.862278	Not vulnerable to dam failure.
Greenway Park	Infrastructure or Facility	East of SW Greenway between SW Hall Boulevard and SW Scholls Ferry Road	45.45396	-122.795863	Not vulnerable to dam failure.
Griffith Park	Infrastructure or Facility	Access off SW Griffith Drive, S of Beaverton-Hillsdale Highway	45.4850683	-122.795863	Not vulnerable to dam failure.
Howard M. Terpenning Recreation Complex	Infrastructure or Facility	15707 SW Walker Road	45.5197221	-122.836632	Not vulnerable to dam failure. Recreation complex with a variety of fields, facilities, courts, and trails. Designated shelter site and backup Emergency Operations Center.
Hansen Ridge Park	Infrastructure or Facility	4075 NW 147th Avenue	45.5500663	-122.82703	Not vulnerable to dam failure.
Harman Swim Center	Infrastructure or Facility	7300 SW Scholls Ferry Road	45.4672254	-122.775764	Not vulnerable to dam failure or drought.
Hart Meadows Park	Infrastructure or Facility	Power line corridor between SW Hart Road and SW Bridle Hills Drive	45.4615761	-122.841255	Not vulnerable to dam failure.
Hartwood Hylands Woods Natural Area	Natural Resource	Access W off SW Murray Boulevard between SW Tierra Del Mar Drive and SW Hart Road	45.4682989	-122.826658	Not vulnerable to dam failure.
Hazeldale Park	Infrastructure or Facility	Access off SW 196th Avenue, N of SW Farmington Road	45.4739427	-122.877179	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Hideaway Park	Infrastructure or Facility	Access off SW 67th Avenue, E of SW Oleson Road	45.4712187	-122.746746	Not vulnerable to dam failure.
Hiteon Park	Infrastructure or Facility	13800 SW Brockman Street	45.454306	-122.816237	Not vulnerable to dam failure.
Hiteon Wetlands Natural Area	Natural Resource	Access off SW Davies Road between SW Otter Lane and SW Scholls Ferry Road	45.4423049	-122.816438	Not vulnerable to dam failure.
Holland Park	Infrastructure or Facility	7087 SW Queen Lane	45.468348	-122.796043	Not vulnerable to dam failure.
Hubert Lee Cain Wetlands Natural Area	Natural Resource	Northeast corner of SW 175th Avenue and SW Rigert Road	45.4622683	-122.856524	Not vulnerable to dam failure.
Hyland Woods Natural Area	Natural Resource	Access off SW 135th Avenue or SW Sexton Mountain Drive, E of SW Murray Boulevard	45.4611424	-122.819463	Not vulnerable to dam failure.
Jackie Husen Park	Infrastructure or Facility	10955 NW Reeves Street	45.5291579	-122.789979	Not vulnerable to dam failure.
Jenkins Estate	Infrastructure or Facility and Historical Property	8005 SW Grabhorn Road	45.4602651	-122.891418	Not vulnerable to dam failure. Historical property with multiple facilities, structures, trails, open space, gardens, natural areas, and restrooms.
John Marty Park	Infrastructure or Facility	Power line corridor between Charlais Street and Joscelyn Street	45.545664	-122.846601	Not vulnerable to dam failure.
John Quincy Adams Young House	Historical Property	12050 NW Cornell Road	45.526538	-122.800514	Not vulnerable to dam failure or drought.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Jordan Woods Natural Area	Natural Resource	Access N end of NW 107th Avenue, N of NW Cornell Road	45.5301529	-122.787379	Not vulnerable to dam failure.
Kaiser Woods Natural Area	Natural Resource	Power line corridors east of NW Kaiser Road	45.5620835	-122.829054	Not vulnerable to dam failure.
Kaiser Woods Park	Infrastructure or Facility	NW Wenmarie Drive and NW Mcgregor Terrace	45.5655183	-122.826621	Not vulnerable to dam failure.
Kaiser Woods South Park	Infrastructure or Facility	NW Wenmarie Drive and NW 145th Place	45.565518	-122.826621	Not vulnerable to dam failure.
Koll Center Wetlands Natural Area	Natural Resource	Access via Greenway Park	45.4561672	-122.791337	Not vulnerable to dam failure.
La Raiz Park	Infrastructure or Facility	SW Baker Street and SW Lombard Avenue	45.4688452	-122.79600	Not vulnerable to dam failure.
Lawndale Park	Infrastructure or Facility	Access off E end of SW Wright Street at SW 176th Avenue	45.4773223	-122.856751	Not vulnerable to dam failure.
Lilly K. Johnson Woods Natural Area	Natural Resource	Access off SW Division Street, W of SW 153rd Avenue	45.4823618	-122.835519	Not vulnerable to dam failure.
Little Peoples Park	Infrastructure or Facility	Northeast corner of Highway 217 and SW 5th Street	45.4834858	-122.791313	Not vulnerable to dam failure.
Lost Park	Infrastructure or Facility	2120 NW 111th Avenue	45.5345957	-122.789498	Not vulnerable to dam failure.
Lowami Hart Woods Natural Area	Natural Resource	14895 SW Hart Road	45.4674501	-122.831782	Not vulnerable to dam failure.
Madrona Woods Natural Area	Natural Resource	Northeast and southwest corners of SW Arbutus Drive and SW Ravine Drive	45.4575976	-122.853092	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Matrix Hill Woods Natural Area	Infrastructure or Facility	Access off SW 149th Place, North of SW Ruby Street	45.45727	-122.830766	Not vulnerable to dam failure.
McMillan Park	Infrastructure or Facility	Access off SW Chestnut Place, N of SW Cypress Street	45.4844946	-122.777165	Not vulnerable to dam failure.
Meadow Park Tennis Courts	Infrastructure or Facility	14100 SW Downing Street	45.514859	-122.82398	Not vulnerable to dam failure.
Meadow Waye Park	Infrastructure or Facility	13275 SW Davies Road	45.460654	-122.813534	Not vulnerable to dam failure.
Melilah Park	Infrastructure or Facility	Access off SW Arborcrest Court or SW 180th Place, east of SW 182nd Avenue	45.4984831	-122.862617	Not vulnerable to dam failure.
Merritt Woods Natural Area	Natural Resource	Access south of NW 101st Avenue or SW 102nd Avenue, south of SW Washington Street	45.517021	-122.78213	Not vulnerable to dam failure.
Millikan Wetlands Natural Area	Natural Resource	North of SW Tualatin Valley Highway, west of SW 153rd Drive			Not vulnerable to dam failure.
Mitchell Park	Infrastructure or Facility	Access off NW 93rd Place, west of NW Leahy Road	45.5197968	-122.773468	Not vulnerable to dam failure.
Moonshadow Woods Natural Area	Natural Resource	Access off SW Alden Street, east of SW 71st Avenue	45.4607204	-122.746848	Not vulnerable to dam failure.
Morrison Woods Natural Area	Natural Resource	Trailhead access off SW Muledeer Drive	45.4557119	-122.847524	Not vulnerable to dam failure.
Moshofsky Woods Natural Area	Infrastructure or Facility	1001 NW Winged Foot Terrace	45.527363	-122.848287	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Mountain View Champions Park	Infrastructure or Facility	5915 SW 170th Avenue	45.4783433	-122.854339	Not vulnerable to dam failure. Sports complex with restrooms, concessions, open space, and gardens.
Mountain View Tennis Courts	Infrastructure or Facility	17500 SW Farmington Road	45.4796849	-122.854303	Not vulnerable to dam failure.
Mt. Williams Park	Infrastructure or Facility	Trail access from SW 160th Avenue and SW Sumac Street	45.473844	-122.841289	Not vulnerable to dam failure.
Murrayhill Park	Infrastructure or Facility	Access from SW Teal Boulevard	45.4388602	-122.832206	Not vulnerable to dam failure.
NE Neighborhood Park	Natural Resource	4950 NW Saltzman Road	45.5547179	-122.807511	Not vulnerable to dam failure.
North Bethany Greenway	Infrastructure or Facility	17700 NW Springville Road	45.5612815	-122.859032	Not vulnerable to dam failure.
North Bethany Park Blocks	Infrastructure or Facility	15224 NW Marie Way			Not vulnerable to dam failure.
North Bethany Trail C1.1	Infrastructure or Facility	South of NW West Union Road, E of NW 185th Avenue			Not vulnerable to dam failure.
Northridge Woods Natural Area	Natural Resource	No Access	45.4632231	-122.872232	Not vulnerable to dam failure.
Northwest Park	Infrastructure or Facility	NW Landing Drive, South of NW West Union Road	45.5648474	-122.892679	Not vulnerable to dam failure.
PCC Rock Creek Recreational Facility	Infrastructure or Facility	17705 NW Springville Road	45.5652215	-122.855374	Not vulnerable to dam failure. Sports complex with restrooms, concessions, trails, and a dog park.
Parivar Park	Infrastructure or Facility	7765 NW 167th Avenue			Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Peppertree Wetlands Natural Area	Natural Resource	Access off SW 121st Place, S of Sunset Highway	45.5168974	-122.804468	Not vulnerable to dam failure.
Pioneer Park	Infrastructure or Facility	14545 NW Pioneer Road	45.5223628	-122.826102	Not vulnerable to dam failure.
Pirate Park	Infrastructure or Facility	Near NW Energia Street between NW Brandberry Drive and NW Graf Street	45.5615449	-122.843772	Not vulnerable to dam failure.
Progress Lake Park	Infrastructure or Facility and Natural Resource	Intersection of SW Barrows Road and SW Mallard Drive	45.42972	-122.833757	Not vulnerable to dam failure.
Pío Park	Infrastructure or Facility	2135 SW 187th Avenue	45.504435	-122.870823	Not vulnerable to dam failure.
Quarry Woods Natural Area	Natural Resource	Access off NW Skycrest Parkway, N of Jacob Wismer Elementary School	45.5593896	-122.821657	Not vulnerable to dam failure.
Raleigh Scholls Park	Infrastructure or Facility	Off SW Scholls Ferry Road	45.4833343	-122.753178	Not vulnerable to dam failure.
Raleigh Swim Center/Park	Infrastructure or Facility	3500 SW 78th Avenue	45.494555	-122.75531	Not vulnerable to dam failure.
Raleighwood Wetlands Natural Area	Natural Resource	Access off SW Dogwood Lane, N of SW Scholls Ferry Road	45.4904802	-122.748422	Not vulnerable to dam failure.
Ravine Woods Natural Area	Natural Resource	No Access	45.5048469	-122.769346	Not vulnerable to dam failure.
Recuerdo Park	Infrastructure or Facility	Intersection of SW 174th Avenue and SW Biles Lane	45.50733	-122.858675	Not vulnerable to dam failure.
Reflections Plaza	Infrastructure or Facility	13400 NW Cornell Road	45.5257202	-122.813974	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Reservoir Park	Infrastructure or Facility	Access off SW Inglewood Street, N of SW Imperial Drive	45.5035787	-122.774468	Not vulnerable to dam failure.
Ridgecrest Park	Infrastructure or Facility	Access off SW Cresmoor Drive, W of SW Hillcrest Place	45.4651513	-122.800959	Not vulnerable to dam failure.
Ridgewood Park	Infrastructure or Facility	Southeast corner of Highway 217 and SW Wilshire Street	45.5062783	-122.77661	Not vulnerable to dam failure.
Ridgewood View Park	Infrastructure or Facility	10001 SW Ardenwood Street	45.5036081	-122.781047	Not vulnerable to dam failure.
Rock Creek Greenway	Infrastructure or Facility	Southwest and southeast corner of NW West Union Road and NW Kahneeta Drive	45.562359	-122.823801	Not vulnerable to dam failure.
Rock Creek Landing Park	Infrastructure or Facility	Northeast corner of NE Cornelius Pass Road and NW Rock Creek Boulevard	45.5610985	-122.897101	Not vulnerable to dam failure.
Rock Creek North Soccer Fields	Infrastructure or Facility	4125 NW 185th Avenue	45.5507633	-122.86947	Not vulnerable to dam failure.
Rock Creek Park	Infrastructure or Facility	20107 NW Rock Creek Boulevard	45.5491282	-122.883483	Not vulnerable to dam failure.
Rock Creek Powerlines Soccer Fields	Infrastructure or Facility	Access off NW Rock Creek Boulevard between NW Ponderosa Drive and NW Salishan Drive	45.5570086	-122.890443	Not vulnerable to dam failure.
Roger Tilbury Memorial Park	Infrastructure or Facility	965 NW 93rd Avenue	45.5261118	-122.772242	Not vulnerable to dam failure.
Roxbury Park	Infrastructure or Facility	Southeast corner of SW Berkshire Street and SW Roxbury Avenue	45.5024295	-122.787724	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Roxie's Wetlands Natural Area	Natural Resource	Access off NW 173rd Avenue, N of NW Elaine Court	45.5216483	-122.855303	Not vulnerable to dam failure.
Roy E. Dancer Park	Infrastructure or Facility	5915 SW Murray Boulevard	45.4768343	-122.828998	Not vulnerable to dam failure.
Sato Trail	Infrastructure or Facility	7700 NW Kaiser Road			Not vulnerable to dam failure.
Satterberg Heights Park	Infrastructure or Facility	Northeast and southeast corners of SW Sexton Mountain Drive and SW 160th Avenue	45.456497	-122.843688	Not vulnerable to dam failure.
Schiffler Park	Infrastructure or Facility	Access off SW Bonnie Brae Street, SW Erickson Avenue, or SW Berthold Avenue	45.479527	-122.814288	Not vulnerable to dam failure.
Schlottman Creek Greenway	Natural Resource	Access off NW Blueridge Drive or NW Foxborough Circle, W of NW 158th Avenue	45.5223491	-122.841354	Not vulnerable to dam failure.
Scholls Wetlands Natural Area	Natural Resource	Northeast corner of SW Barrows Road and SW Walnut Lane	45.4341032	-122.825239	Not vulnerable to dam failure.
Scott Wetlands Natural Area	Natural Resource	Access off SW Eirwen Street at SW 174th Avenue	45.4971271	-122.85712	Not vulnerable to dam failure.
Sexton Mountain Park	Infrastructure or Facility	14700 SW Sexton Mountain Drive	45.4597461	-122.827882	Not vulnerable to dam failure.
Shadow Creek Wetlands Natural Area	Natural Resource	Access off SW Opal Drive, E of SW 151st Avenue	45.4518871	-122.829366	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Shaughnessey Wetlands Natural Area	Natural Resource	Access off SW Graphite Terrace between SW Ivory Street and SW Turquoise Loop	45.4536354	-122.833905	Not vulnerable to dam failure.
Skyview Park	Infrastructure or Facility	15780 NW Bronson Road	45.5328914	-122.841226	Not vulnerable to dam failure.
Somerset Meadows Park	Infrastructure or Facility	3400 NW Parkview Drive	45.5450333	-122.852599	Not vulnerable to dam failure.
Somerset West Swim Center/Park	Infrastructure or Facility	18300 NW Parkview Boulevard	45.5444019	-122.866142	Not vulnerable to dam failure.
Steele Wetlands Natural Area	Natural Resource	Access off SW 170th Avenue, North of SW Cashew Way	45.5145217	-122.85147	Not vulnerable to dam failure.
Steeplechase Park	Infrastructure or Facility	14300 SW Weir Road	45.448027	-122.82381	Not vulnerable to dam failure.
Stoller Creek Greenway	Infrastructure or Facility	Access via NW Laidlaw Road	45.55708	-122.85235	Not vulnerable to dam failure.
Summercrest Park	Infrastructure or Facility	East of SW Rigert Terrace and SW 170th Avenue	45.461944	-122.850387	Not vulnerable to dam failure.
Summercrest Woods Natural Area	Natural Resource	Access off SW 171st Place, South of SW Juliann Lane	45.4609646	-122.853463	Not vulnerable to dam failure.
Sunset Swim Center/Park	Infrastructure or Facility	13707 NW Science Park Drive	45.5269072	-122.817965	Not vulnerable to dam failure. Park is a sports complex with restrooms.
Tualatin Valley Water District Athletic Fields- Merlo	Infrastructure or Facility	1700 SW 170th Avenue	45.5074061	-122.850591	Not vulnerable to dam failure.
Taliesen Park	Infrastructure or Facility	Access off SW Heath Place, South of SW Barlow Road	45.4683158	-122.812937	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Tallac Terrace Park	Infrastructure or Facility	East of SW 167th Place on SW Timberland Drive	45.4691841	-122.848496	Not vulnerable to dam failure.
Taylors Creek Wetlands Natural Area	Natural Resource	Northeast corner of SW Taylors Ferry Road and NE 78th Avenue	45.4554144	-122.75613	Not vulnerable to dam failure.
Tenax Woods Natural Area	Natural Resource	11680 SW Eider Avenue	45.435448	-122.843022	Not vulnerable to dam failure.
Terra Linda Park	Infrastructure or Facility	Access South of NW Burton Street, East of NW 139th Place	45.5346635	-122.819856	Not vulnerable to dam failure.
The Bluffs Park	Natural Resource	Access on NW South Drive, NW 177th Drive, NW Blackhawk Drive, or NW Haskell Court	45.5415428	-122.803296	Not vulnerable to dam failure.
Thornbrook Park	Infrastructure or Facility	Access off SW Taft Court, East of SW 166th Avenue	45.47316	-122.847167	Not vulnerable to dam failure.
Thornbrook Woods Natural Area	Natural Resource	Access off SW Timberland Place between SW Ivy Glenn Street and SW Heceta Court	45.4707597	-122.847827	Not vulnerable to dam failure.
Timberland Park	Infrastructure or Facility	11600 NW Stone Mountain Lane	45.5223933	-122.798234	Not vulnerable to dam failure.
Tualatin Hills Nature Park	Infrastructure or Facility and Natural Resource	15655 SW Millikan Way	45.4961399	-122.841698	Not vulnerable to dam failure. Park has extensive number of buildings and trails.
Ulrich Gerber Park	Infrastructure or Facility	14730 NW Shackelford Road	45.571	-122.8286	Not vulnerable to dam failure.
Unity Park	Infrastructure or Facility	17915 SW Alexander Street	45.4951059	-122.862206	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Vale Greenway	Natural Resource	15260 SW Hart Road	45.4638399	-122.834919	Not vulnerable to dam failure.
Valley Park	Infrastructure or Facility	Access off Valley Avenue, North of SW 17th Street	45.4757827	-122.81395	Not vulnerable to dam failure.
Valley West Park	Infrastructure or Facility	Access off SW Valley Avenue, North of SW 17th Street	45.4755528	-122.815542	Not vulnerable to dam failure.
Veterans Memorial Park	Infrastructure or Facility	Intersection of SW Washington Avenue, SW Watson Avenue, and SW 7th Street	45.4815525	-122.806574	Not vulnerable to dam failure.
Vista Brook Park	Infrastructure or Facility	6697 SW 88th Avenue	45.4709832	-122.767213	Not vulnerable to dam failure.
Wake Robin Wetlands Natural Area	Natural Resource	Access off SW 131st Avenue, North of SW Bluebell Lane	45.4618277	-122.812546	Not vulnerable to dam failure.
Wanda L. Peck Memorial Park	Infrastructure or Facility	Access off SW Murray Boulevard, South of SW Butner Road	45.5132491	-122.818876	Not vulnerable to dam failure.
Waterhouse Linear Park	Infrastructure or Facility	Power line corridor, accessible via Walker Road	45.5189	-122.847332	Not vulnerable to dam failure.
Waterhouse Park	Infrastructure or Facility	16405 SW Walker Road	45.5244023	-122.846185	Not vulnerable to dam failure.
West Slope Park	Infrastructure or Facility	2560 SW 73rd Avenue	45.5014176	-122.751219	Not vulnerable to dam failure.
West Sylvan Park	Infrastructure or Facility	8111 SW West Slope Drive	45.5036951	-122.761209	Not vulnerable to dam failure.
Westside Linear Park	Infrastructure or Facility	Access off Galena Way, Weir Road, and SW 155th Avenue	45.4458225	-122.839244	Not vulnerable to dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Latitude	Longitude	Comments
Westview High School Tennis Courts	Infrastructure or Facility	4200 NW 185th Avenue	45.5521336	-122.864388	Not vulnerable to dam failure.
Whispering Woods Natural Area	Natural Resource	East of SW 192nd Avenue, South of Chantal Village Park	45.5094897	-122.873627	Not vulnerable to dam failure.
White Fox Wetlands Natural Area	Natural Resource	Access off NW White Fox Drive or NW 156th Avenue, North of NW Bronson Road	45.5336222	-122.836548	Not vulnerable to dam failure.
Wildhorse Park	Infrastructure or Facility	Access off SW Wildhorse Way, West of SW Davies Road	45.4500341	-122.821667	Not vulnerable to dam failure.
Wildwood Park	Infrastructure or Facility	8545 SW Maverick Terrace	45.4579968	-122.824243	Not vulnerable to dam failure.
Willard Bike Path	Infrastructure or Facility	Access off SW Abbott Lane and SW 158th Avenue	45.4818877	-122.840149	Not vulnerable to dam failure.
Willow Creek Greenway	Infrastructure or Facility	South of NW Autumn Ridge Drive between NW 173rd Avenue and NW 176th Avenue	45.5274335	-122.852632	Not vulnerable to dam failure.
Willow Park	Infrastructure or Facility	Access off SW 144th Avenue, South of SW Millikan Way	45.4922228	-122.824354	Not vulnerable to dam failure.
Winkelman Park	Infrastructure or Facility	10139 SW 175th Avenue	45.447	-122.857	Not vulnerable to dam failure.
Wonderland Park	Infrastructure or Facility	Access off SW King Boulevard, North of SW Imperial Drive	45.4738794	-122.793059	Not vulnerable to dam failure.
Yoshihara Trail	Infrastructure or Facility	Northwest corner of NW Eleanor Avenue and NW Delia Street	45.5685	-122.8315	Not vulnerable to dam failure.

3.2. Natural Hazard Profiles

The THPRD Technical Committee utilized the Oregon OEM's Hazard Analysis Methodology to examine hazard risk by collecting information about the four rating criteria of history, vulnerability, maximum threat, and probability. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants.

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Volume I, Section 2.

The scores for each hazard that impacts the District are presented below. All natural hazards included in the NHMP have the potential to impact the District; however, due to its geographic location and topography, the District cannot be directly impacted by dam failure and landslides. The District assigned relatively low scores to these hazards and identified their potential impacts as secondary and not direct.

Table 261: Natural Hazard Risk Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	Low	Low	Low	Low	24
Drought	Low	High	Low	High	166
Earthquake	Low	Medium	High	Medium	161
Extreme heat	High	High	High	High	199
Flooding, including channel migration and streambed erosion	High	Medium	Low	High	143
Landslide	Low	Low	Low	Medium	72
Volcanic ash	Low	Medium	High	Medium	152
Wildland fire	Low	Medium	Medium	High	143
Windstorm, including tornado	High	High	Medium	High	198
Winter storm	High	High	High	High	208

Full descriptions of each hazard are provided in Volume I, Section 2. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description in this annex and in Volume I, Section 2.

The timeframe of data collected during the planning process for THPRD was from when the District was formed in 1955 to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the County's Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events since 1955, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are presented in the same order, as applicable: populations, economies, structures, improved

property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

3.2.1. Dam Failure

Due to its geographic location and topography, the District cannot be directly impacted by dam failure. The District has not developed mitigation action items for this hazard because it is considered to have no impact. Any impacts in the District due to dam failure are identified as secondary and minimal.

3.2.1.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a dam failure event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event; however, all impacts and vulnerabilities are considered minimal to negligible.

- A failure of Scoggins Dam is not expected to flood or destroy any THPRD property; however, Scoggins Dam does hold water used for irrigation and drinking. THPRD would be affected if dam failure impacted its ability to irrigate and maintain its properties or provide drinking water to patrons.

3.2.2. Drought

Drought typically occurs as a regional event and often affects more than one county and district simultaneously. Drought may occur in THPRD's service area and may primarily affect natural hazard environments. Previous significant events and the potential impacts of and vulnerabilities to drought are identified below.

3.2.2.1. Significant Events

THPRD identified six significant drought events that have occurred in the District's service area since it was formed in 1955.

- **1976–1981, 1986, 1992, and 1999:** Countywide drought conditions.
- **2000–2001:** Countywide drought conditions. Hagg Lake fell to a record low of 9%, but water conservation averted a water crisis. The driest water year on record in the Willamette Valley and warmer than normal temperatures combined with dry conditions.
- **2005:** Drought conditions led to water rationing in some agricultural areas of the County.

3.2.2.2. Potential Impacts

The potential impacts of a drought event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Reduction or loss of water supply.
- Water use restrictions and lack of drinkable water supply.
- Health effects, including increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions.
- Reduced economic productivity or business closures in such industries as agriculture, livestock, recreation, energy, and tourism.
- Supply chain restrictions, including food shortages.
- Loss of power or reduced availability of electricity due to infrastructure damage and high demand.
- Property and infrastructure damage due to expansive soils.
- Damage to natural environments, including low water levels in lakes, rivers, and other water bodies, reduced plant growth, local species reduction or extinction, increased water temperature, and deteriorated water quality, which may result in fish kills and increased waterborne pollutants.
- Concurrent hazards, including extreme heat, wildfires, flooding, and landslides.

3.2.2.3. Vulnerabilities

All populations, economies, improved property, historical properties and cultural resources, and natural environments in the District are vulnerable to drought. These include:

- Staff and those using District facilities who have preexisting health conditions, those without access to clean water, children, pregnant women, and older adults.
- Those employed in water-dependent sectors, such as agriculture and recreation, who may experience a reduction in income.

- THPRD, which is one of the largest consumers of the City of Beaverton and the Tualatin Valley Water District's water supply. THPRD draws water for irrigation at the Jenkins Estate property and holds several water rights at properties across the District.
  - Diversions and/or interruptions of water supplies to the District could stem from failed reservoirs or wells, ruptured pipelines, or contaminated water sources.
- Zoning areas within the District that are designated for agricultural uses.
- THPRD properties, which can institute "brown-out" measures such as stopping the watering of select sports fields, shutting down splash pads, stopping the washing of District vehicles, and educating staff on water-saving practices.
- No structures, critical facilities, or infrastructure are expected to be vulnerable to drought.
- Natural environments such as all District acreage, parks, trails, and outdoor facilities.

3.2.3. Earthquake

The District could experience earthquakes that originate from the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek Fault Zone. It could also experience liquefaction and coseismic landslides as the result of an earthquake. Previous significant events and the potential impacts of and vulnerabilities to earthquake are identified below.

3.2.3.1. Significant Events

THPRD identified nine significant earthquake events that have occurred in the District's service area since it was formed in 1955.

- **November 1961:** 5.0 magnitude earthquake in the Portland area.
- **November 1962:** 5.5 magnitude earthquake in the Portland area.
- **December 1963:** 4.5 magnitude earthquake in the Portland area.
- **March 25, 1993:** The first significant earthquake in recorded history to originate close enough to Beaverton to be felt. Beaverton experienced minor damage.
- **February 28, 2001:** The 6.8 magnitude Nisqually earthquake was felt in the City of Beaverton but did very little damage.
- **2003:** Although too small to be felt, a small earthquake was detected under Cooper Mountain in the southern part of Beaverton on a fault that had been previously designated by geologists as "inactive."
- **2013, 2014, and 2015:** Numerous small quakes occurred in the Portland Metro area. Most of these earthquakes were not strong enough to be felt.

3.2.3.2. Potential Impacts

The potential impacts of an earthquake event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Mental health impacts, including post-traumatic stress disorder.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering, or the need for facility users to shelter in place at the facility being used.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to the District, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Commerce losses from power interruptions, damaged buildings and assets, and road closures. The District may also sustain direct losses to buildings, personnel, and other vital equipment.

- Personal and household economic impacts to staff from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Collapsed buildings and destruction to the District's many outdoor assets, such as swimming pools, which would be expensive to rebuild or replace.
- Damage to underground utilities; residential, public, and private buildings; and transportation systems.
- Blocked roads and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction.
- Downed or damaged power lines that can lead to wildfires.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals in Districtwide natural areas.
- Damage to vegetation and the District's parks, trails, natural areas, and natural systems.
- Change in water flows, including the paths of rivers and streams.
- Concurrent hazards, including floods, wildland fires, and landslides.

3.2.3.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the District are vulnerable to earthquakes. These include:

- Staff and patrons at District facilities during an earthquake event.
- THPRD structures including the Aloha Swim Center, Beaverton Swim Center, Conestoga Recreation & Aquatics Center, Harman Swim Center, Sunset Swim Center, Raleigh Swim Center, Somerset West Swim Center, Cedar Hills Recreation Center, Garden Home Recreation Center, Elsie Stuhr Center, Howard M. Terpenning Recreation & Aquatic Complex, Cooper Mountain Nature House (owned in partnership with Metro), Tualatin Hills Nature Center, PCC-Rock Creek Sports Campus (land leased from Portland Community College), and Sunset Sports Complex.
- Critical THPRD facilities, including the Howard M. Terpenning (HMT) Athletic, Tennis, and Aquatic Center; HMT Dryland Center, Conestoga Recreation Center, Cedar Hills Recreation Center, Garden Home Recreation Center, Elsie Stuhr Center, and Fanno Creek Service Center (designated Emergency Operations Center site).
- The District's current and future regional and community active transportation network, including the Rock Creek, Crescent Park, Westside, Beaverton Creek, Tualatin Valley, Reedville, Fanno Creek, McKernan Creek, and South Cooper Loop Regional Trails; as well as the North Bethany, Bethany Creek, Bronson Creek, Bonny Slope West, Cedar Mill Creek, Willow Creek, Waterhouse, North Johnson Creek, Beaverton Wetlands, South Johnson Creek, and South Cooper Mountain Community Trails.
- Areas near the epicenter of an earthquake event, which are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, historical properties, and natural environments.

  - Any unreinforced masonry structures in the District are more vulnerable to potentially substantial damage during an earthquake compared to other nearby structures built to modern standards.[505]
  - Any wood frame buildings with sill plates not bolted to foundation, cripple wall perimeter systems, and buildings on steep slopes, partially supported on "stilts" in the District are generally more vulnerable to major seismic damage compared to other nearby structures built to modern standards.[506, 507]
- Buildings with very high or high collapse potential, including facilities constructed prior to 1990.
  - Two recreation center buildings are at least 75 years old, and the Red Cross and Washington County have designated both as disaster shelters.
  - The District's historical structures and properties, including the Fanno Farmhouse, Jenkins Estate, Schlottman House, and John Quincy Adams Young House.
- Underground infrastructure, such as pipelines and utility lines, buildings, and roads, which are vulnerable to damage from liquefaction due to the silt-type soil throughout the District.
- Natural environments such as all District acreage, parks, trails, and outdoor facilities.

[505] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[506] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[507] Washington County Natural Hazard Mitigation Plan. (2017). https://www.co.washington.or.us/EmergencyManagement/plans-and-agreements.cfm

3.2.4. Extreme Heat

Due to a rise in frequency, severity, and impacts from extreme heat events, the NHMP Steering Committee chose to include this hazard for the first time in the Washington County NHMP. Previous significant events and the potential impacts of and vulnerabilities to extreme heat are identified below.

3.2.4.1. Significant Events

Extreme heat was not included in previous NHMPs. THPRD identified 12 significant extreme heat events that have occurred in the District's service area since it was formed in 1955.

- **Summer 2015:** Extreme heat occurred June 7–9, June 26–28, July 1–5, July 28–30, and August 18–19. Heat-related illnesses and deaths were markedly greater during these periods, and cooling shelters were opened. High temperatures were 10 ˚F to 20 ˚F above normal.
- **August 1–4, 2017:** Record breaking heat was caused by a strong high-pressure system.
- **July 12–17, 2018:** Extreme heat was caused by a strong high-pressure system.
- **June 23–29, 2021:** The National Weather Service issued an Excessive Heat Watch for multiple days.
- **July 16, 2021:** The heat index reached over 80 ˚F, and THPRD implemented Level 1 of Increased Heat Procedures for staff and patrons.
- **July 26–30, 2021:** The heat index reached over 80 ˚F, and THPRD implemented Level 1 of Increased Heat Procedures for staff and patrons.
- **July 31, 2021:** The heat index reached over 90 ˚F, and THPRD implemented Levels 1 and 2 of Increased Heat Procedures for staff and patrons.
- **August 2–4, 2021:** THPRD implemented Levels 1 and 2 of Increased Heat Procedures for staff and patrons due to excessive heat.
- **August 13–15, 2021:** THPRD implemented Levels 1 and 2 of Increased Heat Procedures for staff and patrons due to excessive heat.
- **August 16–19, 2021:** THPRD implemented Level 1 of Increased Heat Procedures for staff and patrons, and there was an air quality advisory for wildfire smoke.
- **August 20–27, 2021:** THPRD implemented Level 1 of Increased Heat Procedures for staff and patrons.
- **September 2–9, 2021:** THPRD implemented Level 1 of Increased Heat Procedures for staff and patrons.

3.2.4.2. Potential Impacts

The potential impacts from an extreme heat event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths, especially for those working or using THPRD's indoor and outdoor facilities.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, and heat stroke, and death.
- Extended operational hours of District staff and additional resources needed for response to the event, including the operation of daytime cooling centers and overnight cooling shelters.
- Strain on or loss of water supply due to increased demand.

- Commerce losses from power interruptions, damaged buildings and assets, and road closures. The District may also sustain direct losses to buildings, personnel, and other vital equipment.
- Supply chain and personal economic impacts, such as the increased cost of food, goods, and services, including energy.
- Economic losses from less overall worker efficiency and effectiveness and time lost on the job when people need to take more frequent or longer breaks to avoid overheating; short-term economic impacts from the closure of outdoor activities and events, such as those held at many District locations.
- Property damage, such as roof expansion, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding. This may be of particular concern to the District's historic structures and older infrastructure.
- Disruption of essential infrastructure systems from overheated and damaged utilities, including power, water, transportation, and communication systems.
- Impacts to roadways as heat expands concrete or causes cracking and buckling.
- Damage to vegetation, parks, natural systems, and the District's many outdoor environmental assets.
- Impacts to greenspaces, such as scorch and sunscald of new foliage, branches or tops of trees dying due to cavitation, and significant stress and die-off of native trees, particularly Douglas Firs and cedars. These impacts are intensified during times of drought.
- Concurrent hazards, including drought and wildland fire.

3.2.4.3. Vulnerabilities

All populations, economies, structures, improved property, historical properties and cultural resources, and natural environments in the District are vulnerable to extreme heat. These include:

- Populations vulnerable to extreme heat include those working or using THPRD's indoor and outdoor facilities.
    - In 2021, two patrons suffered from extreme heat-related illness while on THPRD property. Both cases were able to be treated on-site.
- People who work in buildings without air conditioning or cooling equipment and users of these THPRD's facilities. Only 20% of the District's buildings have air conditioning.
    - THPRD facilities without air conditioning include all six indoor swim centers, Cedar Hills Recreation Center, Garden Home Recreation Center, Cooper Mountain Pole Barn, HMT Pole Barn, HMT Maintenance Shop Bays and Tool room, Portland Community College Rock Creek Maintenance Shop, Camp Rivendale, and the Fanno Creek Service Center Warehouse, Tool Room, and Vehicle Maintenance Bays.
- People living, working, or spending time in heat islands within the District.
- Populations with higher heat sensitivity, including older adults, infants and children, pregnant women, people with preexisting or chronic diseases, and those who take certain medications that affect thermoregulation or block nerve impulses. This may include users of District facilities and District program participants.
- People with limited mobility and no access to cooling systems who may not be able to travel to cooling centers or shelters.

- Structures (existing and future): Cedar Hills Recreation Center, Garden Home Recreation Center, Cooper Mountain Pole Barn, HMT Pole Barn, HMT Maintenance Shop Bays and Tool room, Portland Community College Rock Creek Maintenance Shop, Camp Rivendale, the Raleigh Swim Center, the Somerset West Swim Center, and the Fanno Creek Service Center Warehouse, Tool Room and Vehicle Maintenance Bays.
- No critical facilities or infrastructure are expected to be vulnerable to extreme heat.
- The overall region includes a limited number of cooling centers and shelters. District facilities may be seen as a place for residents to come to escape extreme heat.
    - In 2021, THPRD ran two cooling centers: one at the HMT Recreation Complex Athletic Center and another at the Conestoga Recreation and Aquatic Center.
- The District must ensure that its electrical, water, and sewage hookups and roads and trails are maintained to accommodate a potential extreme heat event.
- Vehicles, including District maintenance vehicles, are vulnerable to engine overheating and tire deterioration.
- Aboveground utility and power lines can droop or sag and create a heightened fire risk for staff and visitors to District facilities.
- Natural environments such as all District acreage, parks, trails, and outdoor facilities. Plants, animals, ecosystems, and natural environments are vulnerable to high rates of mortality due to excessive heat.

3.2.5. Flooding, Including Channel Migration and Streambed Erosion

Flooding to a greater or lesser degree is fairly common in the County, and events typically occur from October through April. As a planning participant whose assets are widely dispersed, vulnerability may vary from site to site. The District experiences occasional localized flooding, but historically, events have not been significant or severe. Previous significant events and the potential impacts of and vulnerabilities to flooding are identified below.

3.2.5.1. Significant Events

THPRD identified 17 significant flooding events that have occurred in the District's service area since it was formed in 1955.

- **December 1964–January 1965:** Record flooding throughout Willamette Basin due to two intense storms and near-record early season snow depths. This was the largest flood in Oregon since dam construction on the upper Willamette in the 1940s–1950s. Federal disaster declaration FEMA-184-DR-OR was issued.
- **January 1972:** Record flows in rivers. Federal disaster declaration FEMA-319-DR-OR was issued.
- **January 1974:** Flooding followed heavy wet snow and freezing rain. Federal disaster declaration FEMA-413-DR-OR was issued.
- **December 1978:** Intense heavy rain and snowmelt saturated the ground.
- **February 1986:** Severe statewide flooding due to rain and melting snow.
- **February 1987:** Willamette River and its tributaries flooded.
- **February 1996:** Deep snowpack in conjunction with warm temperatures and record-breaking rains. Many rivers and creeks throughout the Willamette River watershed rose to flood levels and power outages occurred. Federal disaster declaration FEMA-1099-DR-OR was issued.
- **November 1996:** Record-breaking precipitation. Washington County suffered almost $10 million in damage from the event; statewide damages surpassed $280 million. National Flood Insurance Program claims from the event surpassed $2.3 million for the County alone. Federal disaster declaration FEMA-1107-DR-OR was issued.
- **December 2007:** Torrential rain caused flooding, landslides, and mudslides in the region. Federal disaster declaration FEMA-1733-DR-OR was issued.
- **December 2008:** Severe winter storm, record or near record snowfall, landslides, and mudslides occurred. Federal disaster declaration FEMA-1824-DR-OR was issued.
- **December 2012:** A 25-year flood event caused road closures throughout the County.
- **December 2015:** Flood levels on the Tualatin River reached major flood stage on two occasions. Flooding caused many landslides, the inundation of dozens of homes and businesses, restricted or closed over 70 roads, damaged miles of roads and numerous culverts, and caused power outages for thousands of residents. Federal disaster declaration FEMA-4258-DR-OR was issued.
- **November 2016:** A moist Pacific front moving slowly across the area produced heavy rainfall, resulting in flooding of several rivers across Northwest Oregon.
- **February 2019:** Excess precipitation flooded roads throughout the County.
- Additional flood events in the County identified by the National Weather Service include March 20, 2012, February 9–10, 2017, and January 12–14, 2021.

3.2.5.2. Potential Impacts

The potential impacts from a flooding event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths, especially to those trying to drive through flooded areas and become trapped in their vehicles while driving to or from District facilities.
- Public health concerns, such as the spread of infectious diseases, exposure to chemicals, hazardous materials, and debris, and water quality issues.
- Need for widespread search and rescue operations, including high-water rescues.
- Displaced residents in need of sheltering, including those who are “stuck” at a facility because water outside rose unexpectedly and rapidly.
- Delayed emergency response times due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Mobility or access issues due to the surrounding water.
- Economic impacts to the District, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Commerce losses from power interruptions, damaged buildings and assets, and road closures. The District may also sustain direct losses to buildings, personnel, and other vital equipment.
    - Facility closures because roads leading to buildings, fields, parks or trails are not open.
- Personal and household economic impacts to staff from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to underground utilities; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Disruption of traffic due to flooded, damaged, or destroyed transportation systems.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals in Districtwide natural areas.
- Damage to vegetation and the District’s parks, trails, natural areas, and natural systems.

3.2.5.3. Vulnerabilities

Population, economic, built environment, infrastructure, and natural environment vulnerabilities to a flooding event include the following:

- Those without access to private transportation for the purpose of evacuation from floodwaters.
- Staff working at all District locations, including indoor and outdoor facilities. Personal safety of staff may be vulnerable, and staff may be unable to get to worksites, move between different locations, and access impeded parking lots.
- No critical facilities are expected to be vulnerable to flooding.
- Portions of THPRD’s current and future regional and community active transportation network including the Rock Creek, Crescent Park, Westside, Beaverton Creek, Tualatin Valley, Reedville,

Fanno Creek, McKernan Creek, and South Cooper Loop Regional Trails; as well as the North Bethany, Bethany Creek, Bronson Creek, Bonny Slope West, Cedar Mill Creek, Willow Creek, Waterhouse, North Johnson Creek, Beaverton Wetlands, South Johnson Creek, and South Cooper Mountain Community Trails.

- THPRD has experienced several instances of minor flood-related environmental damage at the Raleigh Swim Center and Park site when the unnamed stream running through the park overflowed.
- The Tualatin Hills Nature Park, Greenway Park, and Fanno Creek Greenway experience seasonal flooding, which can erode trails and deposit sediment on trails and sports courts.
- Flooding at the Bannister Creek Greenway, Commonwealth Park, and Foothills Park sites wash away engineered wood fibers at the playgrounds, causing trail damage and the need for cleaning operations.
- THPRD sees localized flooding or other small-scale damage and the need for cleaning at points on various regional trails.
- Many of the 90 park sites include a water resource, such as a stream or lake. Beaverton Creek, Rock Creek, North Johnson and Cedar Mill Creeks, Fanno Creek, and Butternut Creek repeatedly flood, making surrounding areas vulnerable. Commonwealth Lake experiences occasional flooding and is connected to North Johnson Creek, which has repeatedly flooded.
- Natural environments such as all District acreage, parks, trails, and outdoor facilities, including Raleigh Swim Center and Park, Tualatin Hills Nature Park, Greenway Park, Fanno Creek Greenway, Bannister Creek Greenway, Commonwealth Park, and Foothills Park.

3.2.6. Landslide

There are several steep slopes in the District's service area; however, they are located outside of THPRD's authority. As such, the District Technical Committee identified potential landslide impacts to be minimal and secondary.

3.2.6.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a landslide event are identified below. The type, magnitude, and extent of these can vary based on the scale of the event.

- Portions of THPRD's current and future regional and community active transportation network including the Rock Creek, Crescent Park, Westside, Beaverton Creek, Tualatin Valley, Reedville, Fanno Creek, McKernan Creek, and South Cooper Loop Regional Trails; as well as the North Bethany, Bethany Creek, Bronson Creek, Bonny Slope West, Cedar Mill Creek, Willow Creek, Waterhouse, North Johnson Creek, Beaverton Wetlands, South Johnson Creek, and South Cooper Mountain Community Trails.
- Steeper sloped areas within the District such as Cooper Mountain Nature Park and areas of Tualatin Hills Nature Park, Matrix Hill Woods, Morrison Woods Natural Area, Madrona Woods Natural Area, Jenkins Estate, Northridge Woods Natural Area, Mount Williams Park, Jordan Woods Natural Area, The Bluffs Park, and Bannister Creek Greenway.

3.2.7. Volcanic Ash

Volcanic activity is possible from mountains near Washington County. It is anticipated that ashfall from a volcanic eruption from Mount St. Helens or Mount Hood has the potential to impact the District. The scale and types of impacts and vulnerabilities may differ depending on which volcano erupts, the level of eruption, the wind direction during and after eruption, and other weather conditions. A previous significant events and the potential impacts of and vulnerabilities to volcanic ash are identified below.

3.2.7.1. Significant Event

The District identified one previous significant event that impacted the area.

- **May 18, 1980:** THPRD experienced light volcanic ashfall from Mount St. Helens' eruption. Parks and outdoor swimming pools were particularly hard hit, requiring pool drainage and frequent filter cleaning. Ash also worked its way into equipment, causing premature failures or requiring unscheduled maintenance.

3.2.7.2. Potential Impacts

Though it is unlikely that an event of this type will occur, the impacts of a significant ashfall could be substantial. Impacts may include:

- Indirect injuries and deaths, such as those sustained during ash cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Displaced residents in need of sheltering, or the need for facility users to shelter in place at the facility being used.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of District staff and resources needed for response to the event.
- Economic impacts to the District, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Commerce losses from power interruptions, damaged buildings and assets, and road closures. The District may also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts to staff from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Extensive need for cleaning of District facilities and outdoor assets, such as pools and tennis courts.
- Damage to underground utilities; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Blocked roads and rail transportation routes due to debris and ash accumulation.

- Downed or damaged power lines that can lead to wildfires.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals in Districtwide natural areas.
- Damage to vegetation and the District's parks, trails, natural areas, and natural systems.

3.2.7.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the District are vulnerable to volcanic ash. These include:

- Staff and patrons using District facilities who have chronic lung problems and/or preexisting health conditions, children, pregnant women, and older adults.
- People without access to effective dust masks, eye protection, and drinking water and food uncontaminated by ash.
- Staff working at all District locations, including indoor and outdoor facilities. Personal safety of staff may be vulnerable, and staff may be unable to get to worksites, move between different locations, and access impeded parking lots.
- THPRD structures including the Aloha Swim Center, Beaverton Swim Center, Conestoga Recreation & Aquatics Center, Harman Swim Center, Sunset Swim Center, Raleigh Swim Center, Somerset West Swim Center, Cedar Hills Recreation Center, Garden Home Recreation Center, Elsie Stuhr Center, Howard M. Terpenning Recreation & Aquatic Complex, Cooper Mountain Nature House (owned in partnership with Metro), Tualatin Hills Nature Center, PCC-Rock Creek Sports Campus (land leased from Portland Community College), and Sunset Sports Complex.
- Critical THPRD facilities, including the HMT Athletic, Tennis, and Aquatic Center and the HMT Dryland Center.
- The District's current and future regional and community active transportation network, including the Rock Creek, Crescent Park, Westside, Beaverton Creek, Tualatin Valley, Reedville, Fanno Creek, McKernan Creek, and South Cooper Loop Regional Trails; as well as the North Bethany, Bethany Creek, Bronson Creek, Bonny Slope West, Cedar Mill Creek, Willow Creek, Waterhouse, North Johnson Creek, Beaverton Wetlands, South Johnson Creek, and South Cooper Mountain Community Trails.
- Natural environments such as all District acreage, parks, trails, and outdoor facilities.
- All THPRD water supplies.
- Areas of higher elevation, including South Cooper Mountain, Cooper Mountain, West Slope, Raleigh West, Bonny Slope West, Cedar Hills, Cedar Mill, Bethany, and North Bethany.

3.2.8. Wildland Fire

Although the District could experience a wildland–urban interface event, historically it is more likely for the District to be affected by smoke and poor air quality due to wildland fires outside its boundaries. Previous significant events and the potential impacts of and vulnerabilities to wildland fire are identified below.

3.2.8.1. Significant Events

The District has not been directly impacted by a wildland fire event; however, THPRD identified two times wildfire smoke has impacted the District's service area since it was formed in 1955.

- **September 1, 2020:** Wildfires south and east of the County caused the Oregon Department of Environmental Quality to issue an air quality advisory.
- **August 15–16, 2021:** Wildfires outside of the County caused the Oregon Department of Environmental Quality to issue an air quality advisory.

3.2.8.2. Potential Impacts

The potential impacts from a wildfire event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Exposure to wildfire smoke, which can lead to eye, nose, and throat irritation and the worsening of chronic heart and lung diseases.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering or the need for facility users to shelter in place at the facility being used.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of District staff and resources needed for response to the event.
- Strain on or loss of water supply due to increased demand.
- Economic impacts to the District, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Economic impacts, including loss of local revenue due to business and property tax losses and reduced recreation and tourism activity.
- Industry and commerce losses from power interruptions, damaged buildings and assets, and road closures. The District may also sustain direct losses to buildings, personnel, and other vital equipment.
- Damage to the District's extensive structures, particularly historical assets; parks and trails; and furnishings/equipment located both indoors and outdoors.
- Damage to underground utilities; residential, public, and private buildings; and transportation systems.

- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged power lines that can lead to additional wildfires.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals in Districtwide natural areas.
- Damage to vegetation and the District's parks, trails, natural areas, and natural systems.
- Concurrent hazards, including flood, landslide and erosion, and air and water quality issues.

3.2.8.3. Vulnerabilities

Given the dynamic nature of wildland fires, all populations, economies, structures, improved property, infrastructure, historical properties and cultural resources, and natural environments in the District are vulnerable to this hazard. These include:

- Staff and patrons using District facilities who experience chronic lung problems and/or preexisting health conditions, children, pregnant women, and older adults.
    - In 2020, one staff member experienced asthma symptoms as a result of poor air quality due to smoke. Also in 2020, THPRD closed parks, trails, and natural areas to staff and the public for approximately 7 days due to poor air quality; it also closed its buildings and facilities for approximately 3 days.
- Staff employed at Cooper Mountain Nature House, Tualatin Hills Nature Center, and Jenkins Estate, who are more vulnerable to wildfire events due to the geographic location of these facilities. These structures are also vulnerable to wildfire events.
- Populations without access to private transportation.
- First responders and other personnel working directly on fire protection, suppression, and patrols or near a wildfire can experience burns, smoke exposure, heat-related impacts such as heat stroke, heat exhaustion, dehydration, physical fatigue, mental health challenges, injuries, and death.
- Potential for damage to heating, ventilation, and air-conditioning (HVAC) systems in public and private buildings and emergency generators.
- THPRD follows Tualatin Valley Fire & Rescue (TVF&R) protocols and has closed parks during high fire danger periods. During regular conditions, fires are only allowed within dedicated BBQ stations to reduce vulnerability to wildfires.
- No critical facilities are expected to be vulnerable to wildland fire.
- Portions or all of THPRD's current and future regional and community active transportation network including the Rock Creek, Crescent Park, Westside, Beaverton Creek, Tualatin Valley, Reedville, Fanno Creek, McKernan Creek, and South Cooper Loop Regional Trails; as well as the North Bethany, Bethany Creek, Bronson Creek, Bonny Slope West, Cedar Mill Creek, Willow Creek, Waterhouse, North Johnson Creek, Beaverton Wetlands, South Johnson Creek, and South Cooper Mountain Community Trails.
- Natural environments such as all District acreage, parks, trails, and outdoor facilities.
- Steeper sloped areas within the District such as Cooper Mountain Nature Park and areas of Tualatin Hills Nature Park, Matrix Hill Woods, Morrison Woods Natural Area, Madrona Woods

Natural Area, Jenkins Estate, Northridge Woods Natural Area, Mount Williams Park, Jordan Woods Natural Area, The Bluffs Park, and Bannister Creek Greenway.

3.2.9. Windstorm, Including Tornado

Across the 50-square-mile District, there are 117 parks and 70 miles of trails operated by THPRD, so wind damages can be significant. Previous significant events and the potential impacts of and vulnerabilities to windstorms and tornadoes are identified below.

3.2.9.1. Significant Events

There have been 268 high-wind events recorded in the District's service area since it was founded in 1955. The most impactful events include:

- **October 12, 1962:** The most destructive storm to ever occur in Oregon in recorded history, both in loss of life and property damage. The storm killed 38 people and did upwards of $200 million in damage. Hundreds of thousands of homes were without power for short periods of time, while others were without power for 2 to 3 weeks. More than 50,000 homes were seriously damaged, and nearly 100 were completely destroyed. Entire fruit and nut orchards were destroyed, and livestock was killed as barns and trees blew over onto animals. Intense wind speeds were recorded in the metropolitan areas, with gusts of 116 mph on the Portland Morrison Bridge.
- **December 18, 1992:** The District filed an insurance claim for wind damage.
- **December 12, 1995:** A large low-pressure system hit Washington County. Gusts of over 100 mph occurred along the coast, while gusts in the Willamette Valley exceeded 60 mph. Hundreds of thousands of people in the state lost power, and there was widespread damage to homes, buildings, and boats. The damage resulted in a presidential disaster declaration. Four Oregonians lost their lives during the storm.
- **January 17, 1996:** The District filed an insurance claim for wind damage.
- **October 23–26, 2014:** A windstorm caused $8,282.50 in damages at 22 THPRD sites. Impacts included downed trees, fence damage, and a damaged tractor shed.
- **November 11, 2014:** A windstorm caused $1,310 in damages at 11 THPRD sites. Impacts included downed trees, railing knocked off a bridge, and fence and vehicle damage.
- **December 11, 2014:** A windstorm caused $500 in damages at 10 THPRD sites. Impacts included downed trees and damage to a boardwalk.
- **April 7, 2017:** A windstorm caused impacts at 35 THPRD sites. The Aloha Swim Center, Beaverton Swim Center, Conestoga Recreation and Aquatic Center, and Harman Swim Center were closed due to damage that resulted in cancelled events and lost revenue. Facilities experienced power outages, blown-off shingles, a bent doorframe, and a broken main circulation water pump. Fifty-two trees were felled, and the District had to spend $10,000 to hire contractors to remove them.

3.2.9.2. Potential Impacts

The potential impacts from a windstorm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths of staff or those coming to or leaving from District facilities.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering, or the need for facility users to shelter in place at the facility being used.

- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of District staff and resources needed for response to the event.
- Economic impacts to the District, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Commerce losses from power interruptions, damaged buildings and assets, and road closures. The District may also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts to staff from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to underground utilities; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged power lines Districtwide that may lead to wildfires.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals in Districtwide natural areas.
- Damage to vegetation and the District's parks, trails, natural areas, and natural systems.

3.2.9.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the District are vulnerable to windstorms, including tornadoes. These include:

- Staff working at all District locations, including indoor and outdoor facilities. Personal safety of staff may be vulnerable, and staff may be unable to get to worksites, move between different locations, and access impeded parking lots.
- THPRD structures including the Aloha Swim Center, Beaverton Swim Center, Conestoga Recreation & Aquatics Center, Harman Swim Center, Sunset Swim Center, Raleigh Swim Center, Somerset West Swim Center, Cedar Hills Recreation Center, Garden Home Recreation Center, Elsie Stuhr Center, Howard M. Terpenning Recreation & Aquatic Complex, Cooper Mountain Nature House (owned in partnership with Metro), Tualatin Hills Nature Center, PCC-Rock Creek Sports Campus (land leased from Portland Community College), and Sunset Sports Complex.
- Older buildings and infrastructure in the District not built to withstand high winds.
    - Two recreation center buildings are at least 75 years old, and the Red Cross and Washington County have designated both as disaster shelters.
    - The District's historical structures and properties, including the Fanno Farmhouse, Jenkins Estate, Schlottman House, and John Quincy Adams Young House.
- Critical THPRD facilities, including the HMT Athletic, Tennis, and Aquatic Center and the HMT Dryland Center.
- The District's current and future regional and community active transportation network, including the Rock Creek, Crescent Park, Westside, Beaverton Creek, Tualatin Valley, Reedville, Fanno

Creek, McKernan Creek, and South Cooper Loop Regional Trails; as well as the North Bethany, Bethany Creek, Bronson Creek, Bonny Slope West, Cedar Mill Creek, Willow Creek, Waterhouse, North Johnson Creek, Beaverton Wetlands, South Johnson Creek, and South Cooper Mountain Community Trails.

- When high winds combine with rain, blowing leaves and debris can clog catch basins, contributing to localized inundation flooding.
- Damage from high winds has generally resulted in many downed utility lines and trees. Trees have also fallen from THPRD property onto a third-party private owner's property.
- Natural environments such as all District acreage, parks, trails, and outdoor facilities.
- Areas at higher elevations, including South Cooper Mountain, Cooper Mountain, West Slope, Raleigh West, Bonny Slope West, Cedar Hills, Cedar Mill, Bethany, and North Bethany.
- Areas within the District that are more vulnerable to windstorms, including tornadoes, than other areas include Cooper Mountain Nature Park, Howard M. Terpenning Recreation Complex, and the Tualatin Hills Nature Park.

3.2.10. Winter Storm

Heavy snowfall rarely occurs within the District. When it does, many of the subsequent issues are directly related to the older infrastructure elements. Previous significant events and the potential impacts of and vulnerabilities to winter storms are identified below.

3.2.10.1. Significant Events

There have been 42 winter storm events recorded in the District's service area since it was founded in 1955. The most impactful events include:

- **January 2017:** The District filed two insurance claims for damage due to snow and ice and one insurance claim due to frozen pipes. Fourteen THPRD sites received damage, including felled trees, washed away gravel and wood chips, and broken gutters.
- **February 11–14, 2021:** Freezing rain and heavy snow came down, and wind gusts up to 50 mph occurred, resulting in an ice storm. The District experienced snowy and icy roads, downed tree limbs, localized power outages, and travel impacts.
- **December 26–30, 2021:** THPRD buildings were closed or had modified openings due to winter weather. On December 29, the HMT Complex had a delayed partial opening while other facilities remained closed. Facilities had delayed and partial openings on December 30.

3.2.10.2. Potential Impacts

The potential impacts from a winter storm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Because many District assets are outdoors, residents utilize parks, trails, gardens, and other assets that, when icy, may cause a staff member or visitor to trip and fall.
- Injuries or deaths, including from carbon monoxide poisoning and falls from slick or icy conditions on trails or other outdoor areas throughout the District.
- Frostbite or hypothermia among District staff or facility users.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components.
- Extended operational hours of District staff who may be needed for response to the event.
- Stranded travelers due to ice, snow, and transportation impacts.
- Economic impacts to the District, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Commerce losses from power interruptions, damaged buildings and assets, and road closures. The District may also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts to staff from loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to underground utilities; residential, public, and private buildings; and transportation systems.
- Increased number of building fires due to improper use of heating methods.

- Significant property damage or loss of water due to thawing of frozen pipes.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked roads and rail transportation routes.
- Downed or damaged power lines that may lead to wildfires and tree debris that has the potential to create fuel load for wildfire.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals in Districtwide natural areas.
- Damage to vegetation and the District's parks, trails, natural areas, and natural systems.
- Concurrent hazards, including drought, wildfire, and flooding.

3.2.10.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the District are vulnerable to winter storms. These include:

- People who do not have access to sufficient heating, insulated clothing, or dry living conditions, including unhoused populations. Such persons may make use of District facilities as heating centers.
- Older adults and infants, people who take certain medications, people who have certain medical conditions, and people who have been drinking alcohol are at increased risk for hypothermia. This may include users of District facilities and District program participants.
- People improperly using generators and heating devices.
- Staff working at all District locations, including indoor and outdoor facilities. Personal safety of staff may be vulnerable, and staff may be unable to get to worksites, move between different locations, and access impeded parking lots.
- THPRD structures including the Aloha Swim Center, Beaverton Swim Center, Conestoga Recreation & Aquatics Center, Harman Swim Center, Sunset Swim Center, Raleigh Swim Center, Somerset West Swim Center, Cedar Hills Recreation Center, Garden Home Recreation Center, Elsie Stuhr Center, Howard M. Terpenning Recreation & Aquatic Complex, Cooper Mountain Nature House (owned in partnership with Metro), Tualatin Hills Nature Center, PCC-Rock Creek Sports Campus (land leased from Portland Community College), Fanno Creek Service Center, and Sunset Sports Complex.
- Older buildings and infrastructure in the District. Snow events typically cause building ingress/egress issues, roof snow load concerns, water pipe leaks, and roof leaks.
    - Two recreation center buildings are at least 75 years old, and the roof systems are not built to withstand heavy snow loads. The Red Cross and Washington County have designated both as winter and disaster shelters.
    - The District's historical structures and properties, including the Fanno Farmhouse, Jenkins Estate, Schlottman House, and John Quincy Adams Young House.
- Critical THPRD facilities, including the HMT Athletic, Tennis, and Aquatic Center and the HMT Dryland Center.

- The District's current and future regional and community active transportation network, including the Rock Creek, Crescent Park, Westside, Beaverton Creek, Tualatin Valley, Reedville, Fanno Creek, McKernan Creek, and South Cooper Loop Regional Trails; as well as the North Bethany, Bethany Creek, Bronson Creek, Bonny Slope West, Cedar Mill Creek, Willow Creek, Waterhouse, North Johnson Creek, Beaverton Wetlands, South Johnson Creek, and South Cooper Mountain Community Trails.
- Natural environments such as all District acreage, parks, trails, and outdoor facilities.
- Areas at higher elevations, including South Cooper Mountain, Cooper Mountain, West Slope, Raleigh West, Bonny Slope West, Cedar Hills, Cedar Mill, Bethany, and North Bethany.

3.3. Historical Events

Hazard events that have affected the entire planning area since the adoption of the 2017 NHMP are detailed in Volume I, Section 2. This is the first time THPRD has had an NHMP. Hazard events that have impacted the District are described in the hazard profiles above. These occurrences include earthquake, drought, extreme heat, flooding, windstorm, and winter storm events. They have also impacted the cities of Portland and Beaverton, which are within the District's service area.

3.4. Overall Vulnerability

Based on the analysis completed by the Technical Committee, the greatest relative risks to the District include winter storm, extreme heat, windstorm, including tornado, drought, and earthquake present the highest relative risk to the District. These hazards may become widespread events, and all populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments in the District can be vulnerable to these hazards.

Areas of greatest vulnerability to these hazards within the District include:

- Populations with higher vulnerability, such as those with preexisting health conditions, older adults, children, and pregnant women. This may include THPRD staff, users of District facilities, and District program participants.
- Populations that are unhoused, do not have access to private transportation, and/or are without access to air conditioning, cooling equipment, sufficient heating, or clean water.
- People working or spending time in heat islands within the District.
- Commerce losses from power interruptions, damaged buildings and assets, and road closures. The District may also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic impacts to the District, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Critical THPRD facilities, including the HMT Athletic, Tennis, and Aquatic Center, Fanno Creek Service Center, and HMT Dryland Center.
- THPRD structures including the Aloha Swim Center, Beaverton Swim Center, Conestoga Recreation & Aquatics Center, Harman Swim Center, Sunset Swim Center, Raleigh Swim Center, Somerset West Swim Center, Cedar Hills Recreation Center, Garden Home Recreation Center, Elsie Stuhr Center, Howard M. Terpenning Recreation & Aquatic Complex, Cooper Mountain Nature House (owned in partnership with Metro), Tualatin Hills Nature Center, PCC-Rock Creek Sports Campus (land leased from Portland Community College), and Sunset Sports Complex.
- The District's current and future regional and community active transportation network, including the Rock Creek, Crescent Park, Westside, Beaverton Creek, Tualatin Valley, Reedville, Fanno Creek, McKernan Creek, and South Cooper Loop Regional Trails; as well as the North Bethany, Bethany Creek, Bronson Creek, Bonny Slope West, Cedar Mill Creek, Willow Creek, Waterhouse, North Johnson Creek, Beaverton Wetlands, South Johnson Creek, and South Cooper Mountain Community Trails.
- Older buildings and infrastructure not built to current building codes or seismic standards may be more vulnerable. Two recreation center buildings are at least 75 years old, and the Red Cross and Washington County have designated both as disaster shelters. The District's historical structures and properties include the Fanno Farmhouse, Jenkins Estate, Schlottman House, and John Quincy Adams Young House.

- Natural environments such as all District acreage, parks, trails, and outdoor facilities. Plants, animals, ecosystems, and natural environments can be vulnerable to high rates of mortality due to hazard events.
- Areas at higher elevations, including South Cooper Mountain, Cooper Mountain, West Slope, Raleigh West, Bonny Slope West, Cedar Hills, Cedar Mill, Bethany, and North Bethany.
- Water supply from the City of Beaverton and the Tualatin Valley Water District, the District's water suppliers. THPRD draws water for irrigation at the Jenkins Estate property and holds several water rights at properties across the District that could be vulnerable to hazard events.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment and safe growth analysis examine the ability of the District to implement and manage a comprehensive mitigation strategy. Strengths, opportunities, and resources of the jurisdiction are identified to develop an effective hazard mitigation action plan. The capabilities identified in this assessment were evaluated collectively to develop feasible recommendations, which support the implementation of effective mitigation activities.

A capability questionnaire was distributed to the District's Technical Committee to initiate this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities. The Technical Committee also completed a safe growth analysis to identify potential gaps in growth guidance instruments and improvements that could be made to reduce vulnerability to future development.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances used by the District, the City of Beaverton, and Washington County that can prevent and reduce the impacts of hazards.

The District does not maintain plans that cover activities falling under the auspices of the City of Beaverton or Washington County, such as land use mapping and transportation management. However, its own properties and assets are well mapped, and the District's environmental policies address best practices in maintaining and restoring protective ecosystems. This is an essential part of operating an organization with unique structural and natural assets. Safety is explicitly included in the District's growth and development policies as Goal 3, and City and County development regulations require development outside of sensitive areas.

The safety of District staff, users of its facilities, and the general community is of considerable importance. The nine-member Safety Services team works with all staff to develop and implement operational safety measures. Plans developed for large and small areas address the need to avoid or mitigate natural hazards, and an evacuation and shelter plan is in place to deal with emergencies from natural hazards.

4.1.1. Types of Plans

The District's 2013 Comprehensive Plan tangentially addresses natural hazards through site and facility maintenance and building standards. It includes no explicit mitigation strategy other than to assess site

maintenance and use energy-efficient building standards, but it may be used to implement mitigation actions and may later be revised to include a larger mitigation focus.

The Capital Improvement Plan includes the preservation and restoration of multiple natural areas, wetlands, and floodplains. It also includes the re-routing and daylighting of streams, enhancing vegetation, modifying hazard trees into wildlife trees, and removing non-native plants and trees.

The Washington County Economic Development Plan includes measures related to the District, as does the County's Transportation Plan.

The District recognizes the need for revisions and updates to the Local Emergency Operations Plan, written in 2007, given the region's significant growth in the past 15 years. The plan is currently being reviewed for updates, and this effort is projected to be completed in 2023. The District does not currently have in place a Continuity of Operations Plan but has begun writing a first draft.

The District follows the 2020 Design and Construction Standards of their water services provider, Clean Water Services, for stormwater management planning and development. The standards set water quality and quantity goals for new construction. The goals may also include efforts to lessen flooding but do not target specific natural hazards.

In 2021, THPRD worked with TVF&R to develop a wildfire management strategy, priorities, and actions to minimize the risk of wildfire in District parks and natural areas, and to mitigate against fire hazards. The District's wildfire planning efforts are complementary and subsidiary to the Washington County Community Wildfire Protection Plan.

The District is in the process of developing a climate action plan that will include mitigation actions, such as shade and cooling in open public spaces, and additional adaptations implemented in parks that may address future climate conditions.

4.1.2. Land Use Planning and Ordinances

The City of Beaverton and Washington County Zoning Ordinances, Subdivision Ordinances, Floodplain Ordinances, and use of FEMA Flood Insurance Rate Maps are administered and enforced by the respective entities. THPRD adheres to these regulations because the District's properties and facilities are within these jurisdictional boundaries. The District follows specific code or ordinance requests from the City, County, and TVF&R, as applicable and appropriate.

The District has a Willing Seller Program for the acquisition of land for open space and public recreation uses. The District acquires several acres of land each year, which may help maintain and increase accessibility to water quantity, cool the local landscape, and serve as emergency gathering areas in the event of an accident or hazard incident.

4.1.3. Building Code, Permitting, and Inspections

The District does not have its own Building Code, Building Codes Effectiveness Grading Schedule (BCEGS) score, or fire department ISO rating and instead uses Washington County ratings. THPRD does not conduct its own site plan review program but requests conditions of approval on City and County projects moving through the development review process.

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff and their skills and tools that can be used for mitigation planning and implementing specific mitigation actions.

The District's Technical Committee will continue to act in the capacity of a planning committee after the conclusion of the NHMP planning process.

THPRD administers maintenance programs to reduce risk, including tree trimming, clearing drainage systems, and landscape maintenance of open spaces and rights of way. An active tree health and hazard program helps reduce the likelihood of damage due to natural hazards. Brush is maintained, and there is a constant effort to eradicate invasive species. Staff conducts a drain check in anticipation of predicted large storm events to prevent unintended water diversion and small-scale flooding.

The District maintains multiple effective mutual aid agreements and planning partnerships, including equipment-sharing agreements with other Washington County agencies, a Red Cross Shelter Agreement, and participation in the Washington County Emergency Management Cooperative.

District staff possesses a strong knowledge of land development and land management practices and have undergone hazard mitigation training. Training efforts for staff will be ongoing after the conclusion of the NHMP planning process. Other assets include an engineer trained in construction practices related to buildings and infrastructure, staff with an understanding of natural hazards, and an ongoing cooperative relationship with the Washington County and Clean Water Services floodplain management staff. The THPRD's Nature & Trails and Design & Development department staff are the primary liaisons to the County and CWS when District projects are in, or may impact, a floodplain.

The Safety Services Manager serves part time as the District Emergency Manager, and staff also work with City of Beaverton and Washington County staff who have expertise in assessing hazard vulnerability. As needed, staff collaborates with Washington County and Clean Water Services on floodplain management efforts to re-meander and straighten streams in order to slow water flow and reduce erosion. District geographic information system (GIS) staffing is adequate, but personnel are not trained in hazard mitigation.

Users of District facilities are able to hear warning signals issued by the City of Beaverton and Washington County. Staff have written and managed grants from local, state, federal, and private funding sources, including grants used for mitigation purposes. Grant-writing capabilities can be utilized as needed to fund mitigation activities.

4.3. Education and Outreach Assessment

The District already has a number of education and outreach programs and methods that could be used to implement mitigation activities and communicate hazard-related information. THPRD's partnerships with other entities may also be leveraged to communicate mitigation-related information and initiatives to its stakeholders and those of partner organizations.

The District collaborates with groups such as the Tualatin Soil & Water Conservation District and the Tualatin Watershed Enhancement Coalition. The latter's Watershed Navigator website and program provide information to the District staff and users of its facilities. The District's website includes a Connect page with links to the Park Watch Report, an e-newsletter, and social media, as well as an Emergency Management page—all vehicles for communicating with District supporters and the greater community. Likewise, all of these communication channels offer opportunities to disseminate messages about the importance of hazard mitigation.

THPRD partner Clean Water Services occasionally holds public meetings at which utility-related improvements that affect the District are discussed. For example, a meeting was held for neighbors and patrons of Tualatin Hills Nature Park to discuss a sanitary sewer line improvement project along Cedar Mill Creek that would run through the park. The meeting offered an opportunity for attendees to provide feedback to Clean Water Services and THPRD staff about detours required for project completion and

possible post-construction trail improvements. These measures were considered mitigation efforts to improve water quality and improve park resilience.

Outreach efforts reach people of all ages when staff from the Tualatin Hills Nature Center deliver a host of environmental education programs for adults, families, and children. This is done at many parks throughout the District, as well as via the traveling Nature Mobile. Preschool and after-school programs Districtwide provide safety-related programs on a regular basis. All of these outreach efforts offer avenues through which mitigation information or actions could be taught and promoted.

While the District is not certified as StormReady, its partner, the City of Beaverton, is.

The District itself is not a Firewise Community but recognizes the importance of fire safety education and mitigation. THPRD works closely with TVF&R to promote fire safety materials and classes. Partnerships with the organizations mentioned above and with Washington County, the City of Beaverton, the American Red Cross, Portland General Electric, the City of Beaverton School District, and the Tualatin Valley Water District have enabled the District to develop a number of avenues for communication about hazards and how to mitigate them, as well as ways each household and business might work with the community to foster resiliency.

4.4. Financial Assessment

The District has access to, or is eligible to potentially use, the following funding resources for hazard mitigation initiatives, many of which have been previously used:

4.4.1. Capital Improvements Project Funding

In 2009, voters approved a measure to raise $4,682,050 in bond capital funds for seismic upgrades at 16 facilities. An additional $18,827 of capital funds were spent to purchase and install gas meter valves at 23 different gas valves in case of an earthquake. Numerous wetland, floodplain, and natural area projects have also been funded.

4.4.2. Property Taxes

Property taxes support THPRD's general fund. This funding could be used to implement future mitigation measures; however, these funds are typically constrained.

4.4.3. Impact Fees for New Development

System development charges support capital improvements to increase program capacity. This money could be used to support future mitigation actions that are part of capacity-increasing capital projects.

4.4.4. Incurrence of Debt Through General Obligation Bonds and/or Special Tax Bonds

THPRD has issued six bond measures since the District's formation in 1955. Funds could be used to fund future mitigation efforts, assuming those efforts were a part of the bond's formal project list approved by voters.

4.4.5. Community Development Block Grant

The District is eligible for these funds; however, THPRD has never received Community Development Block Grant (CDBG) funds because the types of infrastructure built by THPRD are not those that CDBG programs typically fund.

4.4.6. Federal and State Funding Sources

These funding sources are generally limited to park- and trail-specific projects. Mitigation work could be included if it is a necessary piece of the park or trails project.

4.4.7. Public or Private Partnership Funding Sources

Joint funding sources are common, and mitigation work could be included as part of a project's scope of work.

4.5. Capability Expansion and Improvement

Actions that may expand and improve existing authorities, plans, polices, and resources for mitigation include: continuing to update District plans as necessary to ensure they are current and reflect the needs of the community; continuing partnerships with the City of Beaverton and Washington County on planning, codes, and ordinances; adding a part-time emergency manager to devote their full attention to emergency management concerns; adding emergency, natural disaster, and safety-related information to the District's website and social media channels; and collaborating with other NHMP agencies to deliver unified messaging. The District will also ensure there is a mitigation lens on every project undertaken, regardless of funding source.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iv), §201.6(c)(3)(iii), and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) directs local mitigation plans to describe hazard mitigation actions and establish a strategy to implement those actions. Therefore, all other requirements for a local mitigation plan lead to and support the mitigation strategy.

5.1. Mitigation Goals

THPRD did not participate in the 2017 Washington County NHMP; therefore, the Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 City of Beaverton NHMP, 2011 Cities of Cornelius and Forest Grove NHMPs, and 2020 State of Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals detailed in Volume I, Section 3. These goals are the basis of this plan and summarize what the Steering Committee will accomplish by implementing this plan.

5.2. Mitigation Successes

5.2.1. Addressing Flooding and Channel Migration

Throughout 2020 and 2021, the District partnered with Clean Water Services (CWS) to realign the portion of Fanno Creek that runs through Greenway Park and address issues related to flooding and channel migration.

Channel migration was completed over the previously mentioned two-year period, but another flooding issue arose in 2022. Fanno Creek's overflow occurs naturally during the region's wetter months of winter. The wet period was extended because record-level amounts of rain fell well into the summer of 2022. CWS initially worked on a short-term solution to reduce flooding impacts by lowering the beaver-made dam downstream from Scholls Ferry Road twice in July, but the beavers quickly rebuilt the dam.

THPRD and the City of Tigard worked with CWS to quickly prepare the Greenway Park path area for construction using taxpayer dollars from the District and the City, and CWS used in-house construction crews to leverage ratepayer dollars. Work on trail improvement began in August 2022 and was completed in late September 2022. The trail is once again open for public use under Scholls Ferry Road.[508]

5.2.2. Seismic and Compliance Upgrades to THPRD Facilities

A THPRD bond measure was approved by voters in 1994 for District improvements. Additionally, in 2008, the District issued a bond for seismic retrofits for 16 District assets and measures to better protect those who may be using facilities at the time an earthquake occurs. Because District sites are located in and used by residents of multiple communities, as well as those of unincorporated Washington County, upgrades issued by the District improve cross-jurisdictional resiliency.

Since the 1994 bond measure was approved, the District's population has grown by 48,000 residents, or 28%. Another 65,000 residents—30% more than today—are forecast to arrive by 2026. That growth has translated into increased use of THPRD facilities and services. In the last 10 years alone, usage of THPRD programs has increased by 66.7%.

Certain buildings have been expanded to ease crowding and accommodate new services for users of every age across the District. Parks bonds also renovated and rehabilitated facilities, including play structures, bridges, and boardwalks, and made critical safety, seismic, and Americans with Disabilities Act (ADA) access improvements. Improvements funded by the 2008 bond measure were, and are now, being made on an ongoing basis. A special district such as THPRD continually assesses program use and available assets to ensure its programs are optimally meeting community needs.

In 2021, Parks Bond Measure 34-156 to preserve additional natural areas (such as wetlands, forests, and stream corridors) through land acquisition and restoration/enhancement work was passed. Natural areas provide habitat for fish and wildlife and improve water quality.[509] The Park District's Natural Resources Management Plan provides a vision of a network of connected parks that provide for wildlife habitat and migration as well as environmental and recreational needs.[510]

[508] Cortez, J. (2022, September 20). Rainwater Management, Addressing Flooding on the Fanno Creek Trail. https://cleanwaterservices.org/2022/09/20/addressing-flooding-on-the-fanno-creek-trail/
[509] Tualatin Hills Park and Recreation District. (n.d.). Providing for Our Future, Natural Area and Wildlife Habitat Preservation. https://d1vk06ypimt5f2.cloudfront.net/district-information/bond-measure-history/future.cfm
[510] Tualatin Hills Park and Recreation District. (n.d.). Natural Area and Wildlife Habitat Preservation. https://d1vk06ypimt5f2.cloudfront.net/district-information/bond-measure-history/preservation.cfm

5.3. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on mitigation plan requirement 44 CFR §201.6(c)(4)(ii), the vulnerability and capabilities assessments for the District were carefully reviewed and considered when developing the mitigation actions for this plan. The District's Technical Committee will establish a process by which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into the existing local planning strategies.

Once the plan is adopted, the committee will coordinate implementation with the responsible parties in the District and with external stakeholders as needed. The primary means for integrating mitigation strategies will be through the revision, update, and implementation of plans and regulations such as the comprehensive plan, capital improvement plan, and land development regulations, as feasible.

The District's Technical Committee members will be charged with ensuring the goals and strategies of new and updated local planning documents are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.3.1. Comprehensive Plan

Updates to the District's strategic and functional plans will consider and include mitigation strategies, as applicable and appropriate.

5.3.2. Public Engagement, Education, and Outreach

THPRD has established practices for notifying and educating the public, and closing sites due to hazards, such as wildfire smoke, that will be updated as needed. The District will renew its focus on National Preparedness Month to increase opportunities to work with the public.

5.3.3. Day-to-Day Special District Functions

Mitigation strategies and procedures will be considered during the routine update of the District's site functional plans and maintenance procedures when appropriate.

5.3.4. Floodplain Management Program and/or National Flood Insurance Program

The District works to ensure its efforts are in compliance with National Flood Insurance Program (NFIP) standards.

5.3.5. Economic Development Plans and Policies

Actions related to THPRD's financial sustainability plans include future bond measures that can fund District improvements and mitigation initiatives.

5.3.6. Emergency Plans That Address Evacuation and Sheltering

The District has communication plans to inform the public and staff about how to respond to hazards. Staff will ensure proper HVAC systems are in place, emergency power is accessible, and buildings are retrofitted for earthquake resilience. District policies and plans include one for evacuation and sheltering. The District is in the process of developing an emergency management page for its website to further information-sharing capabilities.

5.3.7. Enforcement of Existing Policies

District staff will continue to receive training on how to enforce standards for maintaining THPRD sites and compliance with best practice initiatives.

5.3.8. Day-to-Day Development, Review, and Prioritization of Policies

Functional plan standards that dictate THPRD design standards are included in the routine District policy development, review, and prioritization processes.

6. Action Items

Action items for the 2023 NHMP were determined by the District's Technical Committee based on the review of its risk assessment, its existing capabilities, and the status of its previous action items. This comprehensive range of actions includes local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.1 and 6.2 below. Additional information about how these actions were developed, evaluated, and prioritized is in Volume I, Section 3.

6.1. Tualatin Hills Park & Recreation District Action Items: 2023 Washington County NHMP

Table 262: Tualatin Hills Park & Recreation District Action Items

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
1	Park landscaping, turf, and trees require a great deal of water and irrigation equipment. This project will evaluate current irrigation systems to ensure they meet each park's goals, and also determine how to reduce water usage at each site, while maintaining current services. To preserve important shade trees as the climate warms, new irrigation will be considered. Computer-related control systems, as well as new irrigation heads/systems, will be installed.	Drought	High
2	With climate change concerns, unpredictable droughts, and high energy prices across the country, the District will look for ways to conserve resources, cut costs, and minimize programmatic environmental impacts.	Drought	Medium
3	Consider the feasibility and infrastructure requirements of seismic upgrades at the Fanno Creek Service Center, which would serve as the emergency operations center for THPRD in the event of an earthquake or other major disaster.	Earthquake	High

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
4	Consider the feasibility of adding solar panels at the Fanno Creek Service Center, which would serve as the emergency operations center for THPRD in the event of an earthquake or other major disaster. Should power lines be damaged during an earthquake, the Center would turn to backup solar power in order to continue functioning as an emergency operations center.	Earthquake	High
5	Prepare and equip THPRD facilities to serve as cooling centers during extreme heat events. This includes adding air conditioning capacity and air filtration units, as well as additional equipment.	Extreme Heat	Medium
6	Update THPRD's Athletic Facility Functional Plan to assess current conditions, investigate best practices, and outline future action to address extreme heat.	Extreme Heat	High
7	Install detention and retention facilities such as vegetated parking lot swales, rain gardens near buildings, and green roofs to reduce water from impervious areas that contribute to flooding.	Flooding	Medium
8	Conduct stream bank stabilization projects, including grading, adding large wood, placing soil lifts, re-meandering straightened streams, and planting banks with native trees, shrubs, and herbs.	Flooding	Medium
9	Revegetate steep slopes to treat seepage zones and control surface erosion. These bioengineering techniques fit well with natural ecological restoration.	Landslide	Medium
10	Expand public knowledge of the risks and dangers of unstable steep slopes through the website and public event engagement.	Landslide	Low
11	Develop guidelines and best practices for staff on how to prevent or minimize facility impacts if there is a volcanic ash event.	Volcanic Ash	Low
12	Develop plans and protocols to do the following during a hazard event: shut down filtration at all outdoor pools and splash pads for THPRD, cover pools with winter covers to prevent ash from entering the pool water, remove covers only when the event is over, use cleaning flocculant in pools and vacuum pools prior to restarting circulation, and clean all surfaces with a power washer.	Volcanic Ash	Low
13	Regular mowing, pruning, and chipping of fine fuels such as grasses, branches, and yard debris piles at residential and natural area interfaces.	Wildland Fire	High

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
14	Increase the District's ability to transfer data among its numerous sites via wireless technology (public 5G, private LTE/5G, and/or long-range 5GHz WiFi).	Wildland Fire, Windstorm, including tornado, and Winter Storm	Medium
15	Establish a tree response equipment pool to proactively prune trees and clear those that fall during a windstorm or tornado. Equipment includes a spider lift, chipper, chainsaws, safety equipment, trailers, and hand tools.	Windstorm, including tornado	High
16	Prepare and equip THPRD facilities to serve as warming centers during extreme cold events. This includes evaluations of boilers and heating systems at the five facilities designated as warming centers.	Winter Storm	High
17	This project would consider the feasibility study and condition of asset analysis of the roof at the HMT Athletic Center, which would serve as a community shelter and warming center during extreme winter storm events.	Winter Storm	Medium

Note: THPRD is not vulnerable to dam failure and therefore does not have action items to address this hazard.

6.2. 2023 Mitigation Action Information Worksheets

Table 263: Park Water Resource Conservation

Mitigation Action Information			
Title of action	Park Water Resource Conservation		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☒ Public education/awareness ☐
Action description	Park landscaping, turf, and trees require a lot of water and irrigation equipment. This project will evaluate current irrigation systems, to ensure they meet each park's goals and to determine how to reduce water usage at each site, while maintaining current services. To preserve important shade trees as the climate warms, new irrigation will be considered. Computer related control systems as well as new irrigation heads/systems will be installed.		
Hazard(s) addressed	Dam failure ☐ Drought ☒ Earthquake ☐ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Properly functioning irrigation provides critical means to use water to maintain turf and woody vegetation. This provides important community health and recreation benefits, as well as water conservation.		
Area of action impact	Two hundred different properties in THPRD's service area.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Meets goals in THPRD's Parks and Athletic Facilities Functional Plans.		
Alignment with existing plans and policies	See above.		

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☐ High ☒		
Lead position, office, department, or division responsible for implementation	Park Maintenance Department		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Nature & Trails department, Parks Services department		Water conservation agencies	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
THPRD operating funds, bond funds, capital improvement funds		Funding & Technical Assistance for Climate Adaption, Environmental Quality Incentives Program	
Estimated Cost	$250,000.00		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Saving water means it can be used for other purposes. Using water wisely protects park landscapes and enhances community health needs.		$1,500,000.00	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			
Implementation Benchmarks: How Will Success Be Measured?			
Potential Challenges to Implementation			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 264: Drought-Tolerant Plant Program

Mitigation Action Information	
Title of action	Drought-Tolerant Plant Program
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	With climate change concerns, unpredictable droughts, and high energy prices across the country, it is time to look for ways to conserve resources, cut costs, and minimize environmental impacts.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☒ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Planting new or replacing dead plants with those that are drought tolerant is critical to maintaining balanced and viable eco-systems. As our area's climate continues to warm, droughts have become commonplace.
Area of action impact	Two hundred different properties in THPRD's service area.
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	Meet goals in THPRD's Parks Functional Plans.
Alignment with existing plans and policies	See above
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Park Maintenance Department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Design and Development, Nature and Trails Dept.	
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
THPRD operating funds, Capital Improvement funds, bond funds	Aquatic Ecosystem Restoration, Urban Waters Small Grants Program, Emergency Watershed Protection, Landscape Planning Programs Environmental Quality Incentives Program
Estimated Cost	$150,000.00

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Drought-tolerant plants have built-in features to minimize water loss and maximize water uptake.		$900,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☐ Ongoing ☒		

Implementation Benchmarks: How Will Success Be Measured?

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 265: Feasibility Study and Analysis of Seismic Upgrades at THPRD Fanno Creek Service Center

Mitigation Action Information	
Title of action	Feasibility Study and Analysis of Seismic Upgrades at THPRD Fanno Creek Service Center
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	This project would consider the feasibility and infrastructure requirements of seismic upgrades at the Fanno Creek Service Center, which would serve as the emergency operations center for THPRD in the event of an earthquake or other major disaster.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Allows THPRD to remain a critical communications partner during earthquake or other natural disasters. Key operational staff in maintenance, IS, fleet services, and facilities would report to the center in order to develop response plans for the community. The district currently does not have a resilient emergency operation center.
Area of action impact	Entire THPRD service area.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Fanno Creek Service Center: 6220 SW 112th Ave. Suite 100, Beaverton, OR 97008
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☒ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	Potentially integrated with future capital improvement program and bond measure planning.
Alignment with existing plans and policies	This project would align with and inform THPRD's internal emergency operations plan.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	THPRD's Design & Development and Maintenance Operations departments would coordinate contracting and consulting efforts. Communications and Risk & Safety departments would play support roles.

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Design & Development, Maintenance Operations, IS, and Communications	Washington County, City of Beaverton
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
THPRD Capital Improvement Plan, Bond, EMPG program	BRIC Grant, Hazard Mitigation Grant Program, Homeland Security Grant
Estimated Cost	$100,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Protection of life and safety	Ensuring an operational emergency operations center for THPRD. Sustained communication to the public and other local agencies during natural hazards. Could serve as temporary shelter (housing) for impacted staff and/or those who need to report in an emergency situation.	$600,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	2023	2025

Implementation Benchmarks: How Will Success Be Measured?
• Securing funding and project buy-in • Hiring consultants/engineering firm to conduct assessment • Use study to secure future funding
Potential Challenges to Implementation
• Securing funding, hiring consulting/engineering firm
Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 266: Feasibility Study of Solar Power Installation at THPRD Fanno Creek Service Center

Mitigation Action Information	
Title of action	Feasibility Study of Solar Power Installation at THPRD Fanno Creek Service Center
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	This project would consider the feasibility of adding solar panels at the Fanno Creek Service Center, which would serve as the emergency operations center for THPRD in the event of an earthquake or other major disaster. Should powerlines be damaged during an earthquake this center would turn to back-up solar power in order to continue functioning as an EOC.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Allows THPRD to remain a critical communications partner during earthquake or other natural disasters. Key operational staff in maintenance, IS, fleet services, and facilities would report to the center in order to develop response plans for the community.
Area of action impact	Entire THPRD service area.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Fanno Creek Service Center: 6220 SW 112th Ave. Suite 100, Beaverton, OR 97008
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	Potentially integrated with future capital improvement program and bond measure planning.
Alignment with existing plans and policies	This project would align with and inform THPRD's internal emergency operations plan.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	THPRD's Design & Development and Maintenance Operations departments would coordinate contracting and consulting efforts. Communications and Risk & Safety departments would play support roles.

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Design & Development, Maintenance Operations, IS, and Communications	Washington County, City of Beaverton
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
THPRD Capital Improvement Plan, Bond, EMPG program	BRIC Grant, Hazard Mitigation Grant Program, Homeland Security Grant
Estimated Cost	$100,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Protection of life and safety	Ensuring an operational emergency operations center for THPRD. Sustained communication to the public and other local agencies during major disasters. Alternate source of power at any time traditional electric power is interrupted.	$600,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	2023	2025

Implementation Benchmarks: How Will Success Be Measured?

- Securing funding and project buy-in
- Hiring consultants/engineering firm to conduct assessment
- Use study to secure future funding for installation project

Potential Challenges to Implementation

- Securing funding, hiring consulting/engineering firm

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 267: Cooling Centers for Extreme Heat Events

Mitigation Action Information	
Title of action	Cooling Centers for Extreme Heat Events
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Prepare and equip THPRD facilities to serve as cooling centers during extreme heat events. This includes added air conditioning capacity and added air filtration units as well as additional equipment.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☒ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	With rising temperatures during the summer months and many community members without the means or ability to access locations to temporarily cool down, these community centers will serve as a free option for respite from the heat.
Area of action impact	Entire THPRD service area, Washington County
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? THPRD Athletic Center, THPRD Tennis Center, Cedar Hills Recreation Center, Garden Home Recreation Center, Conestoga Recreation & Aquatic Center
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Statewide Planning Goals 8 & 11
Alignment with existing plans and policies	THPRD Climate Action Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	THPRD's Recreation department, Sports & Inclusion department, Risk & Safety department, Communications department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Recreation, Sports & Inclusion, Risk & Safety, Communications	Washington County, City of Beaverton
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
THPRD Capital Improvement Plan, Bond funds	Funding & Technical Assistance for Climate Adaption, HMA, BRIC, Community Development Block Grants, FEMA HMAG, Oregon HMA
Estimated Cost	$500,000.00

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Protection of life and safety		$3,000,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	2024	2026

Implementation Benchmarks: How Will Success Be Measured?

- Securing funding and project buy-in
- Implementation of cooling center plan, in partnership with Washington County
- Communication to public regarding availability
- Execution of plan during heat-related events
- Additional air-conditioned buildings

Potential Challenges to Implementation

- Funding, staffing, coordination with other local agencies

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Do nothing.	0	Doing nothing will cause increased problems over time.
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 268: Athletic Facilities Functional Plan Updates

Mitigation Action Information	
Title of action	Athletic Facilities Functional Plan Updates
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Update THPRD's Athletic Facility Functional Plan to assess current conditions, investigate best practices, and outline future action to address extreme heat.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☒ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	District athletic facilities are heavily used during the summer months, when extreme heat events are becoming increasingly more common. The district's Athletic Facilities Functional Plan is out of date and does not currently address extreme heat at these facilities. Updating the Athletic Facilities Functional Plan and including extreme heat guidance will help ensure those people who use district facilities continue to be able to do so safely. Will also ensure continued use as county-wide cooling centers.
Area of action impact	Entire THPRD service area, Washington County
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? THPRD Athletic Center, THPRD Tennis Center, Cedar Hills Recreation Center, Garden Home Recreation Center, Conestoga Recreation & Aquatic Center, PCC Rock Creek Complex
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Oregon Statewide Planning Goals 8 & 11
Alignment with existing plans and policies	THPRD's Comprehensive Plan & Climate Action Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	THPRD's Planning Department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Recreation, Sports & Inclusion, Risk & Safety, Maintenance Operations, Design & Development	Washington County, City of Beaverton
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
THPRD Capital Improvement Plan, System Development Charge Funds	State of Oregon Technical Assistance Grants, Community Development Block Grants, FEMA HMAG Grant, Oregon OEM HMA Grant
Estimated Cost	$75,000.00

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Protection of life and safety		$450,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	2023	2025

Implementation Benchmarks: How Will Success Be Measured?

- Securing funding and project buy-in
- Studying existing conditions
- Developing goals and objectives
- Drafting an updated plan
- Board adoption of the updated plan

Potential Challenges to Implementation

- Funding, staffing, coordination with other local agencies

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Do nothing.	0	Doing nothing will cause increased problems over time.
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 269: Green Infrastructure

Mitigation Action Information			
Title of action	Green Infrastructure		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☐		Natural systems protection ☒ Public education/awareness ☐
Action description	Install detention and retention facilities such as vegetated parking lot swales, rain gardens near buildings, and green roofs to reduce waters from impervious areas that contribute to flooding.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☒ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Adding green infrastructure to existing facilities that aren't treated can capture, infiltrate, or slow water to reduce contributions to streams and rivers. By slowing flows during heavy rain events, flooding can be reduced or avoided downstream.		
Area of action impact	Improve facilities at Fanno Creek Service Center, HMT Recreation Complex, Cedar Hills Recreation Center, Harman Swim Center, Conestoga Rec & Aquatic Center, Cedar Hills Rec Center, PCC Rock Creek, Garden Home Rec.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	THPRD Community Visioning Plan, THPRD Parks Functional Plan, Natural Resources Functional Plan, Statewide Planning Goal 6, Clean Water Services Design & Construction Standards		
Alignment with existing plans and policies	These actions fit Clean Water Services' Healthy Streams Plan and THPRD's Natural Resources Functional Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	THPRD's Design & Development Department		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
THPRD's Nature & Trails Department	Clean Water Services
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
THPRD capital improvement funds, bond funds, Clean Water Services Surface Water Management Funds	Water Grants, Urban Waters Small Grants Program, Climate Adaption Funding & Tech Asst., 319 Clean Water Program, EPA Green Infrastructure
Estimated Cost	$50,000 to $400,000 per project. Average of $200,000 per project – four projects = $800,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Reduced water run-off leaving sites.	Mitigates downstream flooding	$4,800,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Benchmarks: How Will Success Be Measured?
• Each project will have a planning, design, and installation phase. Completion of phases shows success.

Potential Challenges to Implementation
• Lack of funding, complex permitting requirements.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 270: Stream Bank Restoration

Mitigation Action Information			
Title of action	Stream Bank Restoration		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☐		Natural systems protection ☒ Public education/awareness ☐
Action description	Conduct stream bank stabilization projects including grading, adding large wood, placing soil lifts, re-meandering straightened streams, and planting banks with native trees, shrubs, and herbs.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☒ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Improving stream banks prevents erosion, slows water, adds storage capacity, and can allow streams to spread into natural floodplains, which lessen water impacts or developed assets.		
Area of action impact	Rock, Bronson, Willow, Beaverton, Butternut, Fanno, Cedar Mill, Johnson Creeks and their tributaries.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	City of Beaverton and Washington County flood control plans; Statewide Planning Goal 6		
Alignment with existing plans and policies	These actions fit Clean Water Services' Healthy Streams Plan, THPRD's Natural Resources Functional Plan, and the Tualatin Watershed Enhancement Coalition's vision for Cedar Mill/Johnson Creek.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	THPRD's Nature & Trails Department		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Planning, Design & Development, and Communications departments	Clean Water Services
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
THPRD capital improvement and bond funds, Clean Water Services Surface Water Management Funds	Aquatic Ecosystem Restoration, NFIP, FMA, EPA 319 Clean Water Act Non-Point Source Program, OR Watershed Enhancement Board Restoration
Estimated Cost	$100,000–$500,000 per project, 10 projects, up to $5,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Reduced flooding of infrastructure.	Improved natural eco-systems.	$30,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Benchmarks: How Will Success Be Measured?
• Implementation of projects, visual observation of stream access to natural flood plains, reduced erosion/bank sloughing of creeks, increase in native plant cover in streamside areas.

Potential Challenges to Implementation
• Lack of funding, complex permitting requirements.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Do nothing.	$0	Doing nothing will cause increased problems over time.
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 271: Steep Slope Revegetation

Mitigation Action Information	
Title of action	Steep Slope Revegetation
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Revegetate steep slopes to treat seepage zones and control surface erosion. The bioengineering techniques used fit well with natural ecological restoration.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☒ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Mitigates areas district-wide where unstable steep slopes may endanger buildings, roadways, trails, and natural areas.
Area of action impact	Entire THPRD service area
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☒ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	State of Oregon & Washington County NHMP
Alignment with existing plans and policies	THPRD Visioning Plan, Nature & Trails Comprehensive Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Nature & Trails department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Design & development department, Communications department	Tualatin Valley Soil Conservation District

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital improvements plan, bond funding, Soil Conservation District grants	Aquatic Eco-System Restoration, Landscape Planning Programs
Estimated Cost	$100,000.00

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Stable slopes provide for safe and secure natural areas	Potential damage to structures/infrastructure is minimized.	$600,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	2024	2027

Implementation Benchmarks: How Will Success Be Measured?
• Number of slopes mitigated

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 272: Public Education for Landslide Prevention

Mitigation Action Information	
Title of action	Public Education for Landslide Prevention
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Expand public knowledge of the risks and dangers of unstable steep slopes through the website and public event engagement.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☒ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Expands public knowledge of risk/dangers of unstable steep slopes through website and public event engagement.
Area of action impact	Entire service area, including City of Beaverton and Washington County.
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	
Alignment with existing plans and policies	
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	Communications department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Nature & Trails department	City of Beaverton, Washington County

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	Aquatic Ecosystem Restoration, The Nature Conservancy
Estimated Cost	$50,000.00

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Public safety/education	Preservation of critical infrastructure such as facilities and roads.	$300,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☐ Ongoing ☒	2026	

Implementation Benchmarks: How Will Success Be Measured?

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 273: Increase Resilience for Volcanic Ashfall

Mitigation Action Information			
Title of action	Increase Building Resilience for Volcanic Ashfall		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	To develop guidelines and best practices for staff on how prevent or minimize facility impacts if there is a volcanic ash event.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☒	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	It would allow THPRD facilities to continue to operate after the volcanic ash event, with no, or minimal damage to infrastructure.		
Area of action impact	Entire service area boundary		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? All THPRD buildings.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	Potential to integrate with future capital improvement program (outdoor pools) and district Best Practices.		
Alignment with existing plans and policies	THPRD's internal emergency operation plan.		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Maintenance operations, Facilities maintenance, Aquatic maintenance.		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Maintenance operations, Facilities maintenance, Aquatic maintenance.		Washington County	

Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
THPRD capital improvement plan		Hazard Mitigation Grant Program	
Estimated cost	$25,000.00		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Minimize property damage, and disruption of essential infrastructure		$150,000.00	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	2024	2026	
Implementation Benchmarks: How Will Success Be Measured?			
Potential Challenges to Implementation			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 274: Outdoor Pools and Volcanic Ash

Mitigation Action Information			
Title of action	Outdoor Pools and Volcanic Ash		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐		Natural systems protection ☐ Public education/awareness ☐
Action description	Develop plans & protocols to do the following: shut down filtration to all outdoor pools & splash pads for THPRD; cover pools with winter covers to prevent ash from entering the pool water, only remove covers when event is over, use flocculant in pool and vacuum pool prior to restarting circulation; clean all surfaces will power washer.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☐ Landslide ☐ Volcanic ash ☒ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	It would prevent THPRD outdoor pools and splash pads filter systems from being damaged during ash events.		
Area of action impact	Outdoor pools and splash pads		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Potential to integrate with future capital improvement program		
Alignment with existing plans and policies	This project would align with and inform THPRD's internal emergency operation plan.		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Maintenance operations, Aquatic Maintenance, Facilities Maintenance		

Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Maintenance operations, Aquatic Maintenance, Facilities Maintenance		Washington County	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
THPRD capital improvement plan		Hazard Mitigation Grant Program	
Estimated Cost	$5,000.00		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Minimize property damage and disruption of essential infrastructure		$30,000.00	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	2024	2025	
Implementation Benchmarks: How Will Success Be Measured?			
Potential Challenges to Implementation			
Resources and References, if Applicable			
Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 275: Wildland Fire Fuel Reduction

Mitigation Action Information			
Title of action	Wildland Fire Fuel Reduction		
Type of action	Plans/regulations ☐		Natural systems protection ☒
	Structure and infrastructure project ☐		Public education/awareness ☐
Action description	Mowing, pruning, and chipping of fine fuels such as grasses, branches, and yard debris piles at residential/natural area interfaces.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	By removing fine fuels from primary ignition sources (people), the likelihood of a wildfire is significantly reduced. These actions are consistent with the Tualatin Valley Fire & Rescue (TVF&R)/THPRD Wildfire Reduction Plan.		
Area of action impact	Approximately 50 urban natural areas district-wide.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	TVF&R Wildfire Reduction Plan		
Alignment with existing plans and policies	THPRD Natural Area Wildfire Management Strategy		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Nature & Trails department		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Parks Maintenance	TVF&R, Washington County, City of Beaverton
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	HMGP, HMA, NFP
Estimated Cost	$150,000.00

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Reduction in the number of fires spreading off of THPRD property	Healthy forests and natural areas	$900,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☐ Ongoing ☒	Fall 2022	Ongoing

Implementation Benchmarks: How Will Success Be Measured?

- Implement funded plan
- Seek funding/continue partnership with TVF&R

Potential Challenges to Implementation

- Securing ongoing funding and staff availability

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	Estimated Cost	Evaluation
Alternative #1	No action/allow natural processes to continue	$0	
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 276: Increase Wireless Capabilities District-Wide

Mitigation Action Information	
Title of action	Increase Wireless Capabilities District-Wide
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☒
Action description	Increase the District's ability to transfer data among its numerous sites via wireless technology (Public 5G, Private LTE/5G, and/or Long Range 5Ghz Wi-Fi)
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	During wildfire and heavy wind events, data communication lines that run on poles as well at underground can be affected by the natural hazard. The ability to transmit data between our sites ensures business continuity in such a disaster and allows us to act in an emergency ops/response capacity. Also permits seamless communication with the entire service area.
Area of action impact	Entire service area
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Admin Building, Fanno Creek Service Center, Warming/Cooling Shelters, designated long-term shelters
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	City of Beaverton & Washington County Emergency Operations Plans
Alignment with existing plans and policies	THPRD Emergency Operations Plans
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Information Services/Facilities Maintenance

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Information Services Dept, Facilities Maintenance Teams, Trades Team	City of Beaverton, Washington County
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund, MACC Grant	Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities
Estimated Cost	$75,000.00 for equipment, and $25,000.00 for implementation support. Ongoing licensing and equipment replacement is estimated at $15,000 annually

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Limit disruption of essential infrastructure Enhance the ability of the District to assist in emergency operations	Build resilience in our network infrastructure and add capacity/bandwidth at our hard-to-reach locations. For example, facilities that do not currently have fiber connectivity and don't exist near current infrastructure to support such connectivity.	$600,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	Winter 2026	Winter 2027

Implementation Benchmarks: How Will Success Be Measured?

- Securing funding and project buy-in
- Procuring equipment
- Implementation complete
- Staff training
- Transmit data between key District sites wirelessly

Potential Challenges to Implementation

- The technology is new to the District, and there will need to be some education in this area in order for the staff to be able to support the installation and ongoing maintenance of such technology.
- Additionally, the full adoption of 5G has been delayed, and as the technology matures, we will need to be prepared to adapt to those changes.
- Finally, as this is something the district has never done before, securing funding may be a challenge.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 277: Tree Evaluation/Remediation

Mitigation Action Information	
Title of action	Tree Evaluation/Remediation
Type of action	Plans/regulations ☐ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	After a windstorm, trees can fail, leading to blocked infrastructure and damage to buildings and park facilities. This project will set up a tree response equipment pool to both proactively prune trees as well as to clear them if they fall during a storm. The equipment will include a spider lift, chipper, chainsaws, safety equipment, trailers, and hand tools.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	The tools identified will allow staff to prevent some tree failures in advance, reducing damage and risk. It will also enable staff to clear downed trees or abate dangerous trees after a storm event quickly and safely.
Area of action impact	Entire service area.
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	Cooperative Public Agencies of Washington County (countywide equipment sharing)
Alignment with existing plans and policies	THPRD's Vision Action Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Nature & Trails Department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Park Maintenance Department	All Washington County government agencies
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
THPRD operating funds, bond funds	USDA, NRCS – maybe Emergency Watershed Protection Program
Estimated Cost	$250,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Increased safety, tree preservation, improved speed of recovery after an event.		$1,500,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	2023	

Implementation Benchmarks: How Will Success Be Measured?
• Acquisition and use of equipment.

Potential Challenges to Implementation
• Lack of funds.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 278: Warming Shelters During Extreme Cold Events

Mitigation Action Information	
Title of action	Warming Shelters During Extreme Cold Events
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Prepare and equip THPRD facilities to serve as warming centers during extreme cold events. This includes evaluations of boilers and heating systems at the five facilities designated as warming centers.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	When temperatures drop below freezing during the winter months, there are many community members without the means or ability to access locations to temporarily warm themselves. These community centers will serve as a free option for respite from the freezing temperatures.
Area of action impact	Entire THPRD service area, Washington County
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? THPRD Athletic Center, Cedar Hills Recreation Center, Garden Home Recreation Center, Elsie Stuhr Center, Conestoga Recreation & Aquatic Center
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	THPRD Emergency Shelter Plan
Alignment with existing plans and policies	Washington County & City of Beaverton Shelter Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	THPRD Recreation department & Sports & Inclusion department

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Recreation, Sports & Inclusion, Risk & Safety, Communications	American Red Cross, Washington County
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital Improvement funds, bond measure funding	Funding & Technical Assistance for Climate Adaption, HMA, BRIC
Estimated Cost	$100,000.00

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Protection of life and safety		$600,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	2024	2025

Implementation Benchmarks: How Will Success Be Measured?
• Securing funding and project buy-in • Implementation of warming center plan, in partnership with Washington County • Communication to public regarding availability • Execution of plan during extreme cold weather events

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 279: Feasibility Study and Analysis of Roof at THPRD Athletic Center

Mitigation Action Information	
Title of action	Feasibility Study and Analysis of Roof at THPRD Athletic Center
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	This project would consider the feasibility study, and condition of asset analysis of the roof at the HMT Athletic Center, which would serve as a community shelter/warming center during extreme winter storm events.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Allows THPRD Athletic Center to remain a critical partner in having warming shelter available to many community members that do not have the means or ability to access locations during extreme cold weather winter storm events.
Area of action impact	Entire THPRD service area, Washington County
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? THPRD Athletic Center
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Potentially integrated with future capital improvement program and bond measure planning.
Alignment with existing plans and policies	This project would align with and inform THPRD's internal emergency operations plan, as well as American Red Cross and Washington County Shelter Plans.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Design and Development, Maintenance Operations

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Recreation, Sports & Inclusion, Risk & Safety, Communications	American Red Cross, City of Beaverton, Washington County
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
THPRD Capital Improvement Plan, Bond, EMPG program	BRIC Grant, Hazard Mitigation Grant Program, Homeland Security Grant, HMA
Estimated Cost	$50,000.00

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Protection and safety from extreme cold weather	Ensuring an operational emergency operations center for community members during extreme cold weather events.	$300,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	2026	2028

Implementation Benchmarks: How Will Success Be Measured?

Potential Challenges to Implementation
• Securing funding and project buy-in • Hiring consultants/engineering firm to conduct assessment • Use study to secure future funding

Resources and References, if Applicable
• Securing funding, hiring consultant/engineering firm

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Annex J: Tualatin Valley Water District

1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for the Tualatin Valley Water District (TVWD) was the Emergency Program Coordinator.

1.2. Annex Organization

This annex has six sections that satisfy mitigation requirements in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

The information provided in this annex is for TVWD alone. All pertinent information that is not identified in this annex is identified in other sections of this NHMP or within the respective appendices.

1.3. NHMP Adoption Process

Once the Washington County NHMP received the designation “Approvable Pending Local Adoption” from the Federal Emergency Management Agency (FEMA), TVWD presented the plan to the Board of Commissioners for final public comment and local adoption. A copy of the resolution was inserted into the NHMP and is held on file at TVWD and Washington County.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

District officials recognize the benefits of having a long-term, all-hazards approach to mitigating natural hazards. The passage of the Disaster Mitigation Act of 2000 (DMA 2000) enabled District officials to recognize the benefits of having a long-term, all-hazards approach to hazard mitigation and mitigating natural hazards. The District's involvement in the Washington County NHMP represents the collective efforts of the NHMP Steering Committee members, all participating local Technical Committee members, the public, and stakeholders.

The District developed this annex in accordance with guidance outlined in 44 CFR §201.6(c)(5) of DMA 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in the geographical service area of the District.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP. An open involvement process was established for the public and all stakeholders, which provided an opportunity for everyone to be involved in the planning process and make their views known.

Two teams worked simultaneously on this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of points of contact from each plan participant. The group met to discuss countywide topics, including hazards and mitigation strategies. The points of contact were the leads of their local Technical Committee.
2. **Local Technical Committee:** Each plan participant had a Technical Committee that consisted of the Steering Committee representative for that jurisdiction or special district as well as designated representatives from within the organization. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. Tualatin Valley Water District Technical Committee

The TVWD annex of the overall NHMP was developed by the local Technical Committee of the TVWD with support from IEM, a consulting firm hired to assist with the planning process. The efforts of the committee, which took place throughout 2022, were led by the Emergency Program Coordinator.

Table 280: Tualatin Valley Water District Technical Committee Members for the 2023 NHMP

Position	Department	Role in Committee and Planning Process
Emergency Program Coordinator	TVWD Administrative Services	General oversight, hazard identification, and plan development
Capital Improvements Program Manager	TVWD Engineering Division	Hazard identification and plan development
Geographic Information System (GIS) Analyst	TVWD Asset Management Division	Hazard identification and plan development
Water Operations Division Manager	TVWD Engineering and Operations	Hazard identification and plan development
Risk Management Coordinator	TVWD Administrative Services	Hazard identification and plan development
Communications and Public Affairs Support	TVWD Customer Service	Communications, community outreach, education, and general support
Chief Operating Officer	TVWD COO	Strategic planning guidance and oversight

In addition, IEM participated in the following activities associated with development, approval, and adoption of the plan:

1. Facilitated the NHMP update process.
2. Based on committee direction and stakeholder and community input, prepared the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.
3. Submitted the proposed plan to the Oregon Department of Emergency Management (OEM) and the Federal Emergency Management Agency (FEMA) for review and approval and completed any edits requested by these organizations.
4. Coordinated plan adoption processes with TVWD, OEM, and FEMA.

2.3. Public Participation

Public participation is an important component of this NHMP. Public participation offers community members the chance to voice their ideas, interests, and opinions. In addition to FEMA's public participation requirement, Oregon's land use system addresses the need for public participation in Statewide Land Use Planning Goal 1, Citizen Involvement, which ensures the opportunity for the community to be involved in the planning process.

A survey regarding community perceptions of natural hazards and priorities was administered and used to help the Steering and Technical committees update their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP. See Appendix B of the NHMP for additional information.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist TVWD in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards.

3.1. Tualatin Valley Water District Profile

This section provides information on TVWD-specific characteristics. Additional discussion of the planning area's community characteristics is outlined in Appendix A of the NHMP.

Many of these characteristics can affect how natural hazards impact the TVWD service area and how the District chooses to plan for natural hazard mitigation. Considering TVWD-specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

The TVWD was founded in 1991 with the merger of the Wolf Creek and Metzger Water Districts and serves an estimated 224,600 customers throughout Washington County and surrounding areas that include the cities of Beaverton, Hillsboro, and Tigard.[511] The District has 133 employees, covers 26,000 acres, 40 pressure zones, 759 miles of pipe, 21 active storage reservoirs, and 12 pump

[511] Tualatin Valley Water District. (2021, December 20). Annual Comprehensive Financial Report. https://www.tvwd.org/sites/default/files/fileattachments/finance/page/2176/2021_tvwd_acfr_final.pdf

stations.[512,513,514,515] TVWD supplies an average of about 23 million gallons of water per day. The District receives approximately 72% of its water from the Portland Water Bureau (PWB). This water primarily comes from the Bull Run watershed and is piped to a 50-million-gallon storage reservoir on Powell Butte, located on the east side of Portland. Around 28% of TVWD's water comes from the Joint Water Commission (JWC), which is jointly owned by the District and the Cities of Hillsboro, Beaverton, and Forest Grove. The JWC source is comprised of water from Hagg Lake (Scoggins Reservoir) and the Barney Reservoir released into the upper portion of the Tualatin River. When flows are available, water from the Tualatin River is used. When the Willamette Water Supply System (WWSS) is operational in 2026, the Willamette River will be an additional water source. The WWSS is currently under construction and will be operational during the five-year timeframe of this NHMP. The Willamette Water Supply System Commission (WWSS Commission) is an Oregon intergovernmental entity formed by TVWD, the City of Hillsboro, and the City of Beaverton.

The WWSS Commission was formed to build the WWSS in response to planned growth in their service areas. The WWSS will provide an additional, resilient water supply for Washington County.

TVWD has been designated the Managing Agency for the WWSS Commission, and TVWD operates the Willamette Water Supply Program (WWSP) to plan, design, and construct the WWSS. When completed TVWD, as the Managing Agency, will be responsible for future mitigation planning and action. Additional information about the WWSP is in Section 7 of this annex.

[512] Tualatin Valley Water District. (n.d.). Getting Water to You. https://www.tvwd.org/district/page/getting-water-you
[513] Tualatin Valley Water District. (n.d.). Water System and Sources. https://www.tvwd.org/district/page/water-system-and-sources
[514] Carollo Engineers. (2016, May 17). Master Planning for Seismic Reliability and Resiliency: Tualatin Valley Water District. PowerPoint Presentation
[515] TVWD NHMP Planning Documentation

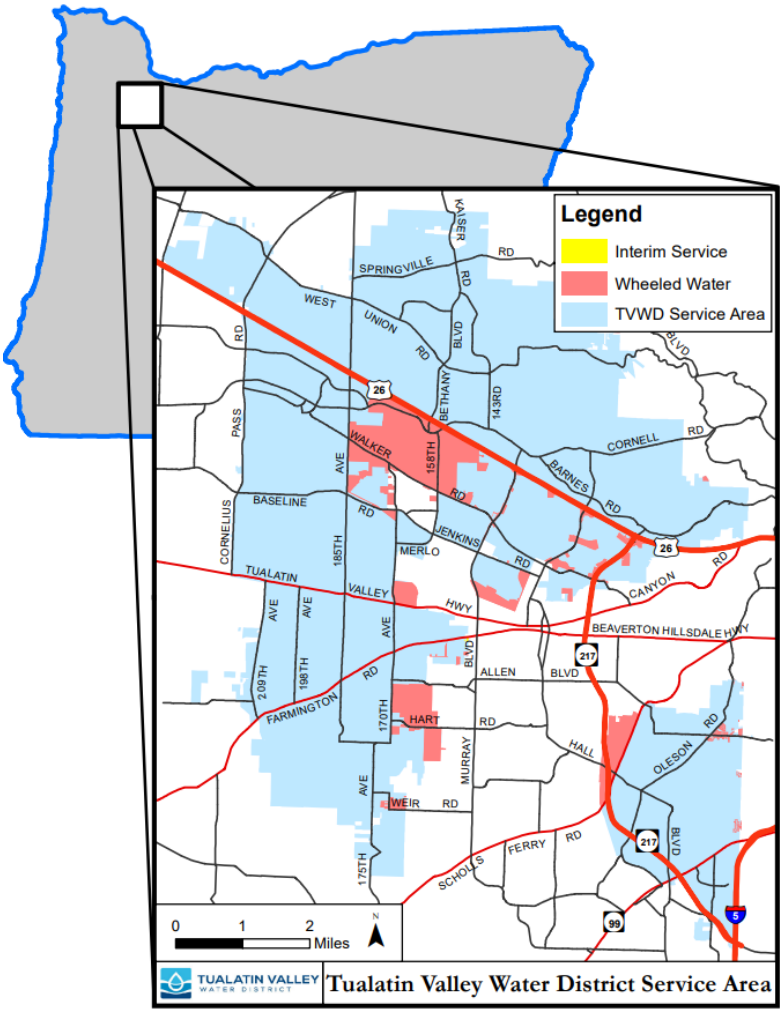


Figure 40: Tualatin Valley Water District Service Area

The District's pipes range from 2 to 60 inches, and pumping stations transmit water from the gravity flow water main to higher elevations within the service area. The gravity flow main is a 60-inch water main serving the District from Portland's Powell Butte Reservoir. The District's gravity line capacity is 42.3 million gallons per day (MGD), with another 14.5 MGD available from the JWC, an amount well above the average and peak daily flow.[516]

Within the system, there are 23 covered reservoirs with a combined storage capacity of 67.35 million gallons. Some reservoirs are belowground, with Tualatin Valley Park & Recreation District tennis courts or soccer fields built on top. The major pumping stations and the reservoirs have full telemetry control systems.[517]

The District's water system is monitored 24 hours a day, 7 days a week. In addition to watching water flows and pressure, the Supervisory Control and Data Acquisition (SCADA) system monitors several water quality parameters and security alarms. If the system identifies anything out of the ordinary, alarms alert an operator to the possible problem and staff are dispatched as needed.

[516] Tualatin Valley Water District. (n.d.). Getting Water to You. https://www.tvwd.org/district/page/getting-water-you
[517] Tualatin Valley Water District. (n.d.). Getting Water to You. https://www.tvwd.org/district/page/getting-water-you

TVWD recognizes the importance of water sector interdependencies and bases planning priorities, mitigation actions, and infrastructure development on these interconnected systems. Figure 41 is a map of these key public sector, infrastructure, and community service partners that rely on TVWD's water system to remain operational. This map has been adapted by WWSS staff from the Water Sector-Specific Plan annex to the National Infrastructure Protection Plan.[518]

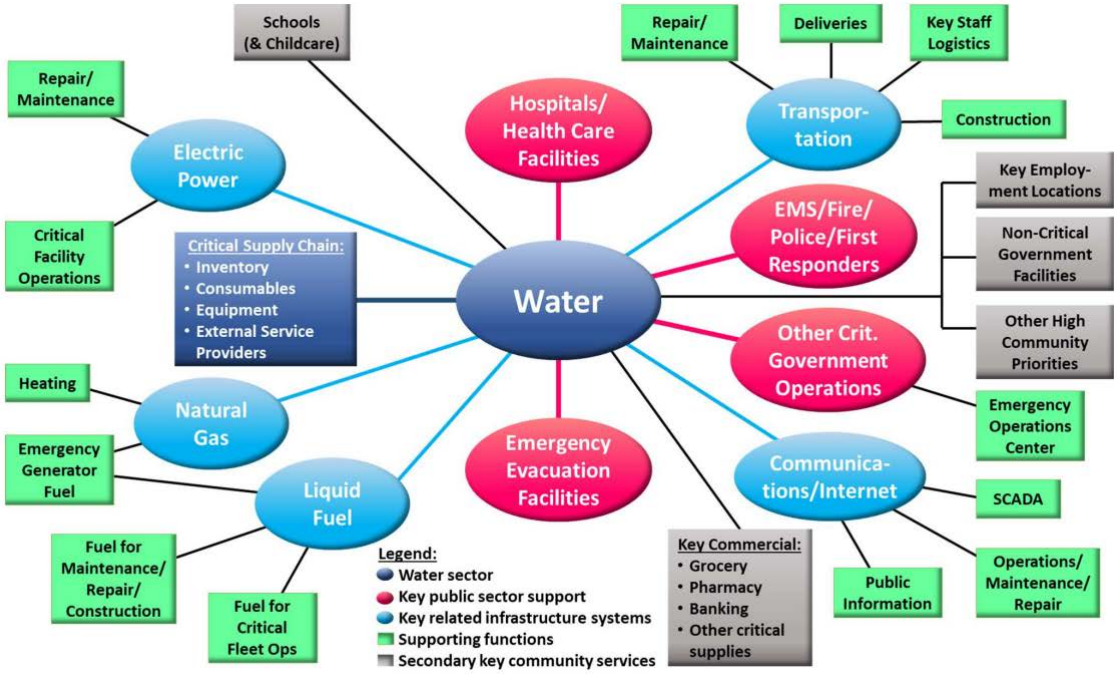


Figure 41: Tualatin Valley Water District Water Sector Interdependencies

TVWD critical and vulnerable facilities listed below in Table 281 may be vulnerable to one or more natural hazards.

[518] TVWD NHMP Planning Documentation; U.S. Department of Homeland Security and U.S. Environmental Protection Agency. (2010). 2010 Water Sector-Specific Plan: An Annex to the National Infrastructure Protection Plan. https://nepis.epa.gov/Exe/ZyPDF.cgi/P100KL4X.PDF?Dockey=P100KL4X.PDF

Table 281: Critical Facility and Asset Inventory

Name of Infrastructure, Facility, or Resource	Type of Asset	Comments
Willamette Water Supply Program Office	Infrastructure or Facility	
TVWD Headquarters		
Distribution system, pumps, and pipe system	Infrastructure or Facility	752 miles of pipe, 12 booster pump stations, 39 pressure zones, 21 active reservoirs, and aquifer storage and recovery wells
Pipes, conveyances, and intakes	Infrastructure or Facility	Encompasses the infrastructure that collects and transports water from source water to treatment or distribution facilities.
TVWD 385, 435, 385/435	Infrastructure or Facility	Zones
Cooper Mountain, intertie, pipe, and pump	Infrastructure or Facility	Zones
West Hills, intertie, pipe, and pump	Infrastructure or Facility	Zones
Metzger, intertie, pipe, and pump	Infrastructure or Facility	Zones
Storage and distribution facilities	Infrastructure or Facility	Encompasses all infrastructure used to store water after treatment, maintain water quality, distribute water to customers.
Emergency Underground Storage, WMP 8.5.4.1	Infrastructure or Facility	
Distributed Drinking Well Concept, mitigation plan to make wells more resilient	Infrastructure or Facility	Mitigation work (seismic upgrade) on existing wells and establish distribution point in proximity to the well and/or plan to haul water.
Center Street Tunnel	Infrastructure or Facility	
Grabhorn Reservoir	Infrastructure or Facility	
Generation station (fluoride)	Infrastructure or Facility	
Beaverton–Hillsdale Connection	Infrastructure or Facility	
Cornelius Pass Connection (PRV and fluoride)	Infrastructure or Facility	
Teufel Reservoir	Infrastructure or Facility	
Ridgewood View Reservoir	Infrastructure or Facility	
189th Street Pump Station	Infrastructure or Facility	

Name of Infrastructure, Facility, or Resource	Type of Asset	Comments
Goyak Pump Station	Infrastructure or Facility	
Springville Reservoirs	Infrastructure or Facility	
75th Street PRV and Fluoride Station	Infrastructure or Facility	
Taylors Ferry Reservoirs (backup connect to Portland)	Infrastructure or Facility	
Florence Lane Pump Station (Comm Hub)	Infrastructure or Facility	
Ridgewood View Reservoir (Comm Hub)	Infrastructure or Facility	
Florence Lane Reservoirs	Infrastructure or Facility	
Bonny Slope Park Reservoirs N/S	Infrastructure or Facility	
Garden Home Reservoir	Infrastructure or Facility	
North Road Reservoir	Infrastructure or Facility	
Schell Reservoir	Infrastructure or Facility	
Bull Run Connection (Florence Lane and 80th Avenue)	Infrastructure or Facility	
Somerset Reservoir	Infrastructure or Facility	
Sunset Pump Station	Infrastructure or Facility	
Sunset Reservoir	Infrastructure or Facility	
Teufel Pump Station	Infrastructure or Facility	
Thompson Pump Station	Infrastructure or Facility	
Thompson Reservoir	Infrastructure or Facility	
Inglewood Pump Station	Infrastructure or Facility	
Goyak Reservoir	Infrastructure or Facility	
Bethany Pump Station	Infrastructure or Facility	
Center Street PRV	Infrastructure or Facility	
Cooper Mountain Tanks	Infrastructure or Facility	
Inglewood Reservoir	Infrastructure or Facility	
189th Street Reservoir	Infrastructure or Facility	

Name of Infrastructure, Facility, or Resource	Type of Asset	Comments
Grabhorn Aquifer Storage and Recovery (ASR)Well	Infrastructure or Facility	
Rosander Reservoir	Infrastructure or Facility	
Cooper Mountain Pump Station	Infrastructure or Facility	
Catlin Crest Pump Station	Infrastructure or Facility	
Viewmont Pump Station	Infrastructure or Facility	
Garden Home Meter	Infrastructure or Facility	
Hoyt Park Connection	Infrastructure or Facility	
Multnomah Connection	Infrastructure or Facility	
Portable Pump (flow and eddy)	Infrastructure or Facility	
Willamette Water Supply System		
Name of Infrastructure, Facility, or Resource	**Type of Asset**	**Comments**
Intake Facilities (RWF_1.0)	Infrastructure or Facility	Under construction. Owned by Water Intake Facilities. Located in the City of Wilsonville in Clackamas County. Not vulnerable to dam failure.
Facilities, 66" Pipeline, Appurtenances (RWF_1.0)	Infrastructure or Facility	Under construction. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the City of Wilsonville in Clackamas County. Not vulnerable to dam failure.
66" Pipeline, Appurtenances (PLM_1.1)	Infrastructure or Facility	Construction complete. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the City of Wilsonville in Clackamas County. Not vulnerable to dam failure, drought, extreme heat, flood, landslide, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.

Name of Infrastructure, Facility, or Resource	Type of Asset	Comments
66" Pipeline, Appurtenances (PLM_1.2)	Infrastructure or Facility	Construction complete. Owned by TVWD and the cities of Hillsboro and Beaverton Located in the City of Wilsonville in Clackamas County. Not vulnerable to dam failure, drought, extreme heat, flood, landslide, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
66" Pipeline, Appurtenances (PLM_1.3)	Infrastructure or Facility	Under construction. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the City of Wilsonville in Clackamas County. Not vulnerable to dam failure, drought, extreme heat, flood, landslide, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
66" Pipeline, Appurtenances (PLM_2.0)	Infrastructure or Facility	Construction complete. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the City of Wilsonville in Clackamas County. Not vulnerable to dam failure, drought, extreme heat, flood, landslide, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
66" Pipeline, Appurtenances (PLM_3.0)	Infrastructure or Facility	Construction complete. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the cities of Sherwood and Tualatin in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
60 MGD Water Treatment Plant (WTP_1.0)	Infrastructure or Facility	Under construction. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the City of Sherwood in Washington County. Not vulnerable to dam failure, drought, or flood.
Deferred Projects (WTP_1.0)	Infrastructure or Facility	Future project. Will be owned by TVWD and the cities of Hillsboro and Beaverton. Will be located in the City of Sherwood in Washington County. Will not be vulnerable to dam failure, drought, or flood.

Name of Infrastructure, Facility, or Resource	Type of Asset	Comments
On-Site Hypochlorite Generation (WTP_1.0)	Infrastructure or Facility	Future project. Will be owned by TVWD and the cities of Hillsboro and Beaverton. Will be located in the City of Sherwood in Washington County. Will not be vulnerable to dam failure, drought, flood, landslide, or volcanic ash.
66" Pipeline, Appurtenances (PLM_4.1)	Infrastructure or Facility	Under construction. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the City of Sherwood in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, landslide, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
66" Pipeline, Appurtenances (PLM_4.2)	Infrastructure or Facility	Future project; in bidding stage. Will be owned by TVWD and the cities of Hillsboro and Beaverton. Will be located in the City of Sherwood in Washington County. Will not be vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
66" Pipeline, Appurtenances (PLM_4.3)	Infrastructure or Facility	Under construction. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in Washington County. Not vulnerable to drought, extreme heat, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
66" Pipeline, Appurtenances (PLM_4.4)	Infrastructure or Facility	Under construction. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the City of Sherwood in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
66" Pipeline, Appurtenances (PLM_5.1)	Infrastructure or Facility	Under construction. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the City of Tigard in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.

Name of Infrastructure, Facility, or Resource	Type of Asset	Comments
66" Pipeline, Appurtenances (PLM_5.2)	Infrastructure or Facility	Construction complete. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the City of Beaverton in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
66" Pipeline, Appurtenances (PLM_5.3)	Infrastructure or Facility	Under construction. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
15 MG Reservoir, Facilities, 66" Pipeline, Appurtenances (RES_1.0)	Infrastructure or Facility	Under construction. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in Washington County. Not vulnerable to dam failure, drought, or flood.
15 MG Reservoir, 66" Pipeline, Appurtenances (RES_1.0)	Infrastructure or Facility	Future project. Will be owned by TVWD and the cities of Hillsboro and Beaverton. Will be located in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, windstorm, including tornado, or winter storm.
48" Pipeline, Appurtenances (PLW_1.1)	Infrastructure or Facility	Construction complete. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in the City of Hillsboro in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, landslide, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
48" Pipeline, Appurtenances (PLW_1.2)	Infrastructure or Facility	Construction complete. Owned by TVWD and the City of Hillsboro. Located in the City of Hillsboro in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.

Name of Infrastructure, Facility, or Resource	Type of Asset	Comments
66" Pipeline, 48" Pipeline, Appurtenances (PLW_1.3)	Infrastructure or Facility	Under construction. Owned by TVWD and the cities of Hillsboro and Beaverton. Located in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
48" Pipeline, Appurtenances (PLW_2.1)	Infrastructure or Facility	Future project; in bidding stage. Will be owned by TVWD and the City of Hillsboro. Will be located in the City of Hillsboro in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
Facilities, 48" Pipeline, Appurtenances (PLW_2.2)	Infrastructure or Facility	Future project. Will be owned by TVWD and the City of Hillsboro. Will be located in the City of Hillsboro in Washington County. Not vulnerable to dam failure, drought, or flood.
48" Pipeline, Appurtenances (MPE_1.1)	Infrastructure or Facility	Under construction. Owned by TVWD. Located in the City of Beaverton in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, landslide, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.
48" Pipeline, Appurtenances, Facility (MPE_1.2)	Infrastructure or Facility	Under construction. Owned by TVWD. Located in the cities of Beaverton and Tigard in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, or volcanic ash.
48" Pipeline, Appurtenances (MPE_1.3)	Infrastructure or Facility	Future project; in bidding stage. Will be owned by TVWD. Will be located in the cities of Beaverton and Tigard in Washington County. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, wildland fire, windstorm, including tornado, or winter storm.

Name of Infrastructure, Facility, or Resource	Type of Asset	Comments
Fiber Optic Installation (Communications)	Infrastructure or Facility	Future project. Will be owned by TVWD and the cities of Hillsboro and Beaverton. Will be located throughout the service area. Not vulnerable to dam failure, drought, extreme heat, flood, volcanic ash, windstorm, including tornado, or winter storm.
Emergency Spare Parts & Storage Facilities (Parts/Storage)	Infrastructure or Facility	Future project. Will be owned by TVWD and the cities of Hillsboro and Beaverton. Location to be determined. Will likely not be vulnerable to dam failure, drought, extreme heat, flood, or volcanic ash.
ShakeAlert System (Communications)	Warning System	Future project. Will be owned by TVWD and the cities of Hillsboro and Beaverton. Location WTP_1.0. Will likely not be vulnerable to dam failure, drought, extreme heat, flood, landslide, volcanic ash, wildland life, windstorm, including tornado, or winter storm.

3.2. Natural Hazard Profiles

TVWD Technical Committee utilized the OEM's hazard analysis methodology to examine hazard vulnerability and probability by collecting information about history, probability, vulnerability, and maximum threat for each hazard that impacts the District. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants.

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Volume I, Section 2.

The scores for each hazard that impact TVWD are presented below. All natural hazards included in the NHMP have the potential to impact TVWD.

Table 282: Natural Hazard Risk Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	Low	Medium	Medium	High	133
Drought	High	High	Medium	High	186
Earthquake: Cascadia (3–5-minute event)	Low	High	High	Medium	201
Earthquake: Crustal (1-minute event)	Low	High	High	Low	159
Extreme heat	High	Medium	High	High	177
Flooding, including channel migration and streambed erosion	Low	Low	Low	Medium	67
Landslide	High	Low	Low	Medium	88
Volcanic ash	Low	Medium	High	Low	119
Wildland fire	High	Medium	Medium	High	161
Windstorm, including tornado	High	Medium	Medium	High	169
Winter storm	High	Medium	High	High	206

Full descriptions of each hazard are provided in Volume I, Section 2. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description in this annex and in Volume I, Section 2.

The timeframe of data collected during the planning process for TVWD was from as far back as available to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the District's Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are presented in the same order, as applicable: populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

3.2.1. Dam Failure

Because of the mission of TVWD, a dam failure could affect their operations and the customers they serve. Potential impacts of and vulnerabilities to dam failure are identified below.

3.2.1.1. Potential Impacts

The potential impacts of a dam failure event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- **Scoggins Dam and Reservoir:** TVWD obtains about 28% of their water from the JWC. Water is provided from Hagg Lake and Scoggins Dam and Reservoir. A dam failure could reduce the amount of water available for customers.
- **Eldon Mills Dam and Barney Reservoir:** Located at the headwaters of the North Fork Trask River. Should the dam fail, there is the potential for a reduction in water delivered from this source to their customers. The Barney Reservoir Joint Ownership Commission owns and operates the dam and reservoir. Its membership is comprised of five partners: the cities of Hillsboro, Forest Grove, and Beaverton, TVWD, and Clean Water Services.
- **Bull Run Water Shed:** Approximately 70% of TVWD's water is purchased from the City of Portland. Portland's primary source is water from the Bull Run watershed and the City uses pumped groundwater from the Columbia South Shore Well Field next to the Columbia River to augment the Bull Run supply when needed.
- **Aquifer Storage and Recovery (ASR):** During the winter when water is plentiful, TVWD stores treated drinking water underground in the aquifer surrounding the Grabhorn well on Cooper Mountain. During the hot summer months, the stored water is pumped from the aquifer to help meet peak water demands. The Grabhorn ASR well can store in excess of 300 million gallons of treated water. A dam breach could limit the amount of water available and could contaminate the aquifer storage water.

3.2.1.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments related to TVWD that are vulnerable to a dam failure event.

TVWD-specific vulnerabilities include:

- Staff working at all District locations and/or responding to a dam failure event, including those at indoor and outdoor facilities. Personal safety of staff may be a vulnerability as well as staff's inability to get to worksites, move between different locations, and access impeded parking lots.
- TVWD's identified critical infrastructure.
- Transportation networks used to execute daily District functions and transportation systems staff rely on to report to duty. These transportation assets are not all owned by TVWD; however, their vulnerability can affect District operations.
- Natural environments and acreage utilized and owned by the District.

Vulnerabilities within the TVWD service area include:

- Failure of any of the dams mentioned could adversely affect the population, economies, structures, improved property, critical facilities and infrastructure, historical and cultural resources, and natural environments of the service area via flooding and water shortages.

- The Clean Water Services Hillsboro Treatment Facility is in the potential dam failure impact area. This facility provides wastewater treatment for the cities of North Plains, Banks, the western region of Hillsboro, the southeastern portion of Cornelius, and the northwestern portion of Forest Grove. The facility cleans approximately 4 million gallons of wastewater on an average day.[519]
- The JWC Water Treatment Plant could be vulnerable to flooding created by a Scoggins Dam failure event. The plant could be vulnerable to higher-than-normal water levels and damage to infrastructure due to debris flows, which could lead to changes in the amount of water available for use.

[519] Clean Water Services. (2022). Locations. https://cleanwaterservices.org/about/locations/

3.2.2. Drought

Drought typically occurs as a regional event and often affects more than one city, county, and special district simultaneously. TVWD is a member of the JWC and has water storage reservoirs, therefore it may be impacted by drought differently than other NHMP participants. Significant events and the potential impacts of and vulnerabilities to drought are identified below.

3.2.2.1. Significant Events

TVWD identified three significant drought events.

- **1992:** During 1992, PWB and its wholesale customers, including the District, experienced severe water supply shortages for five reasons: (1) the Bull Run watershed, which serves the Portland metropolitan region, had experienced the lowest spring rainfall and stream flows since the year 1899; (2) demand for water during May and June of that year was unusually high due to record-breaking temperatures that occurred in the region; (3) reservoir levels were low, as is typical in the late summer months; (4) the PWB backup source, the Columbia South Shore wellfield, was unavailable because of concern that a contamination plume would move into the well field aquifer if those wells were used; and (5) voluntary requests to reduce water use were not effective. (Similar shortages also occurred in 1952, 1987, and 1991.)
- **2001:** The summer of 2001 was not particularly hot, but Hagg Lake filled to only 51%. As a result, all municipalities using supplies from the JWC were asked to curtail use in order to leave supplies for more senior irrigation water rights, as well as to leave adequate water supplies for instream use. Evaporation in the lake during the summer further reduced municipal supplies. The District was able to meet its customers' demands by purchasing additional water from the City of Portland.
- **April–August 2021:** April was the driest April on record since 1941. May had only 6 days of measurable rain. There was a heat dome in June 2021. The temperature reached 116 degrees Fahrenheit (°F) on June 28. Dry weather and heat continued until rain in September 2021. There was heat sheltering of staff and restricted operations.

3.2.2.2. Potential Impacts

The potential impacts of a drought event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Reduction or loss of water supply, water use restrictions, and lack of potable water supply.
- Health effects, including increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions.
- Reduced economic productivity or business closures, including agriculture, livestock, recreation, energy, tourism, timber, and fisheries.
- Supply chain restrictions, including food shortages.
- Loss of power or reduced availability of electricity due to infrastructure damage and high demand.
- Property and infrastructure damage due to expansive soils, which are clay-based soils that expand and contract based on the amount of moisture in the soil.
- Damage to natural environments, including low water levels in lakes, rivers, and other water bodies, reduced plant growth, local species reduction or extinction, increased water temperature, and deteriorated water quality, which may result in fish kills and increased waterborne pollutants.
- Concurrent hazards, including extreme heat, wildfire, flooding, and landslides.

The District has adopted a four-stage Water Curtailment Plan to be invoked in the event of a water supply shortage. These stages are designed to be initiated and implemented in progressive steps. The plan includes both voluntary and mandatory rationing, depending upon the cause, severity, and anticipated duration of the shortage. The four stages and their initiating conditions are presented below. Curtailment could be initiated by any of the corresponding initiating conditions.

Table 283: Water Curtailment Event Triggers and Stages[520]

Curtailment Stages	Initiating Conditions
Stage 1: Routine Summer Advisory	• Portland Water Bureau (PWB) issues a "notice of drawdown," announcing the release of stored water in the Bull Run System. • PWB activates groundwater wells as part of its supplies. • Hagg Lake fails to fill 100% by May 1. • Barney Reservoir fails to fill 100% by May 1. • The JWC issues a "notice of drawdown," announcing the release of stored water.
Stage 2: Moderate Water Supply Shortage	• PWB is operating under a warm-dry scenario. • Hagg Lake is filled to less than 80% before May 1. • District customer use reaches contractual and/or facility capacity for seven consecutive days.
Stage 3: Severe Water Supply Shortage	• PWB has only groundwater sources available. • PWB cannot meet supply demands of wholesale customers. • JWC reservoirs drop below 40% of "normal conditions"; under such circumstances JWC enacts mandatory curtailment for its members. • Water supplies fail to meet U.S. Environmental Protection Agency Safe Drinking Water Act standards. • The District's distribution system experiences a significant and sustained reduction of water pressure. • District customer use reaches contractual and/or facility capacity for 14 consecutive days.
Stage 4: Critical Water Supply Shortage	• PWB offloads (i.e., ceases serving) the District from its system and JWC cannot meet the District's resulting additional demands for water. • JWC offloads the District from its system, and PWB supplies cannot meet the District's resulting additional demands for water. • Water supplies from the JWC or the PWB are either physically cut off or otherwise become unavailable. • District customer use reaches contractual and/or facility capacity for 28 consecutive days.

[520] Tualatin Valley Water District. (n.d.). Municipal Water Curtailment Element. https://www.tvwd.org/sites/default/files/fileattachments/district/page/2157/tvwd_curtailment_plan.pdf

3.2.2.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments related to TVWD are vulnerable to drought. This includes:

- Staff with preexisting health conditions, staff without access to clean water, and staff who are pregnant women and/or older adults.
- TVWD's identified critical infrastructure.
- Water sources used by the District.
- Natural environments and acreage utilized and owned by the District.

3.2.3. Earthquake

The District could experience earthquakes that originate from the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek Fault Zone. It could also experience liquefaction and coseismic landslides as the result of an earthquake. Potential impacts of and vulnerabilities to earthquake are identified below.

3.2.3.1. Potential Impacts

The potential impacts of an earthquake event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Mental health impacts, including post-traumatic stress disorder.
- Public health hazards resulting from disruption of drinking water and wastewater systems.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to ground utilities; residential, public, and private buildings; and transportation systems above and below.
- Disruption of essential infrastructure systems, such as power systems, public utilities, and telecommunications.
- Blocked roads and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction.
- Downed or damaged powerlines that can lead to wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Change in water flows, including paths of rivers and streams.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards initiated by an earthquake, including flood, wildland fire, and landslide.

3.2.3.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments related to TVWD are vulnerable to earthquakes. This includes:

- Staff working at all District locations: The personal safety of staff may be a vulnerability as well as staff's inability to get to worksites, move between different locations, and access impeded parking lots.
- TVWD's identified critical infrastructure, particularly the TVWD Headquarters building.[521] The District has done significant planning for seismic reliability and resiliency. Vulnerable facilities and infrastructure, anticipated damage to storage and pumping facilities, anticipated damage to pipelines, estimation of system leakage, and estimation of "time-to-drain" have been evaluated and the findings are on file at TVWD.
- Other critical infrastructure, including power sources and emergency generators.
- The Critical Infrastructure Hub (CEI Hub) is vulnerable to an event, and if damaged, TVWD's ability to obtain fuel could be significantly affected and water supplies may become contaminated. The CEI Hub is a six-mile area in Northwest Portland along the Willamette River. More than 90% of the state's liquid fuel supply is transported through CEI Hub facilities, including gasoline and diesel. Roughly 70% of the fuel arrives by pipe and another 30% arrives by tanker barge. In addition to the fuel storage facilities, the CEI Hub also contains liquid fuel and natural gas pipelines and transfer stations, a liquefied natural gas storage tank, storage of other non-fuel materials, a high-voltage electrical substation, and transmission lines.[522]
    - The CEI Hub is located on top of a high-risk liquefaction zone, as the NW Industrial Area was developed on top of the Willamette River Floodplain. In total, 397 tanks could release stored materials as a result of a Cascadia Subduction Zone earthquake. Based on tank age and location, approximately 365 tanks could release 50 to 100% of their materials, and 32 tanks could release up to 10% of stored materials. Together, the total potential releases from the materials stored in tanks at the CEI Hub range from 94.6 million to 193.7 million gallons. Approximately 57% of the total potential releases would be released onto ground, and 43% have the potential to flow into the Willamette River.[11]
    - A fire at the CEI Hub involving the fuels stored on-site is a likely scenario following a Cascadia Subduction Zone earthquake. Many fuel storage tanks have a metal floating lid which in an earthquake could scrape against the metal perimeter, creating a spark and potentially a fire. Fires within tanks could result in large explosions, further threatening people, property, and environmental resources. There are also power lines throughout the CEI Hub which could fall due to the earthquake and serve as a potential ignition source.[11]
    - Of the 393 active tanks that are not empty and have known contents at the CEI Hub, 200 tanks (approximately 51%) have materials that are known to be flammable. Based on the total estimate of releases, approximately 93% of releases will be of flammable materials. The total capacity of tanks with flammable materials is 298.7 million gallons. Therefore, the contents of these tanks all have the potential to burn, either on land or in the water. Because burning requires both a fuel and an ignition source, the specific amount of materials that would burn are a function of location and event-specific factors.[523]
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to all buildings, infrastructure, facilities, and property.

[521] Carollo. (2019, January 27). R&R Assessment and ERP Update: America's Water Infrastructure Act (AIWA) Compliance, Workshop #4 presentation.
[522] Portland Bureau of Emergency Management. (2022, April). The Mitigation Action Plan. https://www.portland.gov/sites/default/files/2022/mapfulldraft_6-15.pdf
[523] Portland Bureau of Emergency Management. (2022, April). The Mitigation Action Plan. https://www.portland.gov/sites/default/files/2022/mapfulldraft_6-15.pdf

- Buildings with very high or high collapse potential include those constructed prior to 1990.
- Transportation networks used to execute daily District functions and transportation systems staff rely on to report to duty. These transportation assets are not all owned by TVWD; however, their vulnerability can affect District operations.
- Natural environments and acreage utilized and owned by the District.

3.2.4. Extreme Heat

Due to a rise in the frequency and severity of extreme heat events and the impacts from those events, the NHMP Steering Committee chose to include this hazard for the first time in the Washington County NHMP. Significant events and the potential impacts of and vulnerabilities to extreme heat are identified below.

3.2.4.1. Significant Events

Extreme heat was not included in previous NHMPs. TVWD identified one significant extreme heat event.

- **June 25–30, 2021:** An unprecedented heat dome enveloped the City of Portland, which is in the TVWD service area, reaching a record-breaking peak temperature of 116 °F on June 28. This surpassed the previous day's record high of 112 °F, which in turn broke the record set the day before of 108 °F. These temperatures reached around 30 to 40 °F higher than the average normal temperatures for these days in previous recorded years. The Governor declared a state of emergency in several Oregon counties. The heat caused roads and sidewalks to crack and forced closures of the Portland Streetcar public transit system. Portland's Bureau of Emergency Communications saw a surge of 911 calls, receiving over 240 calls related to heat incidents between June 24 and June 30. Multiple deaths were recorded due to heat.

3.2.4.2. Potential Impacts

The potential impacts of an extreme heat event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, heat stroke, and death.
- Extended operational hours of TVWD staff and additional resources needed for response to the event, including the operation of daytime cooling centers and overnight cooling shelters.
- Strain on or loss of water supply due to increased demand.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic losses from decreased worker efficiency and effectiveness and time lost on the job when workers take more frequent or longer breaks to avoid overheating.
- Economic impacts of closure of outdoor activities and events, such as farmers markets and concerts.
- Property damage, such as roof expansions, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding.
- Disruption of essential infrastructure systems from overheated and damaged utilities, including power, water, transportation, and communication systems.
- Impacts to roadways as heat expands concrete or causes cracking and buckling. Public transit can also be impacted due to melted cables, sagging wires, and warping tracks.
- Damage to crops, livestock, vegetation, parks, and natural systems.

- Impacts to greenspaces, such as scorch and sunscald of new foliage, branches or tops of trees dying, and significant stress and die-off of native trees, particularly Douglas fir and cedar. These impacts are intensified if drought is also occurring.
- Concurrent hazards include drought and wildland fire.

3.2.4.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments related to TVWD are vulnerable to extreme heat.

Populations substantially vulnerable to extreme heat include:

- Staff who work or spend a significant amount of time outdoors, including those in operations and maintenance.
- Staff who live and/or work in buildings without air conditioning or cooling equipment.
- Staff living, working, or spending time in heat islands within the District's service area.
- Staff with higher heat sensitivity, including older adults, pregnant women, people with preexisting or chronic diseases, and those who take certain medications that affect thermoregulation or block nerve impulses.
- TVWD's identified critical infrastructure.
- Transportation networks used to execute daily District functions and transportation systems staff rely on to report to duty. These transportation assets are not all owned by TVWD; however, their vulnerability can affect District operations.
- Vehicles, including District maintenance vehicles, are vulnerable to engine overheating and tire deterioration.
- Aboveground utility and power lines can droop or sag and create a heightened fire risk to staff and District facilities.
- Natural environments and acreage utilized and owned by the District.

3.2.5. Flooding, Including Channel Migration and Streambed Erosion

Flooding to a greater or lesser degree is fairly common in the county, and events typically occur from October through April. As the District is a planning participant whose assets are widely dispersed, its vulnerability to flooding may vary from site to site. The District experiences occasional localized flooding, but historically events have not been significant or severe. Potential impacts of and vulnerabilities to flooding are identified below.

3.2.5.1. Potential Impacts

The potential impacts of a flooding event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Need for widespread search and rescue operations, including water rescues.
- Displaced residents in need of sheltering.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal economic impacts of loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.2.5.2. Vulnerabilities

TVWD-related population, economic, built environment, critical facility, infrastructure, and natural environment vulnerabilities to flooding include:

- Staff working at all District locations, including indoor and outdoor facilities. Personal safety of staff may be a vulnerability as well as staff's inability to get to worksites, move between different locations, and access impeded parking lots.
- TVWD's identified critical infrastructure.

- Transportation networks used to execute daily District functions and transportation systems staff rely on to report to duty. These transportation assets are not all owned by TVWD; however, their vulnerability can affect District operations.
- Natural environments and acreage utilized and owned by the District.

3.2.6. Landslide

There are several steep slopes in the District's service area; however, they are located outside of TVWD's purview. As such, the District's Technical Committee identified potential landslide impacts to be minimal and secondary. Potential impacts of and vulnerabilities to landslides are identified below.

3.2.6.1. Potential Impacts and Vulnerabilities

The potential impacts of and vulnerabilities to a landslide event are identified below. The type, magnitude, and extent of these can vary based on the scale of the event.

- TVWD's identified critical infrastructure, particularly the TVWD Headquarters building.[524]
- Areas and infrastructure located on or near steep slopes.
- Transportation networks used to execute daily District functions and transportation systems staff rely on to report to duty. These transportation assets are not all owned by TVWD; however, their vulnerability can affect District operations.
- Natural environments and acreage utilized and owned by the District.

[524] Carollo. (2019, January 27). R&R Assessment and ERP Update: America's Water Infrastructure Act (AIWA) Compliance, Workshop #4 presentation.

3.2.7. Volcanic Ash

Volcanic activity is possible from mountains near the County. It is anticipated that ashfall from a volcanic eruption from Mount St. Helens or Mount Hood has the potential to impact the District. The scale and types of impacts and vulnerabilities may differ depending on which volcano erupts; the level of eruption; the wind direction during and after eruption; and other weather conditions. Potential impacts of and vulnerabilities to volcanic ash are identified below.

3.2.7.1. Potential Impacts

Though it is unlikely that an event of this type will occur, the impacts of a significant ash fall could be substantial. Impacts may include:

- Indirect injuries and deaths, such as those sustained during ash cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation. This includes public water systems that rely on outdoor reservoirs.
- The need to shelter individuals to protect them from poor air quality, including houseless persons and persons displaced from their residences due to poor residential air filtration systems.
- Delayed emergency response times due to decreased visibility and increased traffic hazards.
- Extended operational hours of TVWD staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and cleanup activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Downed or damaged powerlines can lead to wildfires.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.2.7.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments related to TVWD are vulnerable to volcanic ash. This includes:

- Staff who experience chronic lung problems and/or preexisting health conditions or are older adults.
- Staff working at all District locations, including indoor and outdoor facilities. Personal safety of staff may be a vulnerability as well as staff's inability to get to worksites, move between different locations, and access impeded parking lots.

- Staff without access to effective dust masks, eye protection, and drinking water and food uncontaminated by ash.
- TVWD's identified critical infrastructure.
- Other critical infrastructure, including emergency generators and powerlines.
- Transportation networks used to execute daily District functions and transportation systems staff rely on to report to duty. These transportation assets are not all owned by TVWD; however, their vulnerability can affect District operations.
- Water sources used by the District could become contaminated.
- Natural environments and acreage utilized and owned by the District.

3.2.8. Wildland Fire

Although the District could experience a wildland–urban interface event, historically it is more likely to be affected by smoke and poor air quality due to wildland fires outside its boundaries. Potential impacts of and vulnerabilities to wildland fire are identified below.

3.2.8.1. Significant Events

TVWD has not been directly impacted by a wildland fire event in recent history; however, it experienced effects from two events that occurred outside the County.

- **September 2–November 30, 2017:** The Eagle Creek Fire was located approximately 45 miles east of Washington County. The fire burned 50,000 acres and the Air Quality Index (AQI) daily average in the County reached as high as 99 particulate matter 2.5 micrometers or smaller ($PM_{2.5}$) during the event.
- **September 2020:** Multiple wildfires throughout Oregon and Washington caused some evacuees to come into the County. The AQI daily average in the County reached as high as 328 $PM_{2.5}$ during the month.[525] During these events, Washington County residents and evacuees were required to take protective actions, such as staying indoors with the doors and windows closed, using air-cleaning filters indoors, and wearing goggles and face masks when outside.

3.2.8.2. Potential Impacts

The potential impacts of a wildfire event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Exposure to wildfire smoke, which can lead to eye, nose, and throat irritation and the worsening of chronic heart and lung diseases.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to blocked transportation routes and debris, congested transportation routes due to evacuations, and damaged infrastructure and vehicles.
- Extended operational hours of TVWD staff and resources needed for response to the event.
- Strain on or loss of water supply due to increased demand.
- Economic impacts to governments, including costs for fire suppression, staff, equipment, supplies, transportation and mobilization of first responders, evacuations, sheltering operations, post-fire recovery, and rebuilding costs associated with government-owned buildings, property, and infrastructure.
- Economic impacts, including loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity. Scoggins Valley Park receives one million visitors a year, most during summer, which is when wildland fires tend to occur.

[525] Air Quality Historical Data Platform. (n.d.). City of Beaverton data. https://aqicn.org/data-platform/register/

- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property, causing blocked road and rail transportation routes.
- Downed or damaged powerlines. This impact may be compounded since powerline failures can lead to additional wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including air and water quality issues. Landslide and erosion issues are common following a wildland fire.

3.2.8.3. Vulnerabilities

Given the dynamic nature of wildland fires, all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments related to TVWD are vulnerable to this hazard. This includes:

- Staff who experience chronic lung problems and/or preexisting health conditions or are older adults.
- Staff working at all District locations, including indoor and outdoor facilities. Personal safety of staff may be a vulnerability as well as staff's inability to get to worksites, move between different locations, and access impeded parking lots.
- First responders and other personnel working directly on fire protection, suppression, and patrols or near a wildfire can experience burns, smoke exposure, heat-related impacts such as heat stroke, heat exhaustion, dehydration, physical fatigue, mental health challenges, injuries, and death.
- TVWD's identified critical infrastructure.
- Other critical infrastructure, including emergency generators and powerlines.
- Areas and infrastructure located in the wildland/urban interface.
- Transportation networks used to execute daily District functions and transportation systems staff rely on to report to duty. These transportation assets are not all owned by TVWD; however, their vulnerability can affect District operations.
- Water sources used by the District could become contaminated.
- Natural environments and acreage utilized and owned by the District.

3.2.9. Windstorm, Including Tornado

TVWD covers 23,000 acres and wind damages could be spread out and significant. Significant events and potential impacts of and vulnerabilities to windstorm, including tornado, are identified below.

3.2.9.1. Significant Events

TVWD identified two significant windstorm events.

- **October 12, 1962:** The "Columbus Day Storm" is the most destructive storm to ever occur in Oregon in recorded history, both in loss of life and property damage. The storm killed 38 people and did upwards of $200 million in damage. Hundreds of thousands of homes were without power for short periods of time, while others were without power for two to three weeks. More than 50,000 homes were seriously damaged and nearly 100 were completely destroyed. Entire fruit and nut orchards were destroyed, and livestock were killed as barns and trees blew over onto animals. Intense wind speeds were recorded in the metropolitan areas, with gusts of 116 mph on the Portland Morrison Bridge.
- **November 13–15, 1981:** Two cyclone-related windstorms hit the Pacific Northwest in quick succession. The strongest winds in Oregon were on November 14, with 85-mph gusts on the Morrison Bridge. Hundreds of thousands lost power, and 12 people died throughout Oregon and Washington.

3.2.9.2. Potential Impacts

The potential impacts of a windstorm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of TVWD staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked road and rail transportation routes.
- Downed or damaged powerlines can lead to wildfires.
- Power outages.

- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.2.9.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments related to TVWD are vulnerable to windstorms, including tornadoes. This includes:

- Staff working at all District locations, including indoor and outdoor facilities. Personal safety of staff may be a vulnerability as well as staff's inability to get to worksites, move between different locations, and access impeded parking lots.
- TVWD's identified critical infrastructure. Downed branches and trees can damage critical infrastructure and debris can clog or impede water flows and equipment.
- Areas and infrastructure located at higher elevations.
- Older buildings and infrastructure in the District not built to withstand high winds.
- Transportation networks used to execute daily District functions and transportation systems staff rely on to report to duty. These transportation assets are not all owned by TVWD; however, their vulnerability can affect District operations.
- Natural environments and acreage utilized and owned by the District.

3.2.10. Winter Storm

Heavy snowfall rarely occurs within the District's service area. The bigger risk is from low temperatures causing infrastructure to freeze and ice causing impacts to infrastructure and transportation capabilities. Significant events and the potential impacts of and vulnerabilities to winter storms are identified below.

3.2.10.1. Significant Events

The District identified one significant winter storm event.

- **February 11–14, 2021:** Freezing rain and heavy snow came down, and gusty winds up to 50 mph occurred throughout the service area. Thirty calls for service required response. Two water mains broke and over 18 staff worked the response.

3.2.10.2. Potential Impacts

The potential impacts of a winter storm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths, including from carbon monoxide poisoning, falls from slick or icy conditions, frostbite, and hypothermia.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components.
- Stranded travelers due to ice, snow, and transportation impacts.
- Extended operational hours of TVWD staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- An increased number of house fires due to unsafe alternate heating methods.
- Significant property damage and loss of water due to frozen or damaged pipes or the thawing of frozen pipes.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked road and rail transportation routes.
- Downed or damaged powerlines can lead to wildfires, and tree debris can create fuel load for wildfire.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.

- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including flooding.

3.2.10.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments related to TVWD are vulnerable to winter storms. This includes:

- Staff working at all District locations, including indoor and outdoor facilities. Personal safety of staff may be a vulnerability as well as staff's inability to get to worksites, move between different locations, and access impeded parking lots.
- TVWD's identified critical infrastructure.
- Areas and infrastructure located at higher elevations.
- Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of snow and ice.
- Transportation networks used to execute daily District functions and transportation systems staff rely on to report to duty. These transportation assets are not all owned by TVWD; however, their vulnerability can affect District operations.
- Natural environments and acreage utilized and owned by the District.

3.3. Historical Events

Hazard events that have affected the entire planning area since adoption of the 2017 NHMP are detailed in Volume I, Section 2. This is the first time TVWD has had an NHMP. Hazard events that have impacted the District are described in the hazard profiles above. These occurrences include drought, extreme heat, wildland fire smoke, windstorm, including tornado, and winter storm.

Two disaster declarations were issued by the District since adoption of the 2017 NHMP. Declarations for the COVID-19 pandemic went into effect on March 8, 2020. Resolution 07-20 authorized emergency procurement of good and services by the Board of Commissioners, and Resolution 08-20 declared an emergency and granted the chief executive officer emergency powers to prepare for, prevent, and mitigate the effects of COVID-19. Although pandemic is not a hazard included in this NHMP, this declaration is noted because FEMA provided support and Hazard Mitigation Grant Program funding during the event.

3.4. Overall Vulnerability

Based on the analysis completed by the Technical Committee, winter storm, earthquake, drought, extreme heat, and windstorm, including tornado, present the highest relative risk to the District. These hazards may become widespread events, and all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments related to the District can be vulnerable to these hazards.

Areas of greatest vulnerability to these hazards within the District include:

- Staff members with higher vulnerability, such as those with preexisting health conditions, older adults, pregnant women, and those who spend significant time outdoors.
- People working in heat islands within the District.
- Commerce losses from power interruptions, damaged buildings and assets, and road closures. The District may also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic impacts to the District, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- TVWD’s identified critical infrastructure.
- Other critical infrastructure, including power sources and emergency generators.
- The CEI Hub.
- Older buildings and infrastructure not built to current building codes or seismic standards may be more vulnerable.
- Transportation networks used to execute daily District functions and transportation systems staff rely on to report to duty. These transportation assets are not all owned by TVWD; however, their vulnerability can affect District operations.
- Water sources used by the District.
- Natural environments and acreage utilized and owned by the District. Plants, animals, ecosystems, and natural environments can be vulnerable to high rates of mortality due to hazard events.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment and safe growth analysis examine the ability of the District to implement and manage a comprehensive mitigation strategy. Strengths, opportunities, and resources of the jurisdiction are identified to develop an effective hazard mitigation action plan. The capabilities identified in this assessment were evaluated collectively to develop feasible recommendations, which support the implementation of effective mitigation activities.

A capability questionnaire was distributed to the District's Technical Committee to initiate this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities. The Technical Committee also completed a safe growth analysis to identify potential gaps in growth guidance instruments and improvements that could be made to reduce vulnerability to future development.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances within the District that can prevent and reduce the impacts of hazards.

The District does not maintain plans that cover activities or areas that fall under the jurisdiction of the local governments it serves, such as land use mapping, transportation management, and public safety. However, its own properties and assets are well mapped, and the District's environmental policies address best practices in maintaining and restoring protective ecosystems. This is an essential part of operating an organization with unique structural and natural assets. City and County development regulations require development outside of sensitive areas. TVWD follows all local regulations and zoning ordinances as they apply to the organization.

TVWD's Capital Improvement Program and infrastructure policies limit expenditures on projects that would encourage development in areas vulnerable to natural hazards and limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards. The Capital Improvement Program provides funding for hazard mitigation projects identified in this NHMP. The District also has an evacuation and sheltering plan to deal with emergencies from natural hazards.

Types of Plans

The following TVWD plans address natural hazards, identify projects to include in the mitigation strategy, and can be used in a formative manner to implement mitigation actions:

- Master Planning for Seismic Reliability and Resiliency, May 2016.
- Water Master Plan Update, December 2018.
- Risk Resilience Assessment Report, February 2021. Supports compliance with America's Water Infrastructure Act of 2018.
- Emergency Response Plan, February 2021. Supports compliance with America's Water Infrastructure Act of 2018. Updates to this plan are ongoing and will be made in relation to the work done by the Regional Disaster Preparedness Organization (RDPO) on Emergency Water Provision and Curtailment tabletop exercises held in 2022.
- Willamette Water Supply Program, Program Formulation Summary, October 2018.
- Continuity of Operations Plan, 2005. This plan is scheduled for review and updating. The current version does not have projects to include in the mitigation strategy; however, future plan updates

will either include mitigation strategies, or the strategies will be contained in the District's Capital Plan or Master Plan, as appropriate.

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff and their skills and tools that can be used for mitigation planning and implementing specific mitigation actions.

The Mitigation Planning Committee works together effectively to update and maintain the NHMP and consists of Emergency Planning Team and Sustainability Committee members. The Asset Management and Water Operations Departments effectively execute mitigation planning efforts.

TVWD's Facilities Supervisor and two Facilities staff members administer maintenance programs to reduce risk, including tree trimming and clearing drainage systems. Contracted services are used to implement additional maintenance programs to reduce risk. The District has multiple effective mutual aid agreements and planning partnerships, including the JWC, the Regional Water Providers Consortium, and the Oregon Water/Wastewater Agency Response Network.

The District has a full time Capital Improvement Program Manager, Emergency Program Coordinator, and a full-time Risk Management Coordinator in the Human Resources Department. A full-time Geographic Information System (GIS) Coordinator is a part of the Asset Management Division.

TVWD has many technical capabilities that have been used to assess or mitigate risk and could be used in future efforts. The WWSS has a grant writer and additional grant writers are contracted with as necessary. A GIS Analyst and Technician work with the Oregon Department of Geology and Mineral Industries (DOGAMI) on hazard data gathering and mapping and collaborate with the RDPO on hazard data and mitigation planning. Additional hazard data and information can be pulled from a variety of sources, including historical records and DOGAMI.

TVWD maintains a Water Master Plan and conducts regular updates to the Water Master Plan. The most recent plan is from 2018. TVWD is compliant with America's Water Infrastructure Act (AWIA). As part of AWIA compliance, TVWD sponsored a Risk and Resilience Assessment Report. The final report was completed in February of 2021. The report is updated every five years, per regulation, and will be used to update mitigation plans.

4.3. Education and Outreach Assessment

Education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information were assessed to determine the District's capabilities.

TVWD has very strong education and outreach capabilities. TVWD's Communications Department sends customers a monthly newsletter via email. Topics covered include learning how to store water, preventing frozen pipes, planning for wildland fires and extreme heat, signing up for emergency alerts, and creating and keeping an emergency kit.

Additionally, the District is a member of the Regional Water Providers Consortium. Members of this group partner together to increase the reach and scale of public education and outreach opportunities. Consortium public engagement efforts TVWD participated in from February 2, 2022, to June 1, 2022 include:

- Toilet leak detection promotion kit: This promotion was advertised on the Consortium's social media, website, and RegionalH2O newsletter, and through a KUNP newsletter. The promotion kit was available in English and Spanish and helps increase water conservation and drought mitigation efforts.

- School assembly programs: Beginning in the spring, the Mad Science program educated students about water, including conservation efforts. A total of 250 students from three schools participated.
- Digital advertising campaigns: Used to promote water-related issues in lieu of in-person events and workshops due to the COVID-19 pandemic.
- Print piece translation review and new graphics: Printed outreach materials were updated with new graphics and translated into seven languages. The new graphics are a result of feedback received from the multilingual how-to video project listening sessions that occurred from fall 2021 to winter 2022. The Consortium worked with Community Engagement Liaisons (CELs) and received $4,000 in Urban Area Security Initiative (UASI) grant money from Multnomah County to help support this work.
- Multilingual how-to video project: Consortium staff met with CELs to complete video scripts and graphics translations and to ensure that the CELs were prepared to act as on-camera spokespeople for the videos. Staff also negotiated with KUNP television so that their on-air newscaster could serve as the Spanish language spokesperson. Staff coordinated a 4-day video shoot involving 19 CELs that resulted in content for 21 videos in 7 languages.
- Public outreach and education campaigns: The 2022 campaigns began in the first week of May with Drinking Water Week and ran through the third week in October with the Great ShakeOut.
    - Drinking Water Week: The Consortium partnered with KATU television to do three on-air interviews and six “shout outs” on their AM Northwest and Afternoon Live shows during Drinking Water Week. The Consortium also produced a 60-second segment, which ran in the weekend news.
    - Conservation Campaign: The campaign incudes radio, digital online, English language television, and Spanish language television advertising.
        - KATU Television: Five on-air interviews, new and updated ads that aired 294 times, digital advertising, and featured content directed people to regionalH2O.org during Jeopardy and the evening news.
        - KUNP Television: A 60-second segment aired 19 times, new and updated ads aired 366 times, digital ads on KUNP.tv and YouTube, three newsletters, and translation support.
        - Garden Time Television: One interview aired.
        - Alpha Media Radio: Seasonally updated ads aired 2,132 times, and two on-air interviews took place.
        - Digital display advertising: Staff developed a series of ads designed to drive traffic to regionalH2O.org and increase sign-ups for the Weekly Watering Number.
        - Summer promotion: Outdoor watering promotion throughout July.
    - Source water protection campaign: The year-long “Clean Water. It’s Our Future” had delivered 487 ads as of April 30. This campaign concluded in June.
    - Emergency preparedness campaign: The campaign includes outreach tailored to help promote the new multilingual how-to videos on YouTube and in the community. Media partners included KATU television, KUNP television, and Intersection (TriMet bus ads).
    - Annual print order: Consortium members had the opportunity to add their logo to print pieces and to receive a start-up supply of the hose nozzle hangtag and several Junior Leak Detective print pieces in English and Spanish.

- Other public outreach projects:
  - RegionalH2O.org website: A new, interactive Region's Water Sources and Providers map was added to the website and a newly designed Weekly Watering Number widget was rolled out. Consortium staff continued updates to make regionalH2O.org accessible to those using assistive technologies and completed seasonal updates, monthly analytics reports, and weekly website maintenance. The website received 36,257 page views from 18,821 visitors from January 1 to April 30, 2022.
  - Consortium newsletters: The Consortium distributed two issues of The Source and one issue of RegionalH2O News.
    - RegionalH2O News: The March issue highlighted the new interactive Regional Water Providers & Water Sources map and Fix a Leak Week and the accompanying toilet leak detection promotion. It went to 979 recipients, with an open rate of 48% and a click rate of 8.5%.
    - The Source: The January issue provided members with a recap of the December tabletop exercise and outreach resources. It went to 158 members and had a 44.5% open rate and a 6.8% click rate. The April issue included updates on the Weekly Watering Number, Drinking Water Week outreach resources, and a celebration of the Consortium's 23-year involvement in the Children's Clean Water Festival. It went to 159 members and had a 41.7% open rate and a 5.6% click rate.
  - Consortium social media: The Consortium maintained an active presence on each of its three social media channels between January 1 and April 30, 2022.
    - Facebook: The Consortium account rose to 912 followers during the reporting period. A total of 83 posts were published, which resulted in 8,782 impressions and 541 engagements.
    - YouTube: The Consortium's 18 how-to videos and media segments were collectively viewed a total 12,495 times for a total of 395.7 hours and resulted in 73,569 impressions.
    - Twitter: The Consortium account has 644 followers and received 3,679 profile visits. A total of 103 tweets were published, which resulted in more than 24,000 impressions.
  - Spanish language outreach: The Consortium worked with community partners to translate more resources and content into Spanish. Translated content included an outdoor print piece, social media messaging, promotion content, and another KUNP newsletter. The KUNP newsletter went to 27,272 recipients and had a 20.85% open rate and a 2.61% click rate.
  - Member messaging toolkits: Messaging toolkit topics for this reporting period were National Engineers Week, Fix a Leak Week, and Water Week. Toolkits included social media copy, website links, graphic and media assets, and sample newsletter articles for members to use in outreach to their customers.

4.4. Financial Assessment

TVWD has access to or is eligible to potentially use the following funding resources for hazard mitigation initiatives:

- Capital improvements project funding obtained from water sales revenue.
- Authority to levy taxes for specific purposes.
- Fees for water services.

- Fees for new development.
- Incurrence of debt through general obligation bonds and/or special tax bonds.
- Incurrence of debt through private activities.
- Federal funding sources, including Building Resilient Infrastructure and Communities and Hazard Mitigation Assistance Grants. Grants for mitigation were sought for the 2016 Master Planning for Seismic Reliability and Resiliency Plan and 2018 Water Master Plan update. It is anticipated that the District will also apply for mitigation grants to update these plans when needed.
- State funding programs.
- Public or private partnership funding sources.

4.5. Capability Expansion and Improvement

Actions that can expand and improve existing authorities, plans, policies, and resources for mitigation include continuing to update plans as necessary to ensure they are current and reflect the needs of the District and its customers; increasing staff levels and natural hazard training for staff as necessary; further development of warning systems and messaging; and ensuring grant opportunities are capitalized upon to meet goals.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iii), §201.6(c)(3)(iv), and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) directs local mitigation plans to describe hazard mitigation actions and establish a strategy to implement those actions. Therefore, all other requirements for a local mitigation plan lead to and support the mitigation strategy.

5.1. Mitigation Goals

The Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 City of Beaverton NHMP, 2011 Cities of Cornelius and Forest Grove NHMPs, and 2020 State of Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals detailed in Volume I, Section 3. These goals are the basis of this plan and summarize what the Steering Committee will accomplish by implementing this plan.

5.2. Mitigation Successes

Risk Resilience Assessment and Emergency Response Plan Updates

In compliance with the 2018 America's Water Infrastructure Act, TVWD, in partnership with Carollo Engineering, conducted a Risk and Resilience Assessment and published an updated Emergency Response Plan certified with the U.S. Environmental Protection Agency. These February 2021 updates addressed all hazards in this NHMP.

Infrastructure Interdependencies Workshop

A workshop was held in May 2022 to bring together internal and external partners to discuss infrastructure interdependency throughout the service area. TVWD, WWSS, Clean Water Services, Portland General Electric, Washington County, Clackamas County, American Society of Civil Engineers Lifelines 2022 participants, and Cascadia Lifelines Program participants met to identify, assess, and develop mitigation strategies related to improving community resilience.

The activity integrated with the work being done by Metro on the Long-Range Transportation Plan, the RDPO's work with emergency transportation routes, RDPO's work on provisioning of emergency drinking water, and the Regional Water Consortium's work. It aligns with the TVWD Water Master Plan, the Oregon Resiliency Plan, and the plans within Washington County and the RDPO. This workshop addressed all hazards in this NHMP.

Key Customer Meetings

Before the COVID-19 *p*andemic, TVWD held quarterly meetings with key customers, including hospitals and health care organizations, those in the food production, manufacturing, and water quality sectors, fire departments, schools, Tualatin Hills Park & Recreation, Washington County, and the City of Beaverton. These collaboration meetings promoted co-resilience planning and education and helped the District determine each customer's level of mitigation and readiness planning and how that aligned with the Levels of Service as described in the Oregon Resiliency Plan.

The meetings integrated with the work being done by Metro on the Long-Range Transportation Plan, the RDPO's work with emergency transportation routes, RDPO's work on provisioning of emergency drinking water, and the Regional Water Consortium's work. It aligns with the TVWD Water Master Plan, the Oregon Resiliency Plan, and the plans within Washington County and the RDPO. This workshop addressed all hazards in this NHMP.

Emergency Preparedness Email Newsletter

TVWD's Communications Department sends customers a monthly newsletter via email. Topics covered include learning how to store water, preventing frozen pipes, planning for wildland fires and extreme heat, signing up for emergency alerts, and creating and keeping an emergency kit.

Willamette Water Supply System

This ongoing construction project will provide an additional, resilient water supply for Washington County. When complete, the WWSS will be one of Oregon's most seismically-resilient water systems—built to better withstand natural disasters, protect public health, and speed regional economic recovery through restoring critical services more quickly. See Section 7 of this annex for additional information about this system.

Mapping Critical Facilities in Relation to Hazards

TVWD is continually working with the RDPO and Washington County to map critical facilities in relation to exposure and vulnerability to all hazards included in this NHMP.

Development of Supervisory Control and Data Acquisition Master Plan

This ongoing project addresses control system challenges by identifying and prioritizing system upgrades that will increase utility efficiency and safety. The plan will be used for budgeting and planning for future SCADA system additions and enhancements.

Installation of Reservoir Seismic Isolation Layers

Seismic isolation layers were installed on two reservoirs to increase the seismic resiliency of this critical infrastructure.

Development of Emergency Water Provisioning Plan

The RDPO and the Regional Water Providers Consortium, which includes TVWD, are partnering to address how emergency drinking water will be provided to the public following a disaster. The project spans the five-county Portland Metropolitan Region, which includes Clackamas, Clark, Columbia, Multnomah, and Washington Counties.

In the last decade, water providers in the region have been using UASI funds and local budgets to purchase emergency mobile water treatment and distribution systems. Before additional equipment can be funded, the RDPO Steering Committee asked water providers and their partners to develop an emergency water planning framework and identify emergency water gaps to support future grant requests and emergency water distribution efforts. The overarching goal of the project is to advance regionally coordinated planning efforts for the effective and equitable delivery of drinking water post-disaster in the greater Portland metro region.

Vegetation Management

TVWD maintains an ongoing vegetation management program on its properties to decrease wildland fire fuel loads and contribute to wildland fire mitigation efforts in the County.

Emergency Power Supplies and Systems

To align with TVWD's America’s Water Infrastructure Act Risk and Resilience Assessment and the Oregon Resilience Plan, the District has installed backup power generation at its facilities.

Installation of Fuel Storage Tank

The overwhelming majority of TVWD-owned equipment required to construct, operate, and maintain the water system and its facilities is located at TVWD Headquarters, where there is an aboveground 20,000-gallon fuel storage container with the capacity to store and dispense 12,000 gallons of gasoline and 8,000 gallons of diesel. TVWD shares this source of fuel with the Tualatin Hills Park & Recreation District through an intergovernmental agreement for operation and maintenance of the tank and its related fueling infrastructure. This agreement created the Tualatin Regional Fueling Facility.

Provisional Water Trailers

In alignment with the Regional Water Providers and the RDPO Water Provisioning Plan, TVWD maintains and trains for the use of two provisional water trailers that can be used throughout the region in response to an emergency. TVWD has two emergency water distribution systems. These systems are compact and

portable manifold systems comprised of valves, connecting hoses, a circular fan, blivents, and water bags designed to dispense potable water into six-quart, food-grade bags during an emergency. There are additional trailers within the RDPO's area.

Established Radio Communications System

TVWD maintains a very high frequency (VHF) two-way radio system that operates on a Type 3 digital mobile radio (DMR), trunked system. TVWD also operates 1 VHF repeater at the Cooper Mountain Radio Site. The repeater is used for countywide interoperability.

5.3. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on mitigation plan requirement 44 CFR §201.6(c)(4)(ii), the vulnerability and capabilities assessment for TVWD was carefully reviewed and considered when developing the mitigation actions for this plan. TVWD's Technical Committee will establish a process in which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into the existing local planning strategies.

Once the plan is adopted, the committee will coordinate implementation with the responsible parties in TVWD and with external stakeholders as needed. The primary means for integrating mitigation strategies will be through the revision, update, and implementation of the actions as feasible.

The members of TVWD's Technical Committee will remain charged with ensuring the goals and strategies of new and updated local planning documents for the District are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.3.1. Comprehensive Plan

The District's Water System Master Plan update contains mitigation actions, strategies, and goals through the incorporation of a seismic assessment and Capital Improvement Plan. The 2015 Water System Master Plan includes an attachment titled "Seismic Reliability and Resiliency Evaluation" that summarizes gaps and future improvements needed to the system when considering a seismic event. The 2015 Water System Master Plan further separates pipeline projects into groupings described as Tier 1, 2, and 3. When these plans go through regular updates, additional details about hazard mitigation will be added, as applicable. The Water Master Plan was updated in December of 2018. TVWD is currently working on a "Capital Improvement Master Plan."

5.3.2. Public Engagement, Education, and Outreach

TVWD will continue its public engagement efforts, including holding events to educate customers about water conservation and emergency readiness, distributing the TVWD Emergency Preparedness Email Newsletter, hosting school assembly programs, creating new outreach materials in seven languages, and coordinating a public outreach campaign on multiple platforms on the topics of conservation, emergency preparedness, and source water protection. The District will continually assess the need to increase or update engagement opportunities as needed to best serve the organization and its customers.

5.3.3. Emergency Plans That Address Evacuation and Sheltering

The District's 2022 Emergency Response Plan addresses evacuation and sheltering in place, and TVWD works with Washington County, the American Red Cross, and community partners to address sheltering for staff and families. Additionally, specific work regarding evacuation and sheltering is done with Tualatin

Hills Park & Recreation and the Beaverton School District. TVWD will work with its partners to review and update these plans as needed to fit the needs of the District's customers.

5.3.4. Enforcement of Existing Policies

TVWD District's Curtailment Plan has provisions for addressing the District's water curtailment policy that can be implemented during low water levels or water shortages. This policy will be updated as needed to fit the needs of the organization and its customers.

5.3.5. Funding Opportunities

TVWD will continue to review annual, post-disaster, and stand-alone grant opportunities for potential mitigation project funding opportunities. This includes the Hazard Mitigation Grant Program and the Building Resilient Infrastructure and Communities grant program.

6. Action Items

Action items for the 2023 NHMP were determined by TVWD's Technical Committee based on the review of its risk assessment, its existing capabilities, and the status of its previous action items. This range of actions includes structure and infrastructure projects and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.1 and 6.2 below. Additional information about how these actions were developed, evaluated, and prioritized is in Volume I, Section 3.

6.1. Tualatin Valley Water District Action Items: 2023 Washington County NHMP

Table 284: TVWD Action Items

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
1	Florence Lane Pump Station. Retrofit the existing pump station to withstand the effects of natural disasters. This includes upgrading the existing backup power supply system.	Dam Failure, earthquake, extreme heat, flood, landslide, windstorm, including tornado, and winter storm	High
2	Mid-Term Pipeline upgrade to upgrade and retrofit the existing pipeline.	Dam failure, earthquake, flood, landslide, wildland fire, windstorm, including tornado, and winter storm	Medium
3	Retrofit the existing Somerset Reservoir.	Dam failure, earthquake, landslide, windstorm, including tornado, and winter storm	Medium
4	Rosander Pump Station. Upgrade the Sunset Pump Station to withstand seismic and other natural hazards.	Dam failure, earthquake, landslide, windstorm, including tornado, and winter storm	Medium
5	Supply Vulnerability Response Planning for Scoggins Dam. Evaluate supply vulnerability and response to natural hazards associated with Scoggins Dam.	Dam failure, earthquake, flood, landslide, windstorm, including tornado	Medium

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
6	Upgrade the Cornelius Pass Facility to meet current seismic design and provide controls and interconnection between the Willamette Water Supply System and the Joint Water Commission.	Dam failure, earthquake, flood, landslide, volcanic ash, windstorm, including tornado, and winter storm	Low
7	North Road Reservoir. Retrofit the existing structure to withstand anticipated natural hazards.	Dam failure, earthquake, landslide, windstorm, including tornado, and winter storm	Low
8	Partnership with Regional Water Providers Consortium on Public Education efforts.	Drought and earthquake	High
9	Retrofit the Cooper Mountain Pump Station to better withstand the effects of multiple natural hazards.	Earthquake, landslide, windstorm, including tornado, and winter storm	High
10	189th Pump Station seismic upgrade to meet current seismic code requirements and provide automated backup power.	Earthquake, windstorm, including tornado, and winter storm	High
11	Goyak Reservoir. Upgrade/retrofit existing structure to withstand hazards.	Earthquake, flood, windstorm, including tornado, and winter storm	High
12	Goyak Pump Station. Upgrade the existing pump station to withstand the effects of natural hazards, including upgrading the backup power system to be automated.	Earthquake, extreme heat, flood, landslide, wildland fire, windstorm, including tornado, and winter storm	High
13	Taylors Ferry Reservoirs and Site Seismic Improvements. Seismically upgrade water system facilities serving the upper pressure zones in the Metzger service area.	Earthquake, extreme heat, flood, windstorm, including tornado, and winter storm	High
14	Lead joint pipe seismic upgrade to retrofit the existing pump station to withstand the effects of natural disasters. This includes upgrading the existing backup power supply system.	Earthquake	High
15	America's Water Infrastructure Action/Security Recommendation Implementation. Includes adding security cameras to evaluate if sites are in good condition following a hazard event.	Earthquake, flood, landslide, volcanic ash, wildland fire, windstorm, including tornado, and winter storm	Medium

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
16	Meadow and Walker pressure-reducing valves. Upgrade existing facility to improve access and safety.	Flood	High
17	TVWD Headquarters building upgrade so the building can withstand all natural hazards.	All hazards	High
18	Emergency underground storage/water supply well – regional supply planning. Conduct an engineering study to help determine the future ability to use the Emergency Underground Storage sites to assist in the Emergency Drinking Water Provisioning Project and for first responders. Would include, but not be limited to: Scheupbach Well and Grabhorn, Miller, and Copper Mountain aquifer storage and recovery sites.	All hazards	Medium
19	Supply vulnerability planning. Integrate plans and policies into existing plans to identify water supply vulnerabilities and enhance mitigation efforts.	All hazards	Low
20	Supply Vulnerability Planning for the Portland Water Bureau Source. Update and revise existing plans, procedures, and agreements to ensure the water supply system is able to handle various natural disasters.	All hazards	Low
21	Pipeline vulnerability response planning. Evaluate major pipelines that may be vulnerable to natural hazards.	All hazards	Low
22	Retrofit and build an emergency operations center facility to withstand natural hazards.	All hazards	Low
23	Infrastructure interdependencies workshops. TVWD and WWSS activity focused on identification, assessment, and development of mitigation strategies related to improving community resilience.	All hazards	Medium
24	Regional Water Providers Consortium Strategic Plan 2023-28. This will be a TVWD and Regional Water Providers service area activity focused on identification, assessment, and development of mitigation strategies related to improving community resilience.	All hazards	Medium
25	Key and critical customer collaboration. TVWD and WWSS infrastructure interdependency service area activity focused on identification, assessment, and development of mitigation strategies related to improving community resilience. To be held quarterly.	All hazards	High
26	Talkin' Water. Talking to community members about mitigation and preparedness via a virtual forum.	All hazards	High

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
27	Source Water Protection Plan	All hazards	Medium
28	Monthly Mitigation and Preparedness Newsletter. Newsletter sent out to customers of TVWD and covers a monthly emergency readiness / mitigation topic.	All hazards	Low
29	Risk resilience assessment and emergency response plan update in 2025 to support compliance with America's Water Infrastructure Act.	All hazards	Low
30	Increase the District's ability to transfer data among its numerous sites via wired connectivity. To include bandwidth to transmit video data for damage assessment/debris estimate.	All hazards	Medium
31	Increase the District's ability to transfer data among its numerous sites via wireless technology (Public 5G, Private LTE/5G and/or Long Range 5Ghz WiFi.)	All hazards	Medium

6.2. Mitigation Action Information Worksheets

Table 285: Increase Internet Connectivity District Wide (Cable and Fiber Connections)

Mitigation Action Information	
Title of action	Increase Internet Connectivity District Wide (Cable and Fiber Connections)
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☒
Action description	Increase the District's ability to transfer data among its numerous sites via wired connectivity. To include bandwidth to transmit video data for damage assessment/debris estimate.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Existing internet connections are not complete, and during earthquakes, landslides, and winter storms, the current connections are susceptible to disruption of data communication lines that run underground, which can be affected by the natural hazard. The ability to transmit data between our sites ensures business continuity in such a disaster and allows us to act in an emergency ops/response capacity. Also permits seamless communication with the entire service area.
Area of action impact	Entire service area
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? All remote sites, listed in Critical Asset sheet
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	City of Beaverton and Washington County Emergency Operations Plans
Alignment with existing plans and policies	TVWD Emergency Operations Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Information Technology and Facilities

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Information Technology and Facilities	City of Beaverton and Washington County
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund and MACC Grant	Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities
Estimated Cost	$1,000,000.00 for installation of internet connections (cable/fiber connection) from vendors. Ongoing licensing and service costs are estimated at $60,000.00 annually.

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Limit disruption of essential infrastructure Enhance the ability of the District to assist in emergency operations	Build resilience in our network infrastructure and add capacity/bandwidth at our hard-to-reach locations. For example, facilities that do not currently have fiber connectivity, and don't exist near current infrastructure to support such connectivity.	$600,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	Winter 2026	Winter 2027

Implementation Benchmarks: How Will Success Be Measured?

- Securing funding and project buy-in.
- Completing survey to determine type of equipment needed.
- Procuring equipment.
- Installing equipment.
- Training staff of how to use monitoring software and utilize data.
- Creating and implement maintenance plan**.**

Potential Challenges to Implementation

- Securing ongoing funding for maintenance to equipment and software updates.

Resources and References, if Applicable

- Potential vendors: Ziply and Comcast

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action	$0	Continued risks, frequent
Alternative #2	Scale project to four areas	$508,000.00	Continued risks
Alternative #3			
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 286: Increase Wireless Capabilities District-Wide

Mitigation Action Information			
Title of action	Increase Wireless Capabilities District-Wide		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☒	
Action description	Increase the District's ability to transfer data among its numerous sites via wireless technology (Public 5G, Private LTE/5G, and/or Long-Range 5Ghz Wi-Fi)		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☐	Winter storm ☒
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	During wildfire and heavy wind events, data communication lines that run on poles as well at underground, which can be affected by the natural hazard. The ability to transmit data between our sites ensures business continuity in such a disaster and allows us to act in an emergency ops/response capacity. Also permits seamless communication with the entire service area.		
Area of action impact	Entire service area		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	City of Beaverton and Washington County Emergency Operations Plans		
Alignment with existing plans and policies	TVWD Emergency Operations Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Information Technology and Facilities		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Information Technology and Facilities		City of Beaverton and Washington County	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund and MACC Grant	Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities
Estimated Cost	$75,000.00 for equipment and $25,000.00 for implementation support. Ongoing licensing and equipment replacement is estimated at $15,000 annually.

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Limit disruption of essential infrastructure, Enhance the ability of the District to assist in emergency operations,	Build resilience in our network infrastructure and add capacity/bandwidth at our hard-to-reach locations. For example, facilities that do not currently have fiber connectivity and don't exist near current infrastructure to support such connectivity.	$600,000.00

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	Winter 2026	Winter 2027

Implementation Benchmarks: How Will Success Be Measured?

- Securing funding and project buy-in.
- Completing survey to determine type of equipment needed.
- Procuring equipment.
- Installing equipment.
- Training staff of how to use monitoring software and utilize data.
- Creating and implement maintenance plan**.**

Potential Challenges to Implementation

- Securing ongoing funding for maintenance to equipment and software updates.

Resources and References, if Applicable

- Potential vendor

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action	$0	Continued risks, frequent.
Alternative #2	Scale project to two areas		

Alternative #3			USGS only installs flood gauges, and the startup and ongoing costs to implement this type of solution are much more expensive.
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 287: Supply Vulnerability Planning

Mitigation Action Information			
Title of action	Supply Vulnerability Planning		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Integrate plans and policies into existing plans to identify water supply vulnerabilities and enhance mitigation efforts.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	Allows the District to plan for future expenditures to make infrastructure upgrades and capital expenditure decisions that will enhance future hazard mitigation efforts.		
Area of action impact			
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Water supply facilities		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Investing in critical infrastructure		
Alignment with existing plans and policies	Oregon Seismic Resilience Plan		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Engineering & Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
		Joint Water Commission	

Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General funding, Capital Improvement funding		HMGP funding, BRIC funding	
Estimated Cost	$1 million		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Allows plans to be established to help direct funding efforts for supply resilience.		$6 million in financial benefits	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			
Implementation Benchmarks: How Will Success Be Measured?			
Potential Challenges to Implementation			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 288: Supply Vulnerability Response Planning – Portland Water Bureau Source

Mitigation Action Information			
Title of action	Supply Vulnerability Response Planning – Portland Water Bureau Source		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Update and revise existing plans, procedures, and agreements to ensure that the water supply system is able to handle various natural disasters.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	This planning will allow the District to find alternative sources of supply and identify deficiencies in the Portland Water Bureau source specifically that would require upgrading to supply the District with potable water following a natural hazard event.		
Area of action impact	The entire water District service area.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Facilities which supply water from Portland Water Bureau.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Invest in critical infrastructure.		
Alignment with existing plans and policies	Incorporated in the Oregon Seismic Resilience Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Engineering & Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
		Portland Water Bureau	

Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General funding, Capital Improvement funding		BRIC funding, HMGP funding	
Estimated Cost	$1 million		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Allows the District to plan for future supply improvements.		$6 million in potential benefits.	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐			
Implementation Benchmarks: How Will Success Be Measured?			
Potential Challenges to Implementation			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 289: Supply Vulnerability Response Planning – Scoggins Dam

Mitigation Action Information			
Title of action	Supply Vulnerability Response Planning – Scoggins Dam		
Type of action	Plans/regulations ☒		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	Evaluate supply vulnerability and response to natural hazards associated with Scoggins Dam.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☒	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Allows agencies to plan appropriately for responding to and recovering from a dam failure following a natural hazard event.		
Area of action impact			
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Scoggins Dam		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Investing in critical infrastructure.		
Alignment with existing plans and policies	Oregon Seismic Resilience Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Engineering & Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
		Joint Water Commission	

Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General funding, Capital Improvement funding		BRIC funding, HMGP funding	
Estimated Cost	$5 million		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Allows agencies to establish plans to prevent and/or recover from a dam failure.		$30 million in financial benefits	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐			
Implementation Benchmarks: How Will Success Be Measured?			
Potential Challenges to Implementation			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 290: Somerset Reservoir

Mitigation Action Information			
Title of action	Somerset Reservoir		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Retrofit the existing reservoir.		
Hazard(s) addressed	Dam failure ☒ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☒ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	The existing reservoir is the only reservoir in the upper pressure zone in the West Hills area of TVWD. To meet resilience goals, an additional reservoir or a rehabilitated, seismically resilient reservoir would need to be constructed.		
Area of action impact	This impacts the 1045 pressure zone as well as zones served from the Barnes Pump Station.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Somerset Reservoir		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	This meets the District's initiative to invest in critical infrastructure.		
Alignment with existing plans and policies	This aligns with the Oregon Seismic Resilience Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Engineering & Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Engineering, operations, safety, risk.		City of Portland, Washington County	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	BRIC funding, HMGP funding, others to be evaluated.
Estimated Cost	$4 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
District is able to maintain service to the upper West Hills area following a seismic event.	Prevents damage due to potential reservoir failure and the resulting flooding.	$24 million in potential financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐		

Implementation Benchmarks: How Will Success Be Measured?

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 291: Infrastructure Interdependencies Workshops

Mitigation Action Information	
Title of action	Infrastructure Interdependencies Workshops
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	The TVWD and WWSS infrastructure interdependency service area activity focused on identification, assessment, and development of mitigation strategies related to improving community resilience.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☒ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Introduction to "Infrastructure Interdependencies" topic, "Why Now?"; "Hierarchy of infrastructure systems overview"; and "Co-resilience planning" Education within group. • Universe of critical infrastructure systems, from FEMA; includes all the key services represented by the group attending. • Even just for water service, water providers are dependent upon all the other utilities and public services, especially after a disaster. • Recent experience with supply chain issues proves how critical it is to plan ahead and be prepared. What mitigation can we do? • Why now? For WWSP, design is complete, and program activities are transitioning to emergency planning, operational planning, construction, and future mitigation. • Hierarchy of infrastructure dependencies; identify order of problem-solving by specific system at risk, then identify other services needed to address the specific problem; very clear that there are strong interdependencies between utilities.
Area of action impact	Total infrastructure within the service area with combined mitigation activity coordinated within the lifelines and identified infrastructure interdependencies.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? WWSP
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	The program is integrated with the work being done by Metro on the Long Range Transportation Plan, the RDPO work with Emergency Transportation Routes, the RDPO work on Provisioning of Emergency Drinking Water, and the Regional Water Consortium's work.
Alignment with existing plans and policies	Aligned with the Water Master Plan, the Oregon Resiliency Plan, and the plans within Washington County and the RDPO.

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Principal Engineer, TVWD (WWSP)		
Supporting Partners			
Internal Partners	**External Partners, Including Community Partners**		
Willamette Water Supply System (WWSS)/Tualatin Valley Water District Emergency Program Coordinator	• Clean Water Services (wastewater infrastructure) • Portland General Electric (electrical power infrastructure) • Washington County (transportation infrastructure/emergency management) • Clackamas County (emergency management) • ASCE Lifelines 2022 Conference Participants (regional subject matter experts and agencies) • Cascadia Lifelines Program (consortium of lifeline providers)		
Potential Funding Sources			
Non-Federal Funding Sources	**Federal Funding Sources**		
General Funds for staff time and supplies	• Homeland Security Grant Program (HSGP) • Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities		
Estimated Cost	$50,000 per year from TVWD, does not include the funds from the external stakeholders. Estimate $150,000.00 per year required to implement a funded program and implement programs.		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Aligned mitigation planning. Protection of life safety.	Increased understanding of lifelines and infrastructure interdependencies; mitigation actions have added weight and receive higher priority.	$300,000.00 per year	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	May 23, 2022	May 2027	

Implementation Benchmarks: How Will Success Be Measured?
Start date, May 23, 2022. Meeting schedule to meet with individual stakeholders to develop a mission and vision statement. Establishment of framework during 2022 and into 2023. • Align with Lifelines and the Infrastructure Interdependencies. Assessment of current state within TVWD, WWSP, and the listed external partners. • Assessment of the Levels of Service from the Oregon Resiliency Plan. • Assessment of projects within Oregon, and especially within the RDPO and Washington County. • Alignment with FEMA Region 10. • 2023: Establish goals and quarterly workshops. • Work product will be used to inform other programs/projects, as mentioned with the long-range transportation plan and the ETR plans. • Progress measured by infrastructure mitigation work being done, grants awarded, and work started, for example, the two bridges key to the WWSP service. • 2022: Seek sources of funding for the mitigation planning projects.
Potential Challenges to Implementation
• Ability to scale the problem. The mitigation work is significant, our challenge will be to narrow the work, define the scope, and make measurable progress. • Availability of the key stakeholders. • Conflicting projects that are parallel but not integrated. • Work capacity of staff, being able to dedicate time and effort to a non-funded project. • Funding. Currently, this is all in-kind work, and there are no funds for staff time or a budget for supplies.
Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action	0	Lack of coordination and collaboration until emergency response required.
Alternative #2	Scale project to only water providers	Year 1 – 10,000.00 Ongoing 10,000.00	Mitigation focused on only one lifeline.
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 292: Taylors Ferry Reservoirs and Site Seismic Improvements

Mitigation Action Information	
Title of action	Taylors Ferry Reservoirs and Site Seismic Improvements
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Seismically upgrade the water system facilities serving the upper pressure zones in the Metzger service area.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☒ Volcanic ash ☐ Extreme heat ☒ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Upgrading the water system facilities includes reservoir upgrades, pump station upgrades, and storage and maintenance facility upgrades that will keep the facilities operational during and after a seismic event. This has additional benefits for protecting the facilities from other natural hazards.
Area of action impact	The upper pressure zones in the Metzger service area, including the 498 and 643 pressure zones. The operations and maintenance building serves the entire Metzger service area.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Taylors Ferry Facilities
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	This project aligns with the District's initiative to invest in critical infrastructure.
Alignment with existing plans and policies	This aligns with the Oregon Seismic Resilience Plan.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Engineering & Operations

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Engineering, Operations, Finance, IT, Safety, Security, Facilities	Washington County, TVF&R
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	HMGP funding
Estimated Cost	$15.8 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
The District is able to maintain essential potable water service to residents and businesses within the service area.	The District is able to better respond to other system needs and is able to provide emergency sources of water supply. This will assist with economic recovery efforts following a natural hazard event.	$94.8 million in potential financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	April 2023	June 2025

Implementation Benchmarks: How Will Success Be Measured?

- Success measured based on the District's ability to maintain water service following all kinds of anticipated natural hazards.

Potential Challenges to Implementation

- Rising cost of materials and construction costs.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action

	Action Description	Estimated Cost	Evaluation
Alternative #1	Do nothing.		Does not meet the intent of providing a resilient source of supply.
Alternative #2	Rehabilitate.		Does not meet the full hazard mitigation requirements.
Alternative #3	Replace.		Meets all updated seismic standards.

Implementation Progress Report for Plan Maintenance	
Date	August 1, 2022
What progress in implementation has been made to date?	Design efforts are at 90% complete. Awaiting FEMA requests for information to finalize the funding approval and begin construction.
What challenges in implementation have been experienced?	None
What are the next steps in implementation?	Complete design, obtain permits, obtain full FEMA approval of funding, and construct the improvements.

Table 293: North Road Reservoir

Mitigation Action Information			
Title of action	North Road Reservoir		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Retrofit the existing structure to withstand anticipated natural hazards.		
Hazard(s) addressed	Dam failure ☒ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☒ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	By upgrading the facility, the District will be able to provide potable water to customers in the 820 pressure zone following a natural hazard.		
Area of action impact	The 820 pressure zone and downstream residents who would be impacted by a reservoir failure.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? North Road Reservoir		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Meets the initiative of investing in critical infrastructure.		
Alignment with existing plans and policies	Aligns with the Oregon Resilience Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Engineering and Operations.		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Engineering, operations, safety, risk		Multnomah County	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	BRIC funding, HMGP funding, other potential sources to be evaluated.
Estimated Cost	$10 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Allows the District to remain in service and prevents damage to downstream properties following a natural hazard.		$60 million in potential financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	2038	2040

Implementation Benchmarks: How Will Success Be Measured?

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 294: Pipeline Vulnerability Response Planning

Mitigation Action Information			
Title of action	Pipeline Vulnerability Response Planning		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Evaluate major pipelines that may be vulnerable to natural hazards.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	Through studying the vulnerabilities of the existing piping, the District can better prepare for future natural hazards and can prioritize the rehabilitation or replacement of pipelines most in need of seismic or other upgrades to withstand natural hazard events.		
Area of action impact	All of TVWD.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Critical pipeline facilities.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	Incorporate this planning and the prioritization into other regional plans and initiatives. This includes District initiatives to invest in critical infrastructure.		
Alignment with existing plans and policies	This study will help to align spending on critical pipelines with other critical infrastructure projects done by the county.		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Engineering & Operations		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Engineering, operations, finance	Washington County, Cities of Hillsboro, Beaverton, and Tigard.

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	HMGP funding, BRIC funding, others to be evaluated.
Estimated Cost	$500,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Allows the District to coordinate upgrades with other regional infrastructure projects to limit costs and vulnerabilities.		$3 million in estimated financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	2028	2029

Implementation Benchmarks: How Will Success Be Measured?

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 295: Rosander Pump Station

Mitigation Action Information			
Title of action	Rosander Pump Station		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Upgrade the Sunset Pump Station to withstand seismic and other natural hazards.		
Hazard(s) addressed	Dam failure ☒ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☐ Landslide ☒ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Upgrading the Sunset Pump Station by constructing at the Rosander Pump Station and associated pipelines, which will allow the District to serve customers in the West Hills area of the District following natural hazards.		
Area of action impact	West Hills area of the District.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Sunset Pump Station		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Included in the District's initiative to invest in critical infrastructure.		
Alignment with existing plans and policies	Aligns with the Oregon Resilience Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Engineering and Operations.		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Engineering, operations, facilities, asset management, risk, safety.		Washington County	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	BRIC funding, HMGP funding, others to be evaluated.
Estimated Cost	$8 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Allows the District to maintain service to the West Hills area following a seismic event.		$48 million in potential financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	2028	2030

Implementation Benchmarks: How Will Success Be Measured?

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Do nothing.		
Alternative #2	Upgrade facility in place.		
Alternative #3	Upgrade facility by constructing at the Rosander site.		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 296: Goyak Pump Station

Mitigation Action Information			
Title of action	Goyak Pump Station		
Type of action	Plans/regulations ☐		Natural systems protection ☒
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Upgrade the existing pump station to withstand the effects of natural hazards, including upgrading the backup power system to be automated.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	Upgrading the existing pump station will limit the risk of a failure and enhance the District's ability to serve the higher elevations in the Cooper Mountain Area. By upgrading the facility, the District will be able to maintain service to customers, as well as provide a backup source of supply for the City of Beaverton. Upgrading the backup power system will allow the facility to function without operator involvement and delay due to response times.		
Area of action impact	Cooper Mountain service area for TVWD and City of Beaverton as a backup source of supply.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Goyak Pump Station		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☒	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Meets the District's initiative of investing in critical infrastructure.		
Alignment with existing plans and policies	Meets goals of the Oregon Seismic Resilience Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Engineering and Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Engineering, Operations, Risk, Safety		Washington County, City of Beaverton	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	HMGP funding, BRIC funding, others to be evaluated.
Estimated Cost	$2 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Resilient source of potable water to the Cooper Mountain area.	Public confidence that no interruptions anticipated following natural hazard events. Fewer operator challenges following small and large events to keep the facility operational.	$12 million in anticipated benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	2024	2026

Implementation Benchmarks: How Will Success Be Measured?
• Successful completion of design and construction with backup power online following hazards.

Potential Challenges to Implementation
• Difficult site constraints, impacts to neighbors.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Do nothing.	$0	Does not meet objective.
Alternative #2	Combine 189th and Goyak Pump Stations, reducing the number of facilities.	$1.5 million	Swap cost of upgrading the facility to installation of a resilient piping connection to 189th Pump Station.
Alternative #3	Seismic upgrade and new backup power.	$2 million	Ongoing maintenance of separate facilities.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 297: Goyak Reservoir

Mitigation Action Information			
Title of action	Goyak Reservoir		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Upgrade/retrofit the existing structure to withstand hazards.		
Hazard(s) addressed	Dam failure ☒ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☒ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Upgrading the existing facility will allow the District to continue potable water service to customers following a natural hazard identified above. Risks currently involve the structure not meeting full current seismic codes and the current drains not meeting desired goals of limiting water loss.		
Area of action impact	The Cooper Mountain area. The reservoir directly serves the 550 and 400 pressure zones, and indirectly serves the upper pressure zones.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Goyak Reservoir		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	This meets the District's initiative to invest in critical infrastructure.		
Alignment with existing plans and policies	Meets the Oregon Seismic Resilience Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Engineering & Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Engineering, operations, risk, safety			

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	HMPG funding, BRIC funding, others to be evaluated.
Estimated Cost	$1 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Maintains the ability to serve potable water following a seismic event.	Prevents flooding to downstream homes by having a resilient reservoir.	$6 million in estimated financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	2024	2025

Implementation Benchmarks: How Will Success Be Measured?
• Ability to maintain service following a natural hazard.

Potential Challenges to Implementation
• Site constraints, permitting.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Do nothing.	$0	Does not meet objectives.
Alternative #2	Construct new reservoir.	$10 million	Does not include land purchase and piping. Inefficient.
Alternative #3	Rehabilitate existing reservoir.	$1 million	

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 298: Meadow & Walker PRV

Mitigation Action Information			
Title of action	Meadow & Walker PRV		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Upgrade the existing PRV facility to improve access and safety.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☒ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	The existing facility constantly fills with water and road grime, making access and maintenance a challenge. This project will upgrade the facility to improve access and maintenance, reducing the risk of flooding that causes detrimental impacts to the operations of the system.		
Area of action impact	This is a main feed to the 385 pressure zone.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Meadow & Walker PRV facility		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Aligns with the District's initiative to invest in critical infrastructure.		
Alignment with existing plans and policies	Aligns with District plans to improve safety and access to facilities.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Engineering & Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Engineering, operations, risk, safety			
Potential Funding Sources			

Non-Federal Funding Sources	Federal Funding Sources
Capital reserves, water sales revenue, revenue bonds.	BRIC funding, HMPG funding, others to be determined
Estimated Cost	$1.5 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Ability to maintain infrastructure and avoid failures following natural hazards.		$9 million in estimated financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	2023	2025

Implementation Benchmarks: How Will Success Be Measured?

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 299: Mid-Term Pipeline Upgrade

Mitigation Action Information			
Title of action	Mid-Term Pipeline Upgrade		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☒ Public education/awareness ☐
Action description	Upgrade and retrofit existing pipeline.		
Hazard(s) addressed	Dam failure ☒ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☒ Landslide ☒ Volcanic ash ☐ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	This project will evaluate and upgrade existing critical pipelines within the District's system.		
Area of action impact	All of TVWD.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Critical pipelines.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☒ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Meets initiatives for investing in critical infrastructure.		
Alignment with existing plans and policies	Aligns with the Oregon Seismic Resilience Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Engineering and Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Engineering, operations, risk, safety		Washington County	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	BRIC funding, HMGP funding, others to be evaluated.
Estimated Cost	$98 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Improves the resilience of the water transmission mains and the District's ability to meet operational goals following an event.		$588 million in potential financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	2028	2048

Implementation Benchmarks: How Will Success Be Measured?
• District's ability to serve water following a natural hazard.

Potential Challenges to Implementation

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 300: 189th Pump Station Seismic Upgrade

Mitigation Action Information	
Title of action	189th Pump Station Seismic Upgrade
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Upgrade the 189th Pump Station to meet current seismic codes and provide automated backup power.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	The 189th Pump Station is in need of seismic upgrades to meet current code requirements. By upgrading the pump station and providing backup power, the Cooper Mountain area that is served by this pump station will be able to remain in service following the hazards identified. This pump station is also key to providing backup water supply to the City of Beaverton's Cooper Mountain area.
Area of action impact	The Cooper Mountain service area within TVWD.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? 189th Pump Station
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	This meets the District's ongoing initiative of investing in critical infrastructure.
Alignment with existing plans and policies	Meets the Oregon Seismic Resilience Plan.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Engineering and Operations

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Engineering, Operations, Risk & Safety	Washington County

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	BRIC, HMGP, others to be evaluated.
Estimated Cost	$8 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Ability to continue uninterrupted potable water service following major natural hazard events.	Public confidence in the water service which meets anticipated levels of service.Meets District initiatives to invest in critical infrastructure.	$48 million in estimated financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	2023	2025

Implementation Benchmarks: How Will Success Be Measured?
• Success measured based on pump station availability and ability to meet water demands.

Potential Challenges to Implementation
• Rising costs of implementation and ability to construct improvements within existing land footprint. Potential impacts to neighbors and ability to serve potable water during construction.

Resources and References, if Applicable
• 2018 Water Master Plan Update, 2015 Water Master Plan, 2022 Pre-design (in-progress).

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
	Pump replacements	$100,000	TBD
Alternative #2	Rehabilitate in place	$2 million	TBD
Alternative #3	Full seismic upgrade	$8 million	TBD

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 301: Florence Lane Pump Station

Mitigation Action Information			
Title of action	Florence Lane Pump Station		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Retrofit the existing pump station to withstand the effects of natural disasters. This includes upgrading the existing backup power supply system.		
Hazard(s) addressed	Dam failure ☒ Drought ☐ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☒ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Upgrading the existing pump station to meet current codes will allow the District to maintain service to customers following a natural hazard. The existing backup power system may not be active following an event, and this project intends to address that as well.		
Area of action impact	The upper pressure zones in the Metzger service area.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	This meets the District's ongoing initiative of investing in critical infrastructure.		
Alignment with existing plans and policies	Meets the Oregon Seismic Resilience Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Engineering and Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Engineering, operations, risk, safety.		Washington County	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	BRIC funding, HMGP funding, others to be evaluated.
Estimated Cost	$5 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Ability to sustain operations following a natural hazard.	Public confidence in the water system.	$30 million in estimated financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐	2023	2025

Implementation Benchmarks: How Will Success Be Measured?
• Meeting implementation timelines to be online prior to 2026.

Potential Challenges to Implementation
• Site constraints, land use permitting, funding availability.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
	Do nothing		
Alternative #2	Construct new pipeline in Florence Lane		
Alternative #3	Perform upgrades		

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 302: Cooper Mountain Pump Station

Mitigation Action Information			
Title of action	Cooper Mountain Pump Station		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Retrofit the Cooper Mountain Pump Station to better withstand the effects of multiple natural hazards.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	The existing Cooper Mountain Pump Station does not meet all current seismic codes; in particular, a Cascadia Subduction Zone seismic event would be detrimental to being able to serve potable water to the area. This seismic upgrade would allow the District to meet levels of service for the various hazards before and after the events.		
Area of action impact	Upper pressure zones on Cooper Mountain.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	This meets the District's ongoing initiative of investing in critical infrastructure.		
Alignment with existing plans and policies	Aligns with the Oregon Resilience Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Engineering and Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Engineering, Operations, Risk, & Safety		Washington County	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	BRIC, HMGP, others to be evaluated.
Estimated Cost	$5 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Ability to continue uninterrupted potable water service following major natural hazard events.	Public confidence in the water service that meets anticipated levels of service. Meets District initiatives to invest in critical infrastructure.	$30 million in estimated financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☒ Ongoing ☐	2024	2026

Implementation Benchmarks: How Will Success Be Measured?
• Success measured based on pump station availability and ability to meet water demands following a natural hazard event.

Potential Challenges to Implementation
• Rising costs of implementation, ability to construct improvements adjacent to residential area.

Resources and References, if Applicable
• 2018 Water Master Plan Update, 2015 Water Master Plan, 2022 Pre-design (in-progress).

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Pump replacements	$100,000	TBD
Alternative #2	Rehabilitate in place	$3 million	TBD
Alternative #3	Seismic upgrade	$5 million	TBD

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 303: Cornelius Pass Facility Upgrade

Mitigation Action Information			
Title of action	Cornelius Pass Facility Upgrade		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Upgrade the Cornelius Pass Facility to meet current seismic design, and provide controls and interconnection between the Willamette Water Supply System and the Joint Water Commission.		
Hazard(s) addressed	Dam failure ☒ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☒ Landslide ☒ Volcanic ash ☒ Wildland fire ☐	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	This facility upgrade will allow water to move between two regional supply sources: the Willamette Water Supply System and the Joint Water Commission. It will provide regional connectivity and controls to allow water to be shared, providing resiliency for the risks identified above.		
Area of action impact	Potential to include all water service providers served by the Willamette Water Supply System and the Joint Water Commission.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☒
Integration into other initiatives	This meets the District's ongoing initiative of investing in critical infrastructure.		
Alignment with existing plans and policies	Meets the Oregon Seismic Resilience Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Engineering and Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
Engineering, Operations, Risk, Safety, Finance		Washington County, WWSS, JWC, Hillsboro	

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital Reserves, water sales revenue, revenue bonds.	BRIC funding, HMGP funding, others to be evaluated.
Estimated Cost	$20 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Ability to continue uninterrupted potable water service following major natural hazard events.	Public confidence in the water service which meets anticipated levels of service. Meets District initiatives to invest in critical infrastructure.	$120 million in estimated financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	2032	2034

Implementation Benchmarks: How Will Success Be Measured?
• Success measured based on water availability, ability to meet water demands, and supply region before, during, and after a natural hazard.

Potential Challenges to Implementation
• Rising costs of implementation and ability to construct improvements within existing land footprint adjacent to wetlands. Property acquisition.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 304: Emergency Operations Center

Mitigation Action Information			
Title of action	Emergency Operations Center		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Retrofit and build a facility to withstand the natural hazards.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	Following a natural disaster, it is essential to be able to convene a response group at a centralized location to provide response and communicate with stakeholders. A fully resilient Emergency Operations Center will allow the District to better respond following an event and will help the District to return to service in a timely manner.		
Area of action impact	Potential to assist with the emergency response in all of Washington County.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Emergency Operations Center		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	This meets the District's ongoing initiative of investing in critical infrastructure.		
Alignment with existing plans and policies	Meets the intent of the Oregon Seismic Resiliency Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Engineering and Operations		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
All internal departments.	Washington County

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	HMGP funding, BRIC funding, others to be evaluated.
Estimated Cost	$30 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Ability to respond to system failures following a major natural hazard. Improve communications.	Potentially serve as a location for potable water distribution.	$180 million in estimated financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	2032	2035

Implementation Benchmarks: How Will Success Be Measured?
• Ability to respond to disasters, improvement in response times.

Potential Challenges to Implementation
• Location, funding.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
	Do nothing		
Alternative #2	Upgrade existing		
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 305: Emergency Underground Storage/Water Supply Well – Regional Supply Planning

Mitigation Action Information	
Title of action	Emergency Underground Storage/Water Supply Well – Regional Supply Planning
Type of action	Plans/regulations ☒ Natural systems protection ☒ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Conduct an engineering study of emergency underground storage and subsequent water use during response and recovery operations. The project would include, but not be limited to, Schuepbach Well, Grabhorn Aquifer Storage and Recovery (ASR), Miller Hill ASR, and Cooper Mountain. ASR. Include feasibility, methods, and required equipment for use of emergency underground stored water. The project would help determine the future ability to use the Emergency Underground Storage sites during an emergency to assist in the Emergency Drinking Water Provisioning Project and the provisioning of water to firefighters for firefighting efforts.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☒ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Underground storage capabilities exist, and our service area is within the area projected to be impacted by a Cascadia Subduction Zone Earthquake (CSZE), West Hills Earthquake, or other natural hazards that could impact aboveground water storage infrastructure. As part of the goals of the 2013 Oregon Resilience Plan, water utilities will develop a 50-year mitigation plan for resilience to the impact of the CSZE, magnitude 9.0. Redundant water supply systems provide emergency water supply in the event of an emergency disruption in water supply, like a major earthquake event.
Area of action impact	All of TVWD's service area.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? The facilities mentioned in the description.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☒ Goal 7 ☒ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Fulfills initiative to invest in critical infrastructure.

Alignment with existing plans and policies	An Emergency Water Supply Study is aligned with TVWD's AWIA Risk and Resilience Assessment and the Oregon Resilience Plan. Also, in alignment with the Regional Water Providers Consortium and Regional Disaster Preparedness Organization. 2015 Water Master Plan, included in the 2018 update to the Water Master Plan.

Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Engineering & Operations.

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Engineering, Operations, Risk, Safety	Washington County

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	HMGP funding, BRIC funding, others to be evaluated.

Estimated Cost	$150,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Develops a plan that can be implemented to supply emergency water.	Customer involvement and communication can allow public to gain trust and understand the value of water.	$900,000 in estimated financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	2026	2027

Implementation Benchmarks: How Will Success Be Measured?
• Successful completion of the plan. Readiness ability to meet demands in a timely manner.

Potential Challenges to Implementation
• Resource availability to lead the study.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 306: Lead Joint Pipe Seismic Upgrade

Mitigation Action Information			
Title of action	Lead Joint Pipe Seismic Upgrade		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	Retrofit the existing pump station to withstand the effects of natural disasters. This includes upgrading the existing backup power supply system.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Upgrading the existing piping to meet current seismic design standards will allow the District to maintain service to customers following a seismic event.		
Area of action impact	Several areas within the District's service area.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Distribution piping network		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	This meets the District's ongoing initiative of investing in critical infrastructure.		
Alignment with existing plans and policies	Meets the Oregon Seismic Resilience Plan.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Engineering and Operations.		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Engineering, operations, risk, safety.	Washington County

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Capital reserves, water sales revenue, revenue bonds.	BRIC funding, HMGP funding, others to be evaluated.
Estimated Cost	$25 million

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Ability to sustain operations following a natural hazard.	Public confidence in the water system.	$125 million in estimated financial benefits.

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☒ Mid-term ☐ Long-term ☐ Ongoing ☐		

Implementation Benchmarks: How Will Success Be Measured?

Potential Challenges to Implementation
• Site constraints, funding availability.

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1			
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 307: Regional Water Providers Consortium Strategic Plan 2023–28

Mitigation Action Information	
Title of action	Regional Water Providers Consortium Strategic Plan 2023–28
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	The TVWD and Regional Water Providers service area activity focused on identification, assessment, and development of mitigation strategies related to improving community resilience.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☒ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Meeting water needs, emergency preparedness, and resiliency by strengthening regional partnerships. Recent experience with emergency tabletop exercises has underscored how critical it is to plan ahead and be prepared, as well as to determine what mitigation we can do to have resilient customers so that we meet our LOS requirements. Addressing common mitigation issues and using the strength of the Regional Water Providers Consortium.
Area of action impact	Total infrastructure within the service area with combined mitigation activity coordinated within the lifelines and identified infrastructure interdependencies.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Hospitals, care centers, fire stations, and other lifelines as defined in the Oregon Resiliency Plan.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	The Regional Water Consortium's five-year strategic plan for 2023–28 is aligned/integrated with the work of the Regional Disaster Preparedness Organization.
Alignment with existing plans and policies	Aligned with the Water Master Plan, the Oregon Resiliency Plan, and the plans within Washington County and the RDPO.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Emergency Program Coordinator

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
• Communications and Public Affairs Supervisor	• City of Beaverton • Clackamas River Water • City of Cornelius • City of Forest Grove • Gladstone • Gresham • Hillsboro • Lake Oswego • Milwaukie • Newberg • Oak Lodge Water Services • City of Portland • Raleigh Water District • Rockwood • Sandy • Scapoose • Sherwood • South Fork Water Board • Sunrise Water Authority • Tigard • Tualatin • West Slope Water District • Wilsonville
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Funds for staff time and supplies	• Homeland Security Grant Program (HSGP) • Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities
Estimated Cost	$10,000 per year from TVWD

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Aligned mitigation planning. Protection of life safety.	Increased understanding of lifelines and infrastructure interdependencies; mitigation actions have added weight and receive higher priority.	$30,000.00 per year

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	2023	2028

Implementation Benchmarks: How Will Success Be Measured?
• Development of strategic plan. • Development of core planning team. • Assessment of the levels of service from the Oregon Resiliency Plan. • Assessment of projects within Oregon and especially within the RDPO and Washington County. • Alignment with FEMA Region 10. • See Strategic Plan 2018–2023 for elements to be updated.
Potential Challenges to Implementation
• Ability to scale the problem. The mitigation work is significant; our challenge will be to narrow the work, define the scope, and make measurable progress. • Availability of the key stakeholders (critical and key customers). • Conflicting projects that are parallel but not integrated. • Work capacity of staff; being able to dedicate time and effort to a non-funded project. • Funding. Currently, this is all in-kind work, and there are no funds for staff time or a budget for supplies.
Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action	$0	Lack of coordination and collaboration until emergency response required.
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 308: Infrastructure Interdependencies Workshops

Mitigation Action Information	
Title of action	Infrastructure Interdependencies Workshops
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	The TVWD and WWSS infrastructure interdependency service area activity focused on identification, assessment, and development of mitigation strategies related to improving community resilience.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☒ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Introduction to "Infrastructure Interdependencies" topic, "Why Now?"; "Hierarchy of infrastructure systems overview"; and "Co-resilience planning" Education within group. • Universe of critical infrastructure systems, from FEMA; includes all the key services represented by the group attending. • Even just for water service, water providers are dependent upon all the other utilities and public services, especially after a disaster. • Recent experience with supply chain issues proves how critical it is to plan ahead and be prepared. What mitigation can we do? • Why now? For WWSP, design is complete, and program activities are transitioning to emergency planning, operational planning, construction, and future mitigation. • Hierarchy of infrastructure dependencies; identify order of problem-solving by specific system at risk, then identify other services needed to address the specific problem; very clear that there are strong interdependencies between utilities.
Area of action impact	Total infrastructure within the service area with combined mitigation activity coordinated within the lifelines and identified infrastructure interdependencies.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? WWSP
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	The program is integrated with the work being done by Metro on the Long Range Transportation Plan, the RDPO work with Emergency Transportation Routes, the RDPO work on Provisioning of Emergency Drinking Water, and the Regional Water Consortium's work.
Alignment with existing plans and policies	Aligned with the Water Master Plan, the Oregon Resiliency Plan, and the plans within Washington County and the RDPO.

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☒ High ☐		
Lead position, office, department, or division responsible for implementation	Principal Engineer, TVWD (WWSP)		
Supporting Partners			
Internal Partners	**External Partners, Including Community Partners**		
Willamette Water Supply System (WWSS)/Tualatin Valley Water District Emergency Program Coordinator	• Clean Water Services (wastewater infrastructure) • Portland General Electric (electrical power infrastructure) • Washington County (transportation infrastructure/emergency management) • Clackamas County (emergency management) • ASCE Lifelines 2022 Conference Participants (regional subject matter experts and agencies) • Cascadia Lifelines Program (consortium of lifeline providers)		
Potential Funding Sources			
Non-Federal Funding Sources	**Federal Funding Sources**		
General Funds for staff time and supplies	• Homeland Security Grant Program (HSGP) • Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities		
Estimated Cost	$50,000 per year from TVWD, which does not include the funds from the external stakeholders. Estimate $150,000.00 per year required to implement a funded program and implement programs.		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Aligned mitigation planning. Protection of life safety.	Increased understanding of lifelines and infrastructure interdependencies; mitigation actions have added weight and receive higher priority.	$300,000.00 per year	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	May 23, 2022	May 2027	

Implementation Benchmarks: How Will Success Be Measured?
Start date, May 23, 2022. Meeting schedule to meet with individual stakeholders to develop a mission and vision statement. Establishment of framework during 2022 and into 2023. • Align with Lifelines and the Infrastructure Interdependencies. Assessment of current state within TVWD, WWSP, and the listed external partners. • Assessment of the Levels of Service from the Oregon Resiliency Plan. • Assessment of projects within Oregon and especially within the RDPO and Washington County. • Alignment with FEMA Region 10. • 2023: Establish goals and quarterly workshops. • Work product will be used to inform other programs/projects, as mentioned with the long-range transportation plan and the ETR plans. • Progress measured by infrastructure mitigation work being done, grants awarded, and work started, for example, the two bridges key to the WWSP service. • 2022: Seek sources of funding for the mitigation planning projects.
Potential Challenges to Implementation
• Ability to scale the problem. The mitigation work is significant, our challenge will be to narrow the work, define the scope and make measurable progress. • Availability of the key stakeholders • Conflicting projects which are parallel but not integrated • Work capacity of staff, being able to dedicate time and effort to a non-funded project. • Funding. Currently, this is all in-kind work, and there are no funds for staff time or a budget for supplies.
Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action.	$0	Lack of coordination and collaboration until emergency response required.
Alternative #2	Scale project to only water providers.	Year 1 – $10,000.00 Ongoing $10,000.00	Mitigation focused on only one lifeline.
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 309: Key and Critical Customer Collaboration

Mitigation Action Information	
Title of action	Key and Critical Customer Collaboration
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	The TVWD and WWSS infrastructure interdependency service area activity focused on identification, assessment, and development of mitigation strategies related to improving community resilience.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☒ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Reinstate, post-COVID, Key and Critical Customer Collaboration meetings. "Why Now?," Key and Critical Customer Co-resilience Planning and Education within group. • Determine Customer's level of mitigation and readiness planning and how that aligns with our Levels of Service as described in the Oregon Resiliency Plan. • Recent experience with emergency tabletop exercises has underscored how critical it is to plan ahead and be prepared, as well as to determine what mitigation we can do to have resilient customers so that we meet our LOS Requirements. • Hierarchy of lifelines and LOS will define our priority of work during an emergency response.
Area of action impact	Total infrastructure within the service area with combined mitigation activity coordinated within the lifelines and identified infrastructure interdependencies.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Hospitals, care centers, fire stations and other lifelines as defined in the Oregon Resiliency Plan
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	The program is integrated with the work being done by Metro on the Long Range Transportation Plan, the RDPO work with Emergency Transportation Routes, the RDPO work on Provisioning of Emergency Drinking Water, and the Regional Water Consortium's work.
Alignment with existing plans and policies	Aligned with the Water Master Plan, the Oregon Resiliency Plan, and the plans within Washington County and the RDPO.

Mitigation Action Implementation Plan			
Priority	Low ☐ Medium ☐ High ☒		
Lead position, office, department, or division responsible for implementation	Customer Service Manager		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
• Communications and Public Affairs Supervisor • Tualatin Valley Water District Emergency Program Coordinator		• Hospitals and Health Care • Fire Department • Food Production • Manufacturing, water quality • Schools • Tualatin Hills Parks & Recreation • Washington County • City of Beaverton	
Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General Funds for staff time and supplies		• Homeland Security Grant Program (HSGP) • Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities	
Estimated Cost	$50,000 per year from TVWD, which does not include the funds from the external stakeholders. Estimate $150,000.00 per year required to implement a funded program and implement programs.		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Aligned mitigation planning. Protection of life safety.	Increased understanding of lifelines and infrastructure interdependencies; mitigation actions have added weight and receive higher priority.	$300,000.00 per year	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	May 23, 2022	May 2027	

Implementation Benchmarks: How Will Success Be Measured?
• Define key and critical customers via a review of pre-COVID practice. • Outreach to the key and critical customers. • Meeting schedule to meet with individual stakeholders to develop a mission and vision statement. Establishment of framework during 2022 and into 2023. • Group meeting schedule. • Determine level of mitigation planning, what the key and critical customers have done, and what is their capacity? • Assessment of the Levels of Service from the Oregon Resiliency Plan. • Assessment of projects within Oregon, especially within the RDPO and Washington County. • Alignment with FEMA Region 10. • 2023: Establish goals and quarterly workshops. • Progress measured by infrastructure mitigation work being done, grants awarded, and work started, for example, the two bridges key to the WWSP service. • 2022: Seek sources of funding for the mitigation planning projects.
Potential Challenges to Implementation
• Ability to scale the problem. The mitigation work is significant; our challenge will be to narrow the work, define the scope, and make measurable progress. • Availability of the key stakeholders (critical and key customers). • Conflicting projects that are parallel but not integrated. • Work capacity of staff, being able to dedicate time and effort to a non-funded project. • Funding. Currently, this is all in-kind work, and there are no funds for staff time or a budget for supplies.
Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	No action	$0	Lack of coordination and collaboration until emergency response required.
Alternative #2	Scale project to only water providers	Year 1 – $10,000.00 Ongoing $10,000.00	Mitigation focused on only one lifeline.
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 310: TVWD HQ Building Upgrade

Mitigation Action Information			
Title of action	TVWD HQ Building Upgrade		
Type of action	Plans/regulations ☐ Structure and infrastructure project ☒		Natural systems protection ☐ Public education/awareness ☐
Action description	Upgrade the existing headquarters building for TVWD to withstand all natural hazards.		
Hazard(s) addressed	Dam failure ☒ Drought ☒ Earthquake ☒ Extreme heat ☒	Flood ☒ Landslide ☒ Volcanic ash ☒ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Upgrading the existing TVWD headquarters building will allow the District to remain operational following a seismic or other natural hazard event. This is the central hub for providing potable water to over 220,000 residents and businesses.		
Area of action impact	The entire TVWD service area.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? TVWD HQ Building		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☐ Goal 3 ☐	Goal 4 ☒ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Invest in critical infrastructure		
Alignment with existing plans and policies	Oregon Seismic Resilience Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Engineering & Operations		
Supporting Partners			
Internal Partners		**External Partners, Including Community Partners**	
All TVWD departments		Washington County	

Potential Funding Sources			
Non-Federal Funding Sources		**Federal Funding Sources**	
General funding, Capital Improvement funding		HMGP funding, BRIC funding	
Estimated Cost	$15 million		
Estimated Benefit			
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**	
Allows the District to remain operational and to be an emergency operations center available in times of natural hazard.		$90 million in financial benefits	
Project Timeline			
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**	
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐			
Implementation Benchmarks: How Will Success Be Measured?			
Potential Challenges to Implementation			
Resources and References, if Applicable			

Three Alternatives Considered, Including No Action			
Alternative #1	**Action Description**	**Estimated Cost**	**Evaluation**
Alternative #2			
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

7. Willamette Water Supply System

Water needs in Washington County are projected to increase, with new supplies needed as early as 2026. Developing an additional water supply through a partnership improves regional water reliability and supports the region's plans for responsible growth within urban growth boundaries.

The WWSS Commission is an Oregon intergovernmental entity formed by TVWD, the City of Hillsboro, and the City of Beaverton. The WWSS Commission was formed to build the WWSS in response to planned growth in their service areas. The WWSS will provide an additional, resilient water supply for Washington County.

The Willamette River, one of Oregon's largest rivers, is the WWSS' new supply source. The raw water intake is located at the Willamette River Water Treatment Plant in Wilsonville. From there, raw water will be pumped to the WWSS Water Treatment Plant, a new state-of-the-art water filtration plant where multiple treatment processes will produce high-quality drinking water. Drinking water will be pumped to reservoir facilities on Cooper Mountain, then will be gravity-fed to additional storage and customers in the TVWD, Hillsboro, and Beaverton service areas. The new system will be completed by 2026.

TVWD has been designated the Managing Agency for the WWSS Commission, and TVWD operates the Willamette Water Supply Program to plan, design, and construct the WWSS. WWSS staff is comprised of personnel from TVWD and the cities of Hillsboro and Beaverton.

The Willamette Water Supply System Intergovernmental Agreement, effective July 1, 2019, and amended in 2020 and 2021, sets forth the terms for the joint ownership, financing, design, permitting, construction, operation, maintenance, repair, and replacement of the WWSS.

The powers and duties of TVWD as a Managing Agency include creating the "Master Plan" for capital improvements in collaboration with each party participating and maintaining the Capital Improvement Plan budget, which is updated and submitted to the WWSS Board. The TVWD Emergency Program Coordinator also acts as the Emergency Program Coordinator for WWSS.

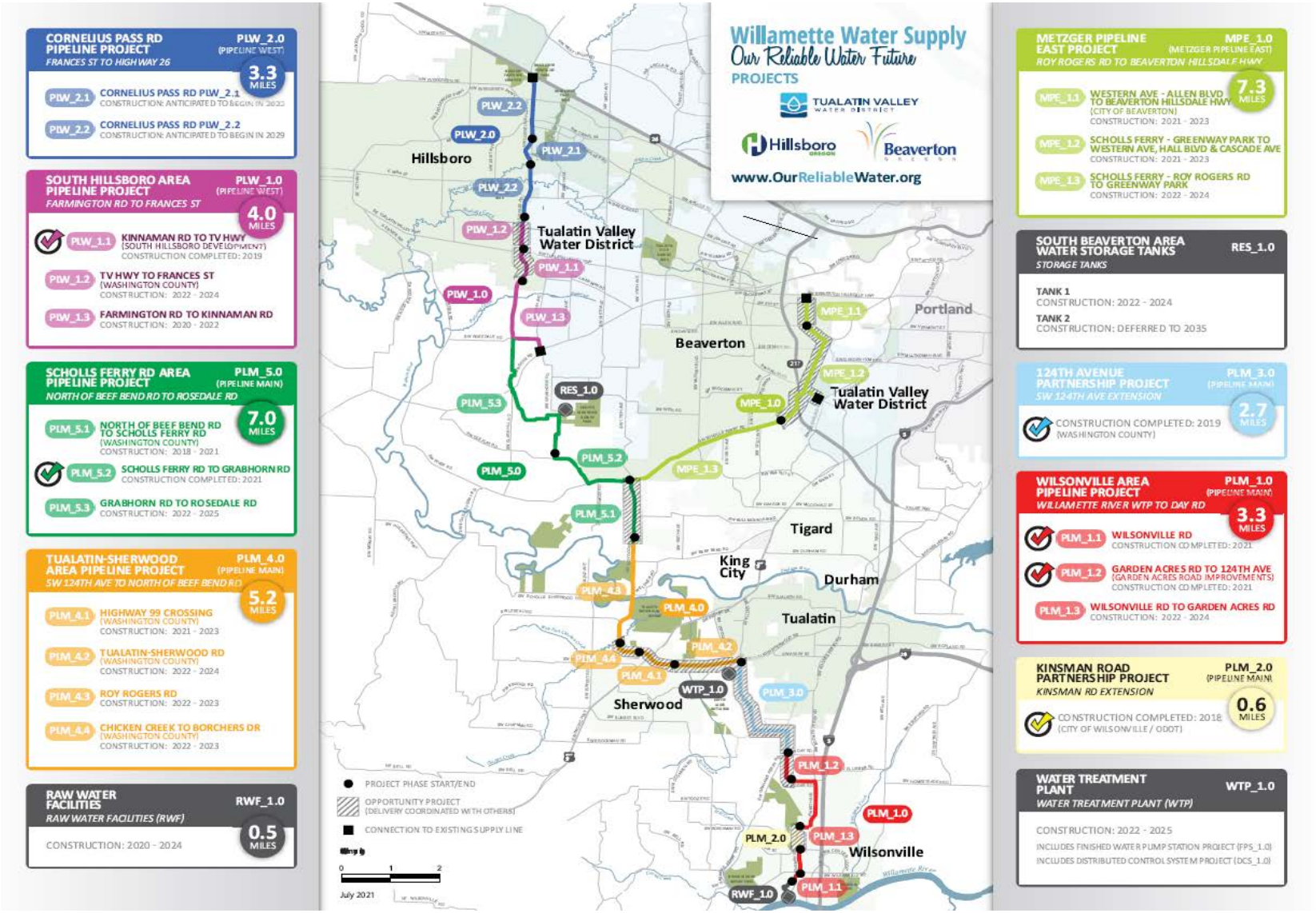


Figure 42: Willamette Water Supply System Project Map

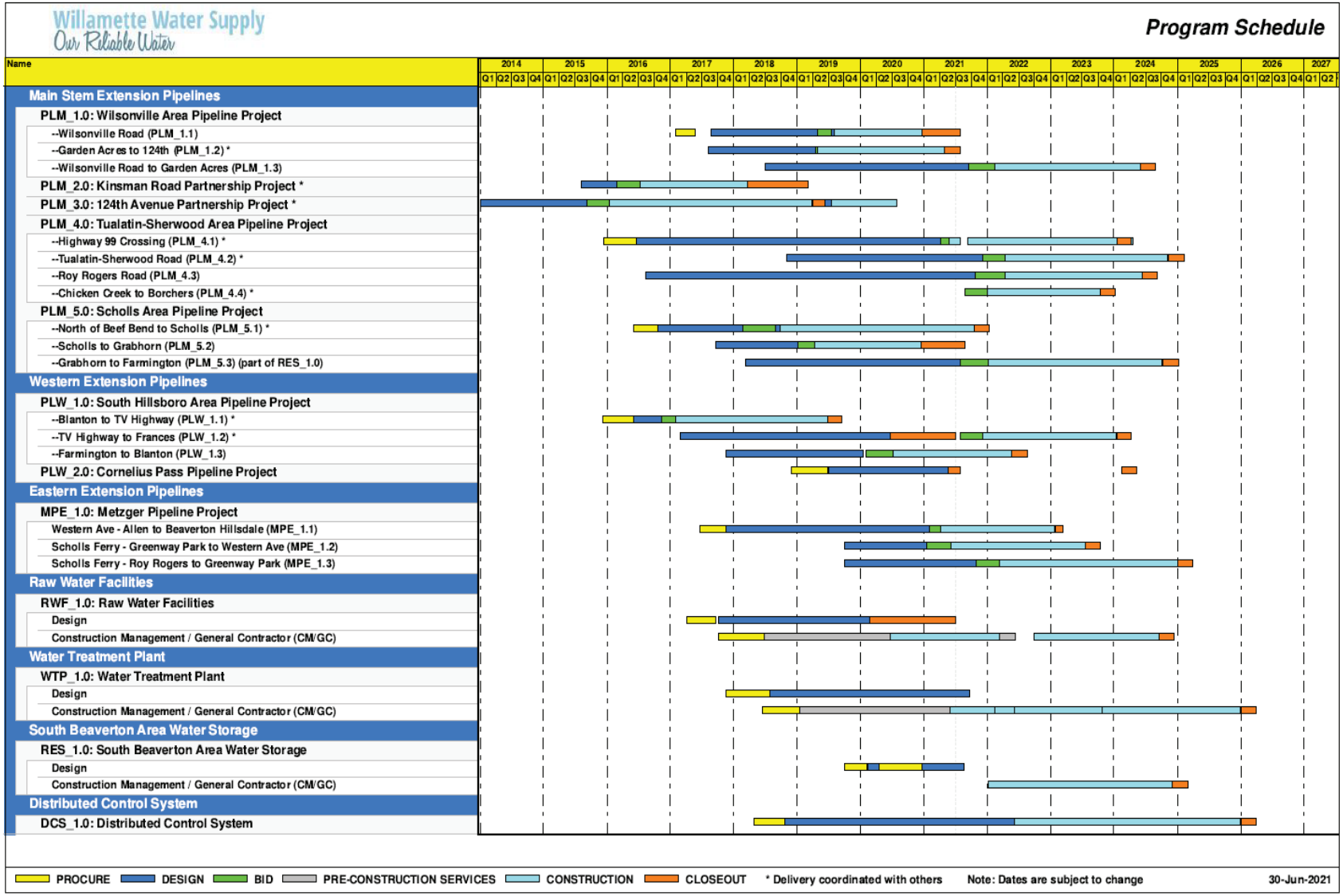


Figure 43: Willamette Water Supply System Program Schedule

7.1. NHMP Planning Process

The WWSS has a three-member Board of Commissioners that serves as the governing body of the WWSS Commission. Once the Washington County NHMP has received the designation “Approvable Pending Local Adoption” from FEMA, WWSS will submit the plan to the Board of Commissioners for final public comment and local adoption. A copy of the resolution will be inserted into the NHMP and held on file in Washington County, TVWD, and WWSS.

WWSP participated in the entire planning process for the NHMP and shared Technical Committee members with TVWD. The TVWD Emergency Program Coordinator was the point of contact for WWSS during the planning process. Additionally, public and stakeholder engagement NHMP requirements for public and stakeholder engagement were executed by TVWD on behalf of WWSS, as it is TVWD’s duty as WWSS Managing Agency to provide public communications and outreach for WWSS. WWSS is being highlighted within the TVWD NHMP annex due to its separate governing body and to ensure the system meets all FEMA planning requirements and is eligible for hazard mitigation assistance grants.

7.2. Hazard Identification and Risk Assessment

WWSS shares natural hazard scores, significant events, potential impacts, vulnerabilities, and overall vulnerability with TVWD for each hazard profiled in this NHMP. Critical facilities and assets identified by WWSS are included in Table 282 of this annex.

7.3. Capability Assessment, Expansion, and Improvement

Because WWSS is managed by TVWD, it has the same planning, regulatory, administrative, technical, educational, public outreach, and financial capabilities and opportunities for capability expansion and improvement as described in Section 4 of this annex. Additionally, because WWSS staff is comprised of personnel from TVWD and the cities of Hillsboro and Beaverton, the system can utilize resources from these three entities if it is ever required.

7.4. Mitigation Strategy

The mitigation goals detailed in Volume I, Section 3 also apply to WWSS, as they were an active participant in the NHMP planning process. The Technical Committee for WWSS will establish a process in which the mitigation strategy, goals, objectives, and actions outlined in this NHMP and the TVWD annex will be incorporated into existing local planning strategies, as applicable. Because WWSS infrastructure is part of the TVWD infrastructure, any mitigation actions taken by either WWSS or TVWD will have a positive impact on the resiliency of the entire water system.

In addition to the TVWD action items included in Section 6.1 of this annex, WWSS identified supplemental action items. A summary of these actions is provided below. Full action item planning worksheets are provided in Section 6.2 of this annex.

Table 311: Willamette Water Supply System Action Items

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
1	ShakeAlert System earthquake early warning network sponsored by the USGS and west coast regional stakeholders.	Earthquake	High
2	Standby power and fuel storage to provide additional standby power generation and associated fuel storage at the Willamette Water Supply System's water treatment plant facility.	Earthquake, extreme heat, wildland fire, windstorm, including tornado, and winter storm	High
3	Emergency Spare Parts and Storage Facility to provide additional emergency spare parts and associated storage facilities for enhanced operations of the Willamette Water Supply System.	Earthquake, extreme heat, wildland fire, windstorm, including tornado, and winter storm	High
4	Seismic Upgrade to two bridges on Roy Rogers Road so they can serve as a critical transportation link within Washington County for critical infrastructure systems and continue to provide critical service to the community following a major seismic event (water, electrical power, transportation, and wastewater).	Earthquake	High
5	Infrastructure interdependencies workshops. TVWD and WWSS activity focused on identification, assessment, and development of mitigation strategies related to improving community resilience. This action is also included in TVWD's action item list.	All hazards	Medium

Annex K: Washington County

1. Introduction

1.1. Planning Process Contact

The point of contact during the Washington County Natural Hazard Mitigation Plan (NHMP) planning process for Washington County was the Emergency Management Coordinator for the Washington County Department of Land Use and Transportation.

1.2. Annex Organization

This annex includes six sections that satisfy mitigation requirements outlined in the Code of Federal Regulations (CFR) Title 44, Part 201 (44 CFR §201):

- **Section 1:** Introduction
- **Section 2:** Planning Process
- **Section 3:** Hazard Identification and Risk Assessment
- **Section 4:** Capability Assessment
- **Section 5:** Mitigation Strategy
- **Section 6:** Action Items

This annex applies to the Washington County local government organization and focuses on the County's service area, which primarily includes the unincorporated geographic area of Washington County. Mitigation information that applies to the entire geographic area of Washington County is included in other NHMP sections, including Volumes I and III.

1.3. NHMP Adoption Process

Once the Washington County NHMP received the designation "Approvable Pending Local Adoption" from the Federal Emergency Management Agency (FEMA), the County presented the plan to the Board of County Commissioners for final public comment and local adoption. A copy of the resolution was inserted into the NHMP and is held on file in Washington County.

2. Planning Process

(In compliance with 44 CFR §201.6(c)(1))

2.1. Development and Adoption Process

To apply for certain types of federal aid, technical assistance, and most post-disaster funding, local jurisdictions and special districts must comply with 44 CFR §201.3, which sets forth the requirement that

communities develop a plan outlining their present and proposed efforts to mitigate risks from natural hazards.

County officials recognize the benefits of having a long-term, all-hazards approach to mitigating natural hazards. This approach has been implemented through the NHMP and five-year NHMP updates as required by law. This has led to a gradual decrease of hazard-associated impacts by building on risk reduction measures outlined in previous iterations of the NHMP. The County's involvement in the Washington County NHMP represents the collective efforts of the Hazard Mitigation Steering Committee members, participating local Technical Committee members, the public, and stakeholders.

Washington County developed this annex in accordance with 44 CFR §201.6(c)(5) as referenced in the Disaster Mitigation Act of 2000. The complete NHMP and this annex identify hazards and mechanisms to minimize damages associated with these hazards as they occur in Washington County, both countywide and, more specifically, in each geographic region of its planning participants.

2.2. Organizing the Planning Effort

A comprehensive approach was taken in developing this NHMP. A process was established to involve the public and all stakeholders. This provided an opportunity for everyone to become engaged throughout the planning process and share their views about perceived hazards and how best to mitigate them.

Two teams worked simultaneously throughout the development of this mitigation plan:

1. **Hazard Mitigation Steering Committee:** This committee consisted of staff members from each planning participant. The group met to discuss countywide topics, including hazards and mitigation strategies. The points of contact were the leads of their local Technical Committee.
2. **Local Technical Committee:** Each plan participant had a Technical Committee consisting of the Steering Committee representative for that jurisdiction or special district as well as designated representatives from within the organization. This team met to assess capabilities, hazards, and mitigation strategies within the planning area.

2.2.1. Washington County Technical Committee

The Washington County annex of the overall NHMP was developed by Washington County's local Technical Committee with support from IEM, a consulting firm hired to support the planning process. The County's Emergency Management Coordinator for the Department of Land Use and Transportation led the committee's efforts throughout 2022.

Table 312: Washington County Technical Committee Members for the 2023 NHMP

Job Title, Department, and Division	Role in Committee and Planning Process
Project Manager/Emergency Management Coordinator, Land Use and Transportation/Administrative Services/Office of the Director	Project Manager, general oversight and guidance
Principal Engineer, Land Use and Transportation/Operations and Maintenance/Operations	Road and bridge interests
Senior Engineer, Land Use and Transportation/Engineering, Traffic and Survey/Engineering	Floodplain and engineering

Job Title, Department, and Division	Role in Committee and Planning Process
Associate Planner, Land Use and Transportation/Planning and Development Services/Long Range Planning/Community Planning	Validation of multiple hazards and integration
Emergency Management Supervisor, Emergency Management	Emergency management review and input
Senior Program Educator, Land Use and Transportation/Capital Project Services/Capital Project Management	Public engagement and survey
Emergency Management Manager, Emergency Management	Emergency management review and input
Superintendent, Support Services/Facilities and Parks Services/Operations	Input regarding County facilities
Senior Planner, Land Use and Transportation/Planning and Development Services/Long Range Planning	Community profile review and plan input
Engineering Associate II, Land Use and Transportation/Engineering, Traffic and Survey/Engineering	Floodplain management and engineering input
Administrative Assistant, Emergency Management	Grant administration and project organization
Superintendent, Support Services/Facilities and Parks Services/Parks	Input regarding County parks
Geographic Information System (GIS) Analyst, Land Use and Transportation/Operations and Maintenance/Operations	Development of GIS data and maps
Associate Planner/Floodplain Program Manager, Land Use and Transportation/Planning and Development Services/Current Planning	Floodplain Management program review and development

IEM also supported or led the following activities associated with the development, approval, and adoption of the plan:

1. Facilitated the NHMP update process.
2. Based on committee direction and stakeholder and community input, prepared the first draft of the plan and provided technical writing assistance for plan review, editing, and formatting.
3. Submitted the proposed plan to the State of Oregon Department of Emergency Management (OEM) and FEMA for review and approval, and completed edits or revisions requested by these organizations.
4. Coordinated the plan adoption processes with the County, OEM, and FEMA.

2.3. Public Participation

Public participation is an important component of this NHMP and also a required element as outlined in 44 CFR §201.6(c)(5), FEMA's mitigation planning guidance. Public participation offered community members the opportunity to voice their ideas, interests, and opinions about hazards that affect them and the best way to mitigate hazard impacts. As the County implements the mitigation actions identified in this annex, there will be additional opportunities for public participation.

Plan participants used a survey to collect information about community perceptions of natural hazards and priorities. The Steering and Technical Committees used the results to inform their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP. See Volume III, Appendix B for additional information about the survey and opportunities for public comment.

3. Hazard Identification and Risk Assessment

(In compliance with 44 CFR §201.6(c)(2)(i), §201.6(c)(2)(ii), §201.6(c)(2)(ii)(A), §201.6(c)(2)(ii)(B), §201.6(c)(2)(ii)(C), §201.6(c)(2)(iii), and §201.6(c)(3)(ii))

The following information serves to assist the County in determining and prioritizing appropriate mitigation action items to reduce losses from identified hazards.

3.1. Changes in Development Since Adoption of 2017 NHMP

(In compliance with 44 CFR §201.6(d)(3))

The population in Washington County as a whole grew by 13% between 2010 and 2021, and this trend is expected to continue. Oregon land use laws require land outside Urban Growth Boundaries (UGBs) to be protected for their farm, forest, and aggregate resource values. For the most part, these state land use laws limit the amount of development allowed in the rural areas. However, the UGBs may be expanded into formerly rural areas, and this may occur in the future if past development trends continue.

Current and future residential development in unincorporated Washington County will be largely contained within two past additions to the regional UGB: North Bethany and Bonny Slope West. These areas are not likely to incorporate in the foreseeable future and will house a large portion of the County's future growth in mixed-use communities as the population grows. The County completed master plans, including development code standards, for both areas. The County proactively addressed natural hazard risk in these planning processes and identified steep slopes, floodplains, and landslide hazard areas. Concept planning accounted for these risks and restricted development within areas of known risk.

- **North Bethany** was added into the regional UGB in 2002. The area underwent concept planning and in 2009, the County developed a concept plan and funding strategies to implement the plans for parks, open space, schools, infrastructure, and neighborhood services. The North Bethany Subarea Plan was adopted in 2010. As of 2022, most of the developable area in North Bethany has received development entitlements and/or has been built out.
- **Bonny Slope West** was added into the regional UGB in 2002 (while within Multnomah County) and was transferred from Multnomah County to Washington County in 2013. The area underwent concept planning starting in 2014, and the Bonny Slope West Subarea Plan was adopted in 2015. As of 2022, approximately half of the developable area in Bonny Slope West has received development entitlements and/or has been built out.
- **Urban and Rural Reserves** have been designated throughout the Metro region. (Metro is the regional government for the Oregon portion of the Portland Metropolitan area, covering portions of Clackamas, Multnomah, and Washington Counties). In 2007, the Oregon legislature authorized Metro and Metro-area counties to designate urban land that might be developed in the future, and rural land to be preserved for farming, forestry, and other rural uses.

- **Urban Reserves** are lands outside the UGB that will provide for: (a) future expansion over a long-term period; and (b) the cost-effective provision of public facilities and services within the area when these lands are included within the UGB.
- **Rural Reserves** are lands reserved to provide long-term protection for agriculture, forestry, or important natural landscape features that will limit urban development.

The most recent Metro expansions of the regional UGB occurred in 2018, when Metro approved three UGB expansion areas within Washington County. These recent expansion areas, which are each being master planned by a nearby city, are Witch Hazel Village South (currently being master planned by City of Hillsboro), Cooper Mountain (currently being master planned by City of Beaverton), and Beef Bend South (currently being master planned by the City of King City).

Extreme heat has emerged as a hazard faced by the County since the 2017 NHMP was adopted. The number of high heat days are increasing in frequency, and the high temperatures being reached are increasing in intensity. The County has also recognized poor air quality from a variety of sources, including wildland fire smoke from events outside the County, has become an increasing concern since the 2017 NHMP was adopted. This annex provides mitigation actions to decrease vulnerability to both of these natural hazards.

3.2. Community Profile

This section provides information on County-specific characteristics. Additional discussion of the planning area's community characteristics is outlined in Volume III, Appendix A of the NHMP.

Some community characteristics may suggest how natural hazards may impact communities and how communities choose to plan for natural hazard mitigation. Identifying and considering the County-specific assets during the planning process may assist in identifying appropriate measures for natural hazard mitigation.

Table 314 reflects the community demographics and vulnerable populations in the County. Population numbers for unincorporated Washington County are in Table 313. All other demographic data is for the County as a whole, including incorporated areas. This information comes from the U.S. Census, Portland State University, Washington County, and Metro (the regional government for the Oregon portion of the Portland Metropolitan area, covering portions of Clackamas, Multnomah, and Washington Counties).

Table 313: Forecasted Population Growth, Unincorporated Washington County

Unincorporated Washington County Population Data	Total	Percent Change
2010 population inside the Urban Growth Boundary[526]	188,148	
2010 population outside the Urban Growth Boundary[1]	30,451	
2021 population	241,800	+11%
2035 forecasted population inside the Urban Growth Boundary [527]	245,766	+31% from 2010
2035 forecasted population outside the Urban Growth Boundary[2]	80,686	+165% from 2010

[526] Oregon Metro. (2013, January 15). 2010 Forecast of Population by City and County. https://www.oregonmetro.gov/sites/default/files/2014/05/29/population_housing_forecasts_by_city_county.pdf
[527] Oregon Metro. (2013, January 15). 2035 Forecast of Population by City and County. https://www.oregonmetro.gov/sites/default/files/2014/05/29/population_housing_forecasts_by_city_county.pdf

Table 314: Community Demographics in Washington County*

Washington County Population Data	Total	Percent Change
2010 population[528]	529,710	
2021 population[529]	600,811	+13%
2035 forecasted population[530]	765,445	+22%
Race and Ethnicity[531]	**Total**	**Percent of Population**
White alone	438,123	74%
Hispanic/Latino/a/x of any race	100,090	17%
Asian alone	64,549	11%
Two or more races	42,887	7%
Black or African American alone	12,931	2%
American Indian and Alaska Native alone	3,456	0.6%
Native Hawaiian and Other Pacific Islander alone	2,341	0.4%
Language Spoken at Home[532]	**Percent of Population**	
English only	75.2%	
Spanish	11.9%	
Asian and Pacific Island languages	6.8%	
Indo-European languages	4.7%	
Other languages	1.4%	
Vulnerable Age Groups[533]	**Percent of Population**	
Less than 15 years of age	13%	
65 years and older	13%	

[528] United States Census Bureau. (2010, April 1). QuickFacts Washington County, Oregon. Accessed September 22, 2022, from https://www.census.gov/quickfacts/fact/table/washingtoncountyoregon/PST045221
[529] United States Census Bureau. (2021, July 1). QuickFacts Washington County, Oregon. Accessed September 22, 2022, from https://www.census.gov/quickfacts/fact/table/washingtoncountyoregon/PST045221
[530] Oregon Metro. (2013, January 15). 2035 Forecast of Population by City and County. https://www.oregonmetro.gov/sites/default/files/2014/05/29/population_housing_forecasts_by_city_county.pdf
[531] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Demographic and Housing Estimates, Table DP05. Accessed September 22, 2022, from https://data.census.gov/cedsci/table?q=washington%20County%20oregon&tid=ACSDP5Y2020.DP05
[532] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Language Spoken at Home, Table S1601. Accessed September 22, 2022 from https://data.census.gov/cedsci/table?q=washington%20County%20oregon%20language.
[533] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Age and Sex, Table S010. Accessed September 22, 2022, from https://data.census.gov/cedsci/table?q=Washington%20County,%20oregon&tid=ACSST5Y2020.S0101

Disability Status of Non-Institutional Civilians [534]	Percent of Population
Total	10%
Less than 17 years of age	5.6%
65 years and older	70.9%

* Due to how respondents identify and answer questions there may be overlapping responses and results may equal greater than 100% of the population. Percentages are rounded.

3.2.1. Geography, Topography, and Climate

Washington County is located in the northwestern portion of Oregon, west of the City of Portland. It is the second most populous county in the state, with a 2021 population of 600,811 people. Covering 726 square miles, this total includes 724 square miles of land and 2.2 square miles of water. Most of the County is in the Tualatin Valley, formed by the Tualatin Mountains to the east and north, the Chehalem Mountains to the south, and the North Oregon Coast Range to the west and north. The northern and western portions of the County are forested, with the remainder of the County comprised of urban areas, agricultural lands, and floodplains.

The climate for Washington County is moderate. Temperatures range from a countywide average high of around 80 degrees Fahrenheit (°F) in July to an average low of 35 °F in January. On average, the County receives approximately 44 inches of rain a year. Additionally, the populated areas of the County can receive up to 5 inches of snow per year. The County receives some form of precipitation approximately 156 days per year, where accumulation of at least .01 inches is measurable.

3.2.2. Transportation, Infrastructure, and Housing

3.2.2.1. Transportation

Urban Washington County meets its current transportation needs through a mixture of municipal road systems, County roads, state and federal highways, and a regional public transportation system, TriMet.

Major highways in the County include Interstate 5; State Highway 26, which runs from southeast to northwest, linking Portland to the coast; State Highway 6, which connects smaller towns and communities on the rural west end of the County subject to wildland interface fire exposure; and State Highway 99W, which runs from Multnomah County to Yamhill County and through the City of Tigard, the County, and the City of Sherwood. State Highway 217 is a bypass route that links Interstate 5 to Highway 26. State Highway 47 runs north–south and links the western cities of Banks, Forest Grove, and Gaston to Columbia and Yamhill Counties.

Approximately 81% of commuters travel by car; eight out of nine of these individuals commute alone, and one in nine carpools. Increased commuting creates a greater dependency on roads, communications, accessibility, and, in the event of a hazard incident, emergency evacuation routes to reunite people with each other.

Several transportation modes options exist throughout the County. TriMet provides public transportation options to the urban portions of the County, connecting it to the greater Portland metropolitan area.

[534] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Disability Characteristics, Table S1810. Accessed September 22, 2022, from https://data.census.gov/cedsci/table?q=washington%20county%20oregon%20s1810&tid=ACSST1Y2021.S1810

3.2.2.2. Infrastructure

The critical infrastructure and facilities listed in Table 315 below are operated by Washington County. Due to their location within identified hazard areas, these facilities are vulnerable to one or more hazards as noted in the table.

Table 315: Critical Facility and Asset Inventory

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Adams Crossing	Facility	161 NW Adams Avenue, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Animal Services – Bonnie Hays Animal Shelter	Facility	1901 SE 24th Avenue, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Beaverton Health Clinic, Special Supplemental Nutrition Program for Women, Infants, and Children	Facility	12550 SW 2nd Avenue, Beaverton, OR 97005	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Blanton (old Tualatin Valley Fire & Rescue site)	Facility	20665 SW Blanton Street, Aloha, OR 97078	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Central Services	Facility	214 W. Main Street, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Courthouse	Facility	145 NE 2nd Avenue, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Community Corrections Center	Facility	260 SW Adams Avenue, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure. Facility open 24 hours a day
Eagle Landing Park	Facility	26001 SW Rainbow Lane, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Facilities Maintenance Building	Facility	169 N. 1st Avenue, Hillsboro, OR 97124	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Fair Complex Operations and Maintenance Facility	Facility	848 NE 28th Avenue, Hillsboro, OR 97124	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Scoggins Valley Park (Hagg Lake, Washington County Sheriff's Office Boathouse)	Infrastructure or Facility	50250 SW Scoggins Valley Road, Gaston, OR 97119	Vulnerable to all hazards.
Harkins House	Facility	244 W. Main Street, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure. Facility open 24 hours a day.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Hillsboro Clinic	Infrastructure or Facility	266 W. Main Street, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Justice Services	Infrastructure or Facility	150 N. 1st Avenue, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Juvenile Services Building	Facility	255 N. 1st Avenue, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Jail	Facility	215 SW Adams Street, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure. Facility open 24 hours a day.
Law Enforcement Center	Facility	215 SW Adams Avenue, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure. Facility open 24 hours a day.
Metzger Park	Infrastructure or Facility	8400 SW Hemlock Street, Tigard, OR 97223	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Washington County Auditor's Office, Washington Street Conference Center(WSCC)	Infrastructure or Facility	221 S. 1st Avenue Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Center for Counseling & Victim's Services (WSCC)	Infrastructure or Facility	160 SW Washington Street, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Parking Garage (WSCC)	Infrastructure or Facility	225 S. 1st Avenue, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Washington Street Conference Center	Facility	102 SW Washington Street, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Public Safety Building (Old Jail)	Facility	146 NE Lincoln Street, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Public Safety Training Center	Facility	600 SW Walnut Street, Hillsboro, OR 97124	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Public Service Building	Facility	155 N. 1st Street, Hillsboro, OR 97124	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.

Name of Infrastructure, Facility, or Resource	Type of Asset	Address	Comments
Public Services Annex	Facility	254 N. 1st Avenue, Hillsboro, OR 97124	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Service Center East	Facility	3700 SW Murray Boulevard, Beaverton, OR 97005	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Tigard Recovery	Facility	10362 SW McDonald Street, Tigard, OR 97224	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Veterans Memorial Gateway	Facility	3450 NE Veterans Drive, Hillsboro, OR 97224	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Walnut Street Center (Fleet Shop, Road Operations, Warehouse F)	Facility	1400 SW Walnut Street, Hillsboro, OR 97123	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
West Slope Library	Infrastructure or Facility	3678 SW 78th Street, Portland, OR 97225	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Washington County Consolidated Communication Agency (WCCCA)	Facility	17911 NW Evergreen Parkway, Beaverton, OR 97006	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Washington County Consolidated Communications Agency (WCCCA new building)	Facility	5900 NE Pinefarm Court Hillsboro, OR 97124	Vulnerable to all identified hazards except landslides, wildland fire, or dam failure.
Washington County-owned roads, bridges, and other transportation infrastructure	Infrastructure	Throughout Washington County	Different localized and general sections are vulnerable to all hazards except drought.

3.2.2.3. Housing

Housing characteristics are an important factor in mitigation planning. The information below is for Washington County as a whole (including incorporated areas within cities) and shows that most housing units are owner-occupied and consist of one-unit buildings built before 1999. The older the housing, the more at risk it can be to damage from natural hazards such as earthquakes and windstorms, including tornadoes.

Table 316: Housing Characteristics*

Households	Total
Total households[535]	223,040
Units in Housing Structure[536]	**Percent of Housing**
One-unit structures	68%
Structures with two or more units	30%
Manufactured homes and all other types	2%
Year Housing Structure Built[537]	**Percent of Housing**
Pre-1979	36%
1980–1999	33%
2000 to present	32%
Housing Tenure and Vacancy	**Percent of Housing**
Owner-occupied	61%
Renter-occupied	39%
Vacant	4%

* Due to how respondents answer questions there may be overlapping responses and results may equal greater than 100%. Percentages are rounded.

3.2.3. Economy

Washington County as a whole is economically diverse with a wide range of key industries. The top industries by total employment in the County are professional and business services, trade, transportation, utilities, manufacturing, education and health services, accommodations and food services, and government. The top revenue-producing sectors in the entire County are manufacturing, wholesale trade, and retail trade. Nike's corporate headquarters is located in the unincorporated area of the County.

[535] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 6, 2022, from https://data.census.gov/cedsci/table?q=washingtonCounty%20oregon%20housing&tid=ACSST5Y2020.S1101
[536] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Households and Families, Table S1101. Accessed September 6, 2022, from https://data.census.gov/cedsci/table?q=washingtonCounty%20oregon%20housing&tid=ACSST5Y2020.S1101
[537] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Physical Housing Characteristics for Occupied Housing Units, Table S2504. Accessed September 7, 2022, from https://data.census.gov/cedsci/table?q=washingtonCounty%20oregon%20housing&tid=ACSST5Y2020.S2504

Washington County employers drew 49% of their workers from outside the County, according to 2019 data. The Washington County economy is a cornerstone of regional economic vitality. According to the U.S. Census Bureau's 2019 Longitudinal Employer-Household Dynamics dataset, 152,000 of the 314,000 jobs in Washington County are held by people commuting in from another county, and 161,000 are held by people living in Washington County. Of the 297,000 employees living in Washington County, 136,000, or 46%, commute out of the County.

The unincorporated portion of the County also includes a large agricultural footprint, with approximately 104,000 acres of prime farmland, according to the United States Department of Agriculture 2017 Census of Agriculture. Nurseries, hazelnuts, wine grapes, Christmas trees, vegetables, livestock, and dairy milk are all a part of this footprint.

In 2020, tourism brought in $462.1 million in direct destination spending to Washington County as a whole via its award-winning wineries, festivals, scenic parks, wetlands and wildlife preserves, and a variety of restaurants and shops.

Table 317: Income Characteristics*[538]

Households by Income Category	Percent of Households
Less than $5,000	2%
$5,000 to $9,999	1%
$10,000 to $14,999	2%
$15,000 to $19,999	2%
$20,000 to $24,999	3%
$25,000 to $34,999	6%
$35,000 to $49,999	10%
$50,000 to $74,999	17%
$75,000 to $99,999	14%
$100,000 to $149,999	21%
$150,000 or more	22%
Median Household Income	
$86,626	

* Due to how respondents answer questions, there may be overlapping responses, and results may equal greater than 100%. Percentages are rounded.

3.3. Natural Hazard Profiles

Washington County's Technical Committee utilized the OEM's hazard analysis methodology to examine hazard risk by collecting information about the four rating criteria of history, vulnerability, maximum threat, and probability. This methodology does not compare hazards to each other or rank hazards against each other. Instead, this process provides a sense of hazard priorities or relative risk and allows comparison of the same hazard across participants.

[538] United States Census Bureau. (2021, July 1). 2016–2020 American Community Survey 5-Year Estimates, Financial Characteristics, Table S2503. Accessed September 22, 2022, from https://data.census.gov/cedsci/table?q=Washington%20County%20oregon%20income&tid=ACSST5Y2020.S2503

Each of the hazards examined by this analysis was scored using a formula that incorporates the four rating criteria, a weight factor, and three levels of severity: low, medium, and high. The score range for this methodology is 24 (lowest possible) to 240 (highest possible). For additional detail about the OEM risk and hazard analysis methodology, see Volume I, Section 2.

The scores for each hazard that impacts the County are presented below. All natural hazards included in the NHMP have the potential to impact the County.

Table 318: Natural Hazard Risk Scores

Natural Hazard	History	Vulnerability	Maximum Threat	Probability	Score
Dam failure	Low	Medium	Medium	Low	83
Drought	High	High	Medium	High	186
Earthquake	Low	High	High	Medium	201
Extreme heat	High	Medium	High	High	177
Flooding, including channel migration and streambed erosion	High	Medium	Medium	High	173
Landslide	High	Low	Low	High	102
Volcanic ash	Low	Medium	High	Low	124
Wildland fire	High	Medium	High	High	191
Windstorm, including tornado	High	Medium	Medium	High	132
Winter storm	High	High	High	High	211

Full descriptions of each hazard are provided in Volume I, Section 2. The potential effects of climate change on the magnitude and frequency of natural hazard events are described in each hazard description in this annex and in Volume I, Section 2.

The timeframe of data collected during the planning process for Washington County was November 1, 2016 to February 22, 2022. Hazard events that occurred during this period and were deemed significant by the County's Technical Committee are included in this annex's hazard profiles.

The following hazard profiles are in alphabetical order and include a brief hazard description, significant events since adoption of the 2017 NHMP, if applicable, and potential impacts and vulnerabilities. The potential impacts for each hazard are presented in the same order, as applicable: populations, economies, structures, improved property, critical facilities and infrastructure, historical properties and cultural resources, and natural environments.

3.3.1. Dam Failure

The Oregon Water Resources Department has identified three high-hazard dams in Washington County—Scoggins Dam, Barney Dam, and Kay Lake Dam. A dam is rated as high hazard when loss of life is expected if the dam fails. The Scoggins Dam is the only dam within the County capable of producing a major emergency or disaster event. If Scoggins Dam failed, it is estimated that there would be 10-foot surge; however, a Scoggins Dam failure is also considered a low risk. Dam failure potential impacts and vulnerabilities are identified below.

3.3.1.1. Potential Impacts

The type, magnitude, and extent of dam failure impacts can vary based on the scale of the event. Potential impacts may include:

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Need for widespread search and rescue operations, including water rescues.
- Displaced residents in need of sheltering.
- Reduction or loss of water supply.
- Water use restrictions and lack of potable and irrigation water supplies.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Economic impacts including loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity. Interruptions to commercial transportation routes could take an economic toll on the County. Scoggins Valley Park receives one million visitors a year and could be severely damaged by a dam failure.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal economic impacts of loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Erosion and flooding.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.1.2. Vulnerabilities

In the event of a dam failure, many aspects of the community would be vulnerable to damage, including buildings, critical facilities, infrastructure, and the natural environment. Vulnerabilities to a dam failure event include:

- Potential impacts on agriculture use and drinking water supply, which could affect the entire County population.
- Reduction in income for those employed in water-dependent sectors, such as agriculture and recreation. Farmers, ranchers, livestock owners, farming-dependent, produce-dependent, and timber-processing businesses, and water companies could be impacted.
- Crop failures and pasture loss within the unincorporated County's agriculture and forest zoning districts, exclusive farm use zoning districts, and 10- and 20-acre future development district zoning areas that allow for agriculture uses.
- Potential inundation of unincorporated areas of Washington County, most notably Gaston, Forest Grove, Cornelius, Dilley, Hillsboro, Tigard, Tualatin, and King City.
- Potential damage to major populated areas downstream of Scoggins Dam: northeastern Gaston, southeastern Dilley, southern sections of Forest Grove, Cornelius, Hillsboro, Tualatin's business district, and homes within the 100-year FEMA floodplain.
- Damage to roadways and infrastructure located immediately downstream of dams. If Scoggins Dam were to fail, the most severe impacts would likely occur to Highway 47, Scoggins Valley Road, Old Highway 47, Patton Valley Road, Spring Hill Road, and Fern Hill Road. Highway 47 is an Emergency Transportation Route.
- Potential for floodwaters to overwhelm the residents in the Scoggins Valley flood area, as well as the communities of Gaston, Dilley, and Forest Grove. Rising waters in tributaries to the Tualatin River would also impact developed areas, bridges, and urban populations. If a dam failure were to occur during high reservoir volume times, flooding impacts could be seen as far down the Tualatin River to where it enters the Willamette River.
- Likely damage to significant properties including, but not limited to, Stimson Lumber, Portland & Western Railroad, Joint Water Commission water treatment plant, Clean Water Services' Forest Grove wastewater treatment plant, outdoor recreational sites, Highways 47 and 8, and several other arterial roads and bridges.
- Potential damage to other critical infrastructure, including communication structures and emergency generators.

3.3.2. Drought

Drought typically occurs as a regional event and often affects more than one city and County simultaneously. Drought may affect the entire Washington County planning area equally. Drought is difficult to measure, due to its diverse geographical and temporal nature. Significant drought events, potential drought impacts, and vulnerabilities to drought are identified below.

3.3.2.1. Significant Events

The County identified three significant drought events it experienced from November 1, 2016 to February 22, 2022.

- **Beginning July 24, 2018:** State agricultural drought declaration with corresponding Small Business Administration Economic Injury Disaster Loans (SBA EIDL) program implementation.
- **Beginning April 18, 2020:** State agricultural drought declaration with corresponding SBA EIDL program implementation.
- **Beginning May 11, 2021:** State agricultural drought declaration with corresponding SBA EIDL program implementation.

3.3.2.2. Potential Impacts

The potential drought impacts are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts may include:

- Reduction or loss of water supply, water use restrictions, and lack of potable water supply.
- Health effects, including increased heat-related, waterborne, and cardiorespiratory illnesses, as well as mental health conditions.
- Reduced economic productivity or business closures, including agriculture, livestock, recreation, energy, tourism, timber, and fisheries.
- Supply chain restrictions, including food shortages.
- Loss of power or reduced availability of electricity due to infrastructure damage and high demand.
- Property and infrastructure damage due to expansive soils, which are clay-based soils that expand and contract based on the amount of moisture in the soil.
- Damage to natural environments, including low water levels in lakes, rivers, and other water bodies, reduced plant growth, local species reduction or extinction, increased water temperature, and deteriorated water quality, which may result in fish kills and increased waterborne pollutants.
- Concurrent hazards, including extreme heat, wildfire, flooding, and landslides.

3.3.2.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County are vulnerable to drought. Vulnerabilities include:

- People with preexisting health conditions, those without access to clean water, children, pregnant women, and older adults.
- Those who are employed in water-dependent sectors, such as agriculture and recreation, may experience a reduction in income. Farmers, ranchers, livestock owners, water utilities, businesses that are farming-dependent or produce-dependent, and semi-conductor manufacturers could be impacted.

- Crop failures and pasture loss in agriculture and forest zoning districts, exclusive farm use zoning districts, and 10- and 20-acre future development district zoning areas that allow for agriculture uses are located in the unincorporated areas of the County.
- Reduction or elimination of water supply sources and negative impacts to ground and surface water quality.
    - Groundwater Limited Areas that are controlled in the event of declining ground water levels include:
        - Chehalem Mountain
        - Sherwood-Dammasch-Wilsonville
        - Parrett Mountain
        - Cooper-Bull Mountain
    - Drastic fall in water levels at Barney Reservoir and Hagg Lake could impact the unincorporated portions of the County.
- Negative impacts to natural environments throughout the County. Washington County owns and operates five natural areas that are vulnerable to drought. These natural environments may experience fish and wildlife habitat decline, the migration of wildlife, stresses on endangered species, a loss of wetlands, increased occurrence for wildland and vegetative fires, poor soil quality, and lessened hydric properties.
- Potential loss of historical, mature landscaping and trees located throughout the County, such as the Porter Sequoias at the county courthouse. At least twelve mature trees at Metzger Park have been lost due to multiple years of drought. It is anticipated that additional mature trees will be lost in upcoming years.

3.3.3. Earthquake

An earthquake is a sudden movement of rock on each side of a fault in the earth's crust that abruptly releases strain that has accumulated. The County could experience earthquakes that originate from the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek Fault Zone. It could also experience liquefaction and landslides as the result of an earthquake. Potential earthquake impacts and vulnerabilities are identified below.

3.3.3.1. Potential Impacts

The potential impacts of an earthquake event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Impacts may include:

- Injuries or deaths.
- Mental health impacts, including post-traumatic stress disorder.
- Public health hazards resulting from disruption of drinking water and wastewater systems.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to ground utilities; residential, public, and private buildings; and transportation systems above and below.
- Disruption of essential infrastructure systems, such as power systems, public utilities, and telecommunications.
- Blocked roads and rail transportation routes due to debris from trees and damaged property, ground deformation, and liquefaction.
- Downed or damaged powerlines that can lead to wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Change in water flows, including paths of rivers and streams.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards initiated by an earthquake, including flood, wildland fire, and landslide.

3.3.3.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County are vulnerable to earthquakes. These vulnerabilities include:

- County-owned critical facilities and infrastructure, including 13 administrative buildings and facilities, 9 public safety buildings, 4 medical facilities, 3 natural recreational areas, 1 fairground, and the road and bridge system.
- Other critical infrastructure, including aboveground power lines, communication structures, and emergency generators.
- Buildings with very high or high collapse potential include residential and commercial buildings constructed prior to 1990 that have not had seismic retrofits.
- Areas near the epicenter of an earthquake event are likely to incur a significant amount of damage to buildings, infrastructure, facilities, and property.
- Buildings in relatively high liquefaction-susceptible areas along Dairy Creek, Gales Creek, and the Tualatin River are at higher risk to damage from liquefaction-induced ground deformation.
- Unreinforced masonry, wood frame buildings with sill plates not bolted to foundation, cripple wall perimeter systems, and buildings on steep slopes partially supported on “stilts” are generally substantially vulnerable to major seismic damage.[539]
- Using 2022 Hazus®-MH information, it is estimated a 6.7 magnitude Gales Creek Fault earthquake event could result in 2,542 yellow-tagged buildings, 817 red-tagged buildings, and $643,401,000 in total economic losses in unincorporated Washington County.[540]
- A 2018 Oregon Department of Geology and Mineral Industries (DOGAMI) report described the following earthquake scenarios and their potential impacts on unincorporated Washington County[541]:
  - A Cascadia Subduction Zone magnitude 9.0 earthquake in “dry” soil conditions could result in $29,512,000 in building repair costs, 847,000 tons of debris, 1,788 long-term displaced residents, and up to 1,535 deaths.
  - A Cascadia Subduction Zone magnitude 9.0 earthquake in “wet” soil conditions could result in $3,913,000,000 in building repair costs, 1,395,000 tons of debris, 16,509 long-term displaced residents, and up to 3,483 deaths.
  - A Portland Hills Fault magnitude 6.8 earthquake in “dry” soil conditions could result in $5,176,000,000 in building repair costs, 1,614,000 tons of debris, 9,563 long-term displaced residents, and up to 4,410 deaths.
  - A Portland Hills Fault magnitude 6.8 earthquake in “wet” soil conditions could result in $8,584,000,000 in building repair costs, 2,603,000 tons of debris, 39,822 long-term displaced residents, and up to 8,328 deaths.
- Natural environments throughout the County.
- Historical, mature landscaping and trees located throughout the County, such as the Porter Sequoias at the county courthouse.

[539] Washington County. (2017, February). Washington County Natural Hazard Mitigation Plan. https://www.co.washington.or.us/EmergencyManagement/plans-and-agreements.cfm
[540] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[541] Bauer, J.M., Burns, W.J., & Madin, I.P. (2018). Open-File Report O-18-02: Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon. Oregon Department of Geology and Mineral Industries. DOGAMI Open-File Report O-18-02, Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon (oregongeology.org)

3.3.4. Extreme Heat

Due to a rise in the frequency and severity of extreme heat events and the impacts of those events, the NHMP Steering Committee chose to include this hazard in the Washington County NHMP for the first time. Previous significant extreme heat events and the potential impacts of and vulnerabilities to extreme heat are identified below.

3.3.4.1. Significant Events

Extreme heat was not included in previous NHMPs. The County identified one significant extreme heat event and five significant heat events it experienced from November 1, 2016, to February 22, 2022.

- **June 26–29, 2021:** During this extreme heat event, a high-pressure heat dome over the region led to a stretch of intense heat, shattering records from June 26 through June 29. All-time maximum temperatures were broken by 8 °F to 10 °F. The maximum temperature reached 108 °F with a heat index of 115 °F. These temperatures of over 110 °F required activation of daytime and overnight cooling shelters. At least one death was reported.
- Significant heat events in June 2017, August 2017, July 2018, August 2019, and August 2021 were of sufficient duration to warrant activation of cooling shelters. An extreme heat event also occurred in May 2017; however, it was not severe enough to activate cooling shelters.

3.3.4.2. Potential Impacts

The potential impacts of an extreme heat event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts may include:

- Injuries or deaths.
- Heat illnesses, including heat rashes, heat cramps, heat exhaustion, heat stroke, and death.
- Extended operational hours of County staff and additional resources needed for response to the event, including the operation of daytime cooling centers and overnight cooling shelters.
- Strain on or loss of water supply due to increased demand.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Economic losses from decreased worker efficiency and effectiveness and time lost on the job when workers take more frequent or longer breaks to avoid overheating.
- Economic impacts of closure of outdoor activities and events, such as farmers markets and concerts.
- Property damage, such as roof expansions, leading to warped, cracked, and leaking shingles; dry, cracked, and leaking caulking around flashing and joints; cracked foundations; excessive drying of wood structures; and melted siding.
- Disruption of essential infrastructure systems from overheated and damaged utilities, including power, water, transportation, and communication systems.
- Impacts to roadways as heat expands concrete or causes cracking and buckling. Public transit can also be impacted due to melted cables, sagging wires, and warping tracks.
- Damage to crops, livestock, vegetation, parks, and natural systems.

- Impacts to greenspaces, such as scorch and sunscald of new foliage, branches or tops of trees dying, and significant stress and die-off of native trees, particularly Douglas fir and cedar. These impacts are intensified if drought is also occurring.
- Concurrent hazards include drought and wildland fire.

3.3.4.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County are vulnerable to extreme heat.

Populations substantially vulnerable to extreme heat include:

- People who work or spend a significant time outdoors, including those in construction, landscaping, farming, agriculture, maintenance and repair, and roofing.
- People who live or work in buildings without air conditioning or cooling equipment.
- People living, working, or spending time in heat islands within the County.
- People living outdoors or in the upper floors of multi-family housing units.
- People with higher heat sensitivity, including older adults, infants and children, pregnant women; people with preexisting or chronic diseases; and people who take certain medications that affect thermoregulation or block nerve impulses.
- People with limited mobility and no access to cooling systems who may not be able to travel to cooling centers or shelters.
- People who live in social isolation, including linguistic isolation, or those living alone with few social relationships.

Additional vulnerabilities to extreme heat include:

- Historically, older homes in the County that do not have air conditioning or cooling equipment installed.
- County-owned critical facilities and infrastructure, including 13 administrative buildings and facilities, 9 public safety buildings, 4 medical facilities, 3 natural recreational areas, 1 fairground, and the road and bridge system.
- Other critical infrastructure, including communication structures and emergency generators.
- Bridge infrastructure is vulnerable to thermal expansion of bridge joints and paved surfaces and deterioration of steel, asphalt, protective cladding, coats, and sealants.
- Asphalt pavement is vulnerable to accelerated deterioration through softening, rutting, and migration of liquid asphalt.
- Vehicles, including first responder vehicles, are vulnerable to engine overheating and tire deterioration.
- Aboveground utility and power lines can droop or sag and create a heightened risk for outages or fires as a result of downed or damaged lines.
- Increased reliance on cooling causes a concern for industries that use off-site servers to maintain their systems.
- Natural environments located throughout the County.
- Plants, animals, ecosystems, and natural environments are vulnerable to high rates of mortality due to excessive heat, especially during repetitive high-heat days.

3.3.5. Flooding, Including Channel Migration and Streambed Erosion

Flooding is a common occurrence in the County, and events typically occur from October through April. The main flooding events in Washington County are located within Tualatin River floodplain areas in the unincorporated County, commercial areas along Beaverton Creek and Fanno Creek, and in a significant portion of commercial areas in the City of Tualatin located along susceptible waterways. There are a few areas throughout the County dispersed along waterways that may, based on projections, experience flood damage. However, a large concentration of flood damage is not expected in any one area of the County.

3.3.5.1. Significant Events

The County identified three significant flooding events it experienced from November 1, 2016 to February 22, 2022. Heavy rain in February 2017, February 2019, and February 2022 caused minor flooding that resulted in road closures throughout the County.

3.3.5.2. Potential Impacts

The potential impacts of a flooding event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts include:

- Injuries or deaths.
- Public health concerns, such as the spread of infectious diseases, exposure to hazardous materials and debris, and water quality issues.
- Need for widespread search and rescue operations, including water rescues.
- Displaced residents in need of sheltering.
- Delayed emergency response times and disruption of traffic due to high water, debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal economic impacts of loss of income and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.5.3. Vulnerabilities

All populations, economies, built environments, critical facilities and infrastructure, and natural environments within the FEMA Special Flood Hazard Area (100-year recurrence flood event) and the

Drainage Hazard Area (25-year recurrence flood event) are potentially vulnerable to a flooding event. Additional vulnerabilities include:

- Populations without access to private transportation for evacuation purposes.
- Past damage done to roads and culverts due to flooding within unincorporated Washington County include:
  - River Road culvert failure, December 2017, $57,000 replacement.
  - Martin Road culvert failure, December 2019, $92,000 replacement.
  - Pongratz Road culvert failure, October 2020, $6,700 repair.
  - Stringtown Road flooding road failure, January 2021, $2,800 repair.
- Other critical infrastructure, including communication structures and emergency generators.
- There are 36 repetitive loss (RL) properties in unincorporated Washington County as of September 30, 2021.
- Properties without flood insurance.
- Special flood hazard areas within the County.
- Portions of the unincorporated County outside of the mapped floodplains are subject to flooding from local storm water drainage and overbank flooding from streams too small to be mapped by FEMA. Buildings and infrastructure in these areas may be at flood risk.
- The following locations in unincorporated Washington County have been identified as prone to flooding. All roads listed are located in rural areas of the County, and closures impact primarily agricultural and residential land uses.
  - Fern Hill Road between Highway 47 and Geiger Road, Forest Grove
  - Bates Road between Old Highway 47 and Patton Valley Road, Gaston
  - Old Highway 47 between Highway 47 and Scoggins Valley Road, Gaston
  - West Union Road at Helvetia Road
  - Susbauer Road between Long Road and Hornecker Road, Cornelius
  - Stringtown Road between Highway 8 and Ritchey Road
  - B Street between Stringtown Road and 16th Avenue, Forest Grove
  - 334th Street between Tualatin Valley Highway and the end, Hillsboro
  - Cook Road at 334th Avenue, Hillsboro
  - Dairy Creek Road between Mountain Dale Road and the end, North Plains
- Cedar Mill Creek and Johnson Creek repeatedly flood and can impact surrounding areas.
- Flood loss estimates determined by Hazus-MH include[542]:
  - 10-year flood scenario
    - Number of buildings lost: 398
    - Loss estimate: $13,022,000

[542] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

- 50-year flood scenario
  - Number of buildings lost: 558
  - Loss estimate: $17,547,000
- 100-year flood scenario
  - Number of buildings lost: 651
  - Loss estimate: $20,649,000
- 500-year flood scenario
  - Number of buildings lost: 1,080
  - Loss estimate: $37,428,000

Table 319: Land Use Type in the 100-Year Floodplain in Unincorporated Washington County

Land Use Type	Total Parcels in 100-Year Floodplain	Total Value of Exposed Parcels	Total Area in Jurisdiction (Acres)	Total Area in the 100-Year Floodplain (Acres)	Percentage of Area in the 100-Year Floodplain
Agricultural	660	$431,494,330	110,087.50	21,341.99	19.39%
Commercial	71	$280,022,030	5,011.19	1374.14	27.42%
Forest	75	$68,831,240	174,259.30	2,799.38	1.61%
Industrial	2	$144,167,930	388.28	164.02	42.24%
Multi-Family Residential	95	$726,601,770	908.20	200.60	22.08%
Public	219	$97,396,580	77,253.60	3,899.60	5.05%
Rural	143	$86,028,930	10,357.79	473.23	4.57%
Single-Family Residential	1,299	$751,091,740	13,610.45	782.20	5.74%
Vacant	141	$12,232,050	3,933.74	303.32	7.71%
Other	124	$427,160,490	4,949.53	1,386.31	28.01%
Total	**2,829**	**$3,025,027,090**	**400,759.50**	**32,724.79**	**8.17%**

Table 320: Facilities in Unincorporated Washington County within FEMA-Mapped Floodplains

Building Classification	Buildings	Buildings within 100-Year Floodplain	Buildings within 500-Year Floodplain	Buildings within Combined 500-Year & 100-Year Floodplain
Total Buildings	104,216	1,437	1,132	2,569
Percentage of Buildings within Unincorporated Washington County	100%	1.38%	1.09%	2.47%

3.3.6. Landslide

In Washington County, the most common landslides are debris flows and shallow and deep landslides. The southern, western, and northern rural areas of Washington County with steep slopes have an increased risk of landslides. A significant landslide event, potential landslide impacts, and vulnerabilities to landslides are identified below.

3.3.6.1. Significant Event

The County identified one significant landslide event it experienced from November 1, 2016 to February 22, 2022.

- **December 7, 2021:** A landslide resulted in an emergency, long-term closure of Dixie Mountain Road from the quarry to the end of the road. The road remains closed, and an alternate access to the quarry was opened up. The response cost to the County as of June 2022 is approximately $3,000.

3.3.6.2. Potential Impacts

Potential impacts of a landslide event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event.

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Mobility or access issues for residents due to blocked or damaged transportation routes.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income and property damage that may not be covered by insurance.
- Debris flows.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Power outages and natural gas leaks.
- Disruption of traffic due to damaged or destroyed transportation systems.
- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, and parks.

3.3.6.3. Vulnerabilities

The populations, structures, and improved property vulnerable to landslides include the following:

- Per DOGAMI, there are 2,694 buildings with a total value of $701,247,000 at very high susceptibility, 3,966 buildings with a total value of $1,176,240,000 at high susceptibility, and 36,081 buildings with a total value of $11,257,655,000 at moderate susceptibility to landslide exposure in unincorporated Washington County.[543] Additionally, a community risk profile completed by DOGAMI shows 12,441 residents may be potentially displaced due to a very high or high susceptibility landslide scenario.[544]
- The southern, western, and northern rural areas of Washington County with steep slopes have increased risk of damage from landslides.[545]
- Scoggins Valley Park in the southwestern portion of the County.
- Landslide hazard is ubiquitous in a large percentage of undeveloped land and may present challenges for future planning and mitigation efforts. Awareness of nearby areas of landslide hazard is beneficial for reducing risk for every community in Washington County.[546]

[543] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[544] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[545] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[546] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

3.3.7. Volcanic Ash

Volcanic activity is possible at mountains within 60 miles of the County, including Mount St. Helens and Mount Hood. Ashfall from a volcanic eruption has the potential to impact the County, although the scale and types of impacts and vulnerabilities may differ depending on which volcano erupts, the level of eruption, and the wind direction during and after eruption. Potential ashfall impacts and vulnerabilities to volcanic ash are identified below.

3.3.7.1. Potential Impacts

Though unlikely, the impacts of a significant ashfall can be substantial, including:

- Indirect injuries and deaths, such as those sustained during ash cleanup operations or in traffic accidents.
- Short-term health effects, including respiratory effects.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation. This includes public water systems that rely on outdoor reservoirs.
- The need to shelter individuals to protect them from poor air quality, including houseless persons and persons displaced from their residences due to poor residential air filtration systems.
- Delayed emergency response times due to decreased visibility and increased traffic hazards.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and cleanup activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, drainage systems, telecommunications, and transportation routes.
- Downed or damaged powerlines can lead to wildfires.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.7.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County are vulnerable to volcanic ash. This includes:

- People in the County with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults.
- People without access to effective dust masks, eye protection, and drinking water and food uncontaminated by ash.

- Major employers, including electronic manufacturing companies and university and research facilities.
- County-owned critical facilities and infrastructure, including 13 administrative buildings and facilities, 9 public safety buildings, 4 medical facilities, 3 natural recreational areas, 1 fairground, and the road and bridge system.
- Other critical infrastructure, including communication structures, drainage systems, and emergency generators.
- Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of volcanic ash.
- Natural environments located throughout the County.

3.3.8. Wildland Fire

Washington County has an elevated wildland fire risk within its forested areas, which are predominantly located in the southern, western, and northern portions of the County. The impacts of wildland fire are elevated in the wildland–urban interface (WUI) where a greater number of people and structures are at risk. Significant wildland fire or wildland fire smoke events, their potential impacts, and vulnerabilities to wildland fire are identified below.

3.3.8.1. Significant Events

The County identified three significant wildland fire or wildland fire smoke events it experienced from November 1, 2016 to February 22, 2022. Washington County saw one federal declaration (DR-4562), two Fire Management Assistance Grants, and one emergency declaration that included wildfire in 2020. The County has also experienced smaller, less significant non-structural fires caused by debris burning.

- **September 2017:** Wildland fire smoke from the Eagle Creek Fire in the Columbia River Gorge entered the area and required that the County take protective actions for residents.
- **September 2020:** Two wildfires burned concurrently in the County: the Powerline wildfire and the Chehalem Mountain–Bald Peak wildfire. Evacuations and shelter operations were required for both events.
    - The Powerline wildfire began on September 8 and was considered contained on September 13. The fire was started by sparks from powerlines and burned 126 to 175 acres. Day- and night-shift wildland resources assigned to the fire included 3 hand crews, 11 engines, 1 dozer, 1 excavator, 3 water tenders, and overhead personnel. A total of 109 personnel worked on the event. A Level 3 evacuation, the highest evacuation level, and an indication of current or imminent danger, was issued to approximately 150 homes, including those throughout the entire city of Cherry Grove and on Dundee Road, SW Patton Valley Road, SW Lee Road, and SW Cascara Road. It also forced the closure of Hagg Lake and Scoggins Valley Park for several days and caused unhealthy air quality.
    - The five-alarm Chehalem Mountain/Bald Peak wildfire also began on September 8 and was declared 100% contained on September 14. The fire was started by an improperly extinguished campfire on private property in unincorporated Washington County and burned approximately 875 acres in Washington and Yamhill counties. Tualatin Valley Fire & Rescue (TVF&R) conducted fire protection, suppression, and patrols throughout 1,555 acres. The fire spread quickly because of dry fuels, low humidity, high winds, and steep and rugged terrain. In some cases, fire jumped over areas, leaving unburned timber and dry fuels. A Level 3 evacuation was issued for approximately 150 people. Level 2 evacuations were issued in several areas. A Level 2 evacuation means there is significant danger to the area and residents should voluntarily relocate to either a shelter or a family or friend's home outside of the affected area. If residents choose to remain in the area, they should be ready to evacuate at a moment's notice. Three barns were destroyed in the fire and power was disrupted. No injuries or deaths were reported.
        - In response to the fire and evacuations, the following support services were established:
            - A staging site and shelter for evacuees was set up at Mountainside High School in the City of Beaverton.
            - Three comfort centers were set up at a church in the City of Newberg in Yamhill County. These centers provided air-conditioning, food, water, and showers.

- Animal shelters were set up at the Washington and Yamhill County Fairgrounds. These shelters accepted pets and livestock.
- Campsites and spots for recreational vehicles were created at the Washington County Fairground.

3.3.8.2. Potential Impacts

The potential impacts of a wildfire event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts may include:

- Injuries or deaths.
- Exposure to wildfire smoke, which can lead to eye, nose, and throat irritation and the worsening of chronic heart and lung diseases.
- Widespread public health issues stemming from failing or damaged infrastructure, such as lack of clean water and sanitation.
- Need for widespread search and rescue operations.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to blocked transportation routes and debris, congested transportation routes due to evacuations, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Strain on or loss of water supply due to increased demand.
- Economic impacts to governments, including costs for fire suppression, staff, equipment, supplies, transportation and mobilization of first responders, evacuations, sheltering operations, post-fire recovery, and rebuilding costs associated with government-owned buildings, property, and infrastructure.
- Economic impacts, including loss of local revenue due to business and property tax losses, agriculture production losses, and reduced recreation and tourism activity. Scoggins Valley Park receives one million visitors a year, most during summer, which is when wildland fires tend to occur.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including above- and belowground utility lines; residential, public, and private buildings; and transportation systems.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property, causing blocked road and rail transportation routes.
- Downed or damaged powerlines. This impact may be compounded since powerline failures can lead to additional wildfires.
- Power outages and natural gas leaks.
- Hazardous material releases due to infrastructure and facility damage.

- Harm to ecosystems from loss of habitat, death and destruction of vegetation and animals, and erosion.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including air and water quality issues. Landslide and erosion issues are common following a wildland fire.

3.3.8.3. Vulnerabilities

The dynamic nature of wildland fires means all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County are vulnerable to this hazard. These include:

- People with chronic lung problems and other preexisting health conditions, children, pregnant women, and older adults.
- Populations without access to private transportation for evacuation purposes.
- Rural populations and those within the WUI are at greater vulnerability. Isolated concentrations of rural populations with limited access for fire suppression and evacuation purposes include Bald Peak, Buxton, Cherry Grove, Dixie Mountain, Fern Hill, Pumpkin Ridge, Dairy Creek, and Timber.
- Many fire hazard mitigation strategies rely on property owner action and this capacity varies. Low-income residents will have fewer financial resources to mitigate risk.
- County-identified critical infrastructure, including several roads, bridges, and culvert crossings, are at risk in the forested and WUI hazard areas. Outside of the WUI/forested hazard area at risk to direct fire contact, the County identified the critical facilities that can be exposed to wildland smoke contaminates in Table 315.
- Other critical infrastructure, including aboveground power lines, communication structures, and emergency generators.
- Drinking water sources and water treatment infrastructure, food supplies and availability, and access to medical resources or care may also be impacted by wildfire and can cause health impacts on a large scale.
- Homes, businesses, and infrastructure adjacent to the forested areas throughout the County.
- Per analysis of the Oregon State University Extension Service Fire Program and Wildland Fire Associates dataset,[547] in unincorporated Washington County, there are:
  - 1,207 buildings with a total value of $303,478,000 at high risk of wildland fire exposure.
  - 904 buildings with a total value of $232,660,000 at moderate risk of wildland fire exposure.
  - 22,635 buildings with a total value of $6,009,638,000 at low risk of wildland fire exposure.
- A community risk profile completed by DOGAMI shows 2,874 residents could be displaced due to a high or moderate risk wildland fire scenario.[548]
- Limited-access areas that are more vulnerable to wildland fire:
  - Areas that lack multiple access routes for sending fire suppression resources or alternative evacuation routes are at risk during wildfire events.

[547] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm
[548] Oregon Department of Geology and Mineral Industries. (2022). Open-File Report O-22-04: Natural Hazard Risk Report for Washington County. https://www.oregongeology.org/pubs/ofr/O-22-04/p-O-22-04.htm

  - Areas with steep slopes and waterways that flood may be more prone to landslides after wildfire events.
  - Rural private roads not maintained by the County that provide residential access to multiple properties, especially those whose terrain or condition negatively impact access.
- Natural environments throughout the County.

3.3.9. Windstorm, Including Tornado

The strongest winds in Washington County are experienced in the western portions of the County in the Coast Range, northern and eastern areas within the Tualatin Mountains, southern areas in the Chehalem Mountains, and Bull Mountain/Little Bull Mountain in the southeastern portion of the County. Tornadoes may also occur in Washington County but are typically very small Enhanced Fujita (EF) scale 0 or 1.

3.3.9.1. Potential Impacts

The potential impacts of a windstorm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event.

- Injuries or deaths.
- Displaced residents in need of sheltering.
- Delayed emergency response times due to debris, blocked transportation routes, and damaged infrastructure and vehicles.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems. Significant damage could lead to the complete loss of structures or totaled vehicles.
- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked road and rail transportation routes.
- Downed or damaged powerlines can lead to wildfires.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.

3.3.9.2. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County are vulnerable to windstorms, including tornadoes. These include:

- County-owned critical facilities and infrastructure, including 13 administrative buildings and facilities, 9 public safety buildings, 4 medical facilities, 3 natural recreational areas, 1 fairground, and the road and bridge system.
- Buildings and infrastructure not built to withstand high winds, including manufactured homes and buildings. All critical County structures are maintained to current building code requirements for

wind, including roof storm straps. Therefore, non-critical County structures and privately owned buildings and infrastructure are likely to be the most vulnerable.

- Other critical infrastructure, including aboveground power lines, communication structures, and emergency generators.
- Areas of greater vulnerability include forested areas along the canyon walls where winds increase in velocity.
- Areas at elevation over 500 feet include the southern series of hills (Cooper, Bull, and Chehalem Mountains), along the northern range of the Tualatin Hills, and in the Coast Range. The County only maintains County roads in these areas. In the Coast Range, roads outside of the County's jurisdiction are privately owned or are under the State's jurisdiction.
- Natural environments located throughout the County.
- Older hardwood (oak), maple, and conifer stands along the canyon walls are more vulnerable to high winds.
- Historical, mature landscaping and trees located throughout the County, such as the Porter Sequoias at the county courthouse.

3.3.10. Winter Storm

Winter storm events occur annually in Washington County, sometimes becoming severe. Severe winter weather in the County is characterized by extreme cold, snow, ice, and sleet. Significant winter storm events, their potential impacts, and vulnerabilities to winter storms are identified below.

3.3.10.1. Significant Events

The County identified five significant winter storm events it experienced from November 1, 2016, to February 22, 2022.

- **January 7–8, 2017:** General snowfall totals of 2–4 inches were reported, with the greatest total being 4.5 inches. Major ice accumulations occurred after the snow, with several locations reporting 0.50–1.00 inches. The combination of snow and ice resulted in significant power outages and closures across the area.
- Events in February 2017, February 2018, and December 2021 had minor impacts, such as travel impacts.
- **February 11–14, 2021:** Freezing rain and heavy snow came down and gusty winds up to 50 mph occurred, resulting in a five-day ice storm. The County experienced snowy and icy roads, downed tree limbs, localized power outages, and travel impacts. The West Hills and the southeast areas in the County were primarily impacted. Multiple trees were downed at Metzger Park in unincorporated Washington County near Washington Square.

3.3.10.2. Potential Impacts

The potential impacts of a winter storm event are identified below. The type, magnitude, and extent of impacts can vary based on the scale of the event. Potential impacts may include:

- Injuries or deaths, including from carbon monoxide poisoning, falls from slick or icy conditions, frostbite, and hypothermia.
- Delayed emergency response times due to debris, blocked transportation routes, damaged infrastructure and vehicles, and difficulty using fire hydrants because of frozen or damaged water system components.
- Stranded travelers due to ice, snow, and transportation impacts.
- Extended operational hours of County staff and resources needed for response to the event.
- Economic impacts to governments, including reduced future revenues, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.
- Personal and household economic impacts of loss of income, increased medical costs, and property damage that may not be covered by insurance.
- Damage and destruction to the built environment, including aboveground utility lines; residential, public, and private buildings; and transportation systems.
- An increased number of house fires due to unsafe alternate heating methods.
- Significant property damage and loss of water due to frozen or damaged pipes or the thawing of frozen pipes.

- Disruption of essential infrastructure systems, such as power systems, public utilities, telecommunications, and transportation routes.
- Debris from trees and damaged property causing blocked road and rail transportation routes.
- Downed or damaged powerlines can lead to wildfires, and tree debris can create fuel load for wildfire.
- Power outages.
- Harm to ecosystems from loss of habitat, and death and destruction of vegetation and animals.
- Damage to crops, livestock, vegetation, parks, and natural systems.
- Concurrent hazards, including flooding.

3.3.10.3. Vulnerabilities

All populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County are vulnerable to winter storms. These include:

- People who do not have access to sufficient heating, insulated clothing, or dry living conditions, including unhoused populations.
- Older adults and infants, people who take certain medications, people who have certain medical conditions, and people who have been drinking alcohol are at increased risk for hypothermia.
- People in households lacking appropriate and functional heating devices.
- Populations with disabilities may be more affected due to mobility issues.
- County-owned critical facilities and infrastructure, including 13 administrative buildings and facilities, 9 public safety buildings, 4 medical facilities, 3 natural recreational areas, 1 fairground, and the road and bridge system.
- Older buildings and infrastructure not built to withstand the weight and impacts of large amounts of snow and ice.
- All roads and bridges can be impacted to a certain degree by a winter storm. However, these typically do not rise to a level beyond normal operations, such as clearing vegetation debris from roads, plowing snow, and applying deicer and sand for icy roads.
- Roads above 500 feet in elevation are more susceptible to snow and ice. Roads in forested areas are more susceptible to long-term snow and ice due to shading. Forested roads also are susceptible to debris from fallen trees and tree limbs. However, the normal maintenance program generally resolves road obstructions and hazardous conditions.
    - The County has implemented two “Snow Zones” on two significant travel routes. These Snow Zones cover areas at 500’ and above and are activated when there is snow and/or ice falling or confidently forecast. These are in addition to normal deicing, plowing, and sanding treatments.
- Natural environments throughout the County.
- Historical, mature landscaping and trees located throughout the County.

3.4. Historical Events

The timeframe of data collected during the planning process for Washington County was November 1, 2016 to February 22, 2022. Hazard events that impacted the entire planning area during these dates are detailed in Volume I, Section 2. During this period, the County experienced impacts of drought, extreme and significant heat, flooding, landslide, wildland fire and wildland fire smoke, and winter storm since adoption of the 2017 NHMP.

One Major Disaster Declaration was issued on September 7, 2020 for wildfire and straight-line winds. Two Federal Fire Management Assistance Declarations were issued on September 8, 2020, and September 10, 2020. One Emergency Declaration for Wildfire was issued on September 10, 2020.

A County disaster declaration for the COVID-19 pandemic was in effect from March 4, 2020, to April 2, 2020.[549] Although pandemic is not a hazard included in this NHMP, this declaration is noted because FEMA provided support and Hazard Mitigation Grant Program funding during the event.

3.5. Overall Vulnerability

Based on the analysis completed by the Technical Committee, winter storm, wildland fire, drought, extreme heat, and flooding present the highest relative and recurring risks to the unincorporated portion of Washington County. These hazards can create widespread events, and all populations, economies, structures, improved property, critical facilities and infrastructure, and natural environments in the County can be vulnerable to these hazards.

Areas of greatest vulnerability to these hazards within the County include:

- Populations with higher vulnerability, such as those with preexisting health conditions and/or disabilities, older adults, children, and pregnant women.
- Populations that are unhoused, do not have access to private transportation for evacuation purposes, and/or are without access to sufficient heating, cooling, and clean water.
- Populations with limited income and financial resources.
- Populations whose primary language is not English.
- Rural populations and those within the WUI are at greater vulnerability. Isolated concentrations of rural populations with limited access for fire suppression and evacuation purposes include Bald Peak, Buxton, Cherry Grove, Dixie Mountain, Dairy Creek, Fern Hill, Pumpkin Ridge, and Timber.
- Limited-access areas that are more vulnerable to wildland fire:
  - Areas that lack multiple access routes for sending fire suppression resources or alternative evacuation routes are at risk during wildfire events.
  - Areas with steep slopes and waterways that flood may be more prone to landslides after wildfire events.
  - Rural private roads not maintained by the County that provide residential access to multiple properties, especially those whose terrain or condition negatively impact access.
- There are 36 RL properties in unincorporated Washington County as of September 30, 2021.
- Industries can experience commerce losses from power interruptions, damaged buildings and assets, and road closures. Industries can also sustain direct losses to buildings, personnel, and other vital equipment.

[549] Washington County, Oregon. (2020, March 17). Emergency Declaration Extended. https://www.washingtoncountyor.gov/bcc/news/emergency-declaration-extended

- Economic impacts to the County, including loss of local revenue due to business and property tax losses, reduced future revenues, reduced recreation and tourism activity, increased costs resulting from response activities, and increased future costs resulting from recovery and reconstruction activities.
- County-owned critical facilities and infrastructure including 13 administrative buildings and facilities, 9 public safety buildings, 4 medical facilities, 3 natural recreational areas, 1 fairground, and the road and bridge system.
- Other critical infrastructure, including communication structures, emergency generators, and aboveground utility and power lines.
- The water supply sources used by the County can dry up, and ground and surface water quality can be impacted.
- Natural environments located throughout the County, and historical, mature landscaping and trees located throughout the County.

4. Capability Assessment

(In compliance with 44 CFR §201.6(c)(3))

The following capability assessment and safe growth audit examine the ability of the County to implement and manage a comprehensive approach to mitigation, also known as a mitigation strategy. Strengths, opportunities, and resources of the jurisdiction are identified to develop an effective hazard mitigation action plan. The capabilities in this assessment were collectively evaluated to determine areas for expansion and improvement that would allow the County to implement mitigation activities more effectively.

A capability questionnaire was distributed to the Washington County Technical Committee to support this assessment. The survey included questions regarding existing plans, policies, and regulations that contribute to or hinder the ability to implement hazard mitigation activities, including legal and regulatory capabilities, administrative and technical capabilities, education and outreach capabilities, and fiscal capabilities. The Technical Committee also completed a safe growth audit to identify potential gaps in growth guidance instruments and improvements that could be made to reduce vulnerability to future development.

4.1. Planning and Regulatory Assessment

Planning and regulatory capabilities include plans, policies, codes, and ordinances within the County that can prevent and reduce the impacts of hazards.

4.1.1. Types of Plans

Washington County has the following plans that address natural hazards:

- Comprehensive Framework Plan for the Urban Area: This plan includes Policy 8 (Natural Hazards), a policy to protect life and property from natural hazards that may be used to implement natural hazard mitigation actions.
- Rural/Natural Resource Plan: This plan includes Policy 8 (Natural Hazards), a policy to protect life and property from natural hazards that may be used to implement natural hazard mitigation actions.

- Emergency Operations Plan: This plan includes an adopted evacuation and shelter plan to deal with emergencies from natural hazards.
- Transportation System Plan: This plan could potentially identify projects to include in the mitigation strategy and may be used to implement mitigation actions.
  - The plan's Goal 4 (Natural Environment) addresses natural hazards in Strategy 4.2.7., which states that existing natural hazards, as well as potential future natural hazards, should be considered during the design and engineering of transportation improvements.
  - The plan's Goal 11 (Maintenance) addresses maintenance of county transportation facilities. Strategy 11.1.3 calls for the implementation of an asset management program to maintain an accurate inventory and condition rating of pavements (including sidewalks and bike lanes), bridges, culverts, gravel roads, roadside drainage facilities, and landscape areas. Additionally, the plan's Road Maintenance Priority Matrix states that the highest maintenance priority will be given to emergencies and/or hazards work related to abating or managing an immediate threat to public safety, private property, or environmental resources.

The County has a Capital Improvement Plan and a Continuity of Operations Plan that do not currently address natural hazards, do not identify projects to include in the mitigation strategy, and cannot be used to implement mitigation actions.

A Food System Plan is in place that contains the strategic initiative of ensuring local food systems are integrated into the County's emergency plans. The performance measures tied to this goal are to incorporate strategies to ensure local food accessibility in County emergency planning processes and review emergency plans for inclusion of local food accessibility issues. This plan could potentially identify projects to include in future mitigation efforts.

The County is planning to participate in updating the 2007 Community Wildfire Protection Plan (CWPP) with the Oregon Department of Forestry. Through development of the CWPP, additional mitigation actions for wildfire, the WUI hazard, and wildfire smoke hazards can be identified and potentially incorporated into this NHMP.

4.1.2. Land Use Planning and Ordinances

Multiple ordinances in the Community Development Code (CDC) are administered and enforced by Washington County staff and are effective measures for reducing hazard impacts. Land use policies discourage development or redevelopment within natural hazard areas and overlays.

- Zoning ordinances in Article III, Land Use Districts, and subdivision ordinances in Article VI, Land Divisions and Property Line Adjustments, reduce wildfire risk by implementing state land use policy to concentrate development within urban growth boundaries.
- The floodplain ordinance in Article IV, Development Standards, Section 421 (Flood Plain and Drainage Hazard Area Development) reduces flood risk by prohibiting development likely to be vulnerable to flooding or to cause increased flood risk to other development. FEMA Flood Insurance Rate Maps are referenced within this CDC section as a tool to determine lands subject to floodplain standards. Regulation of development within the FEMA floodplain maintains it as a protective ecosystem.
- CDC regulations restrict the division of land within or adjacent to natural hazard areas. The County's CDC also allows for clustering of development to conserve environmental resources through planned development and allows density transfer where hazard areas exist.
- A Parks and Natural Areas Master Plan will be developed during the next NHMP planning cycle to promote a balance of resource protection, environmental stewardship, and recreation opportunities.

4.1.3. Building Codes, Permitting, and Inspections

The Washington County Code of Ordinances applies to construction, alteration, moving, demolition, repair, maintenance, and other work associated with any building/structure, except those located in a street, alley, or parcel of land open to the outside air leading to a street or open to public use (public way).

In addition to local codes, the County utilizes and enforces the State of Oregon Building Code, including the following specialty codes:

- Structural Specialty Code: Modified in County code section 14.04.260
- Residential Specialty Code
- Plumbing Specialty Code
- Electrical Specialty Code
- Mechanical Specialty Code: Modified in County code section 14.04.270
- Manufactured Dwelling Code
- 2010 Oregon Solar Installation Specialty Code

Building Code Effectiveness Grading Schedule scores for the County are Class 3 for residential buildings and Class 2 for commercial buildings.

A site plan review is required for building permits and is adequately enforced by Building Services within the Department of Land Use and Transportation.

4.1.3.1. National Flood Insurance Program Compliance

Participation in the National Flood Insurance Program (NFIP) is based on a voluntary agreement between a community and FEMA. For communities that adopt a floodplain management ordinance to reduce flood risks to new construction, federally backed flood insurance is made available to property owners in the community. Compliance with the NFIP, however, extends beyond participation in the program. The three basic components of the NFIP include floodplain identification and mapping risk, responsible floodplain management, and flood insurance.

An RL property is a property insured under the NFIP for which the program has paid at least two claims of more than $1,000 in any 10-year period since 1978, regardless of any change(s) of ownership during that period. As of September 30, 2021, there were 36 FEMA-identified RL properties in unincorporated Washington County.

National Flood Insurance Program Details

Insurance Summary

There are currently 694 NFIP policies in the unincorporated portion of the County and $172,865,600 of coverage in effect. On average, $719,909 in premiums are paid annually by policy holders. There are no limited coverage areas, and policies are available in all locations.

Since 1978, there have been 258 claims paid for a total amount of $3,264,048, 19 of which have been substantial damage claims. There are 4,098 structures exposed to flood risk within the community.

Staff Resources

There are no barriers to running an effective NFIP program in the County. The Certified Floodplain Manager on staff assists with NFIP administration services. The County provides development permit review, building permit review, and building inspection services in the floodplain. Geographic information

system (GIS) data on floodplains is also maintained and County engineering staff has the capability to review floodplain development proposals.

Compliance History

The County is in good standing with the NFIP and there are no outstanding compliance issues. The most recent Community Assistance Visit or Community Assistance Contact was in January 2020.

The County will continue NFIP compliance during the next five years of NHMP implementation by enforcing program requirements, including permit review, building inspection services, upkeep and utilization of floodplain mapping, and undertaking any code amendments needed to maintain compliance.

Regulation

The County entered into the NFIP on January 24, 1975, and has digital flood insurance rate maps. Regulations exceed minimum FEMA and state requirements by identifying Drainage Hazard Areas beyond the FEMA-regulated floodplains. Additional regulations to mitigate flood impacts are implemented in the Drainage Hazard Areas. The Floodplain Manager reviews floodplain development permit applications with the assistance of engineering staff. Following development permit approval, the Building Services group reviews and approves building permit applications and inspects buildings.

Community Rating System

The County does not currently participate in the Community Rating System.

4.2. Administrative and Technical Assessment

This portion of the assessment includes staff, their skillsets, and tools that can be used for mitigation planning and the implementation of mitigation actions.

4.2.1. Administrative Capabilities

Administration capabilities at the County lead to effective mitigation coordination efforts, which support the execution of a strong approach to mitigation. Mitigation planning occurs across most departments in subject-specific divisions (e.g., land use planning, road operations, health and human services, facilities, parks, and emergency management).

The Washington County Planning Commission advises the Board of Commissioners on land use matters, including the adoption, revision, or repeal of portions of the Washington County Comprehensive Plan. For some plan amendments, the Planning Commission makes the final land use decisions for the County; however, Planning Commission decisions may be appealed to the Board.

The Operations and Maintenance Division of the Department of Land Use and Transportation maintains County roads including culverts, drainage ditches, and vegetation in the right of way. This division also replaces culverts, making sure to size them appropriately to manage flood events. The ongoing maintenance programs at County Parks reduce susceptibility and risk to wildfires and flooding.

Washington County is a member of the Cooperative Public Agencies of Washington County, a 24-member consortium focused on public works equipment sharing and combined training opportunities. Members may request to borrow needed equipment from each other as required, which multiplies and enhances the mitigation capabilities of each group participant.

4.2.2. Staff Capabilities

Washington County has sufficient staffing levels to enforce regulations, staff members are trained on hazards and mitigation actions, and staff coordination on mitigation initiatives is effective.

The Department of Land Use and Transportation includes:

- The County's chief Building Official.
- Planners and engineers with knowledge of land development and land management practices.
- Engineers and other professionals trained in construction practices related to buildings and infrastructure.
- Planners and engineers with an understanding of natural hazards.
- Staff with education or expertise in assessing vulnerability to hazards.
- Surveyors.
- Community planners.
- GIS technicians and coordinators.

Additional County staff who are knowledgeable about natural hazards and support mitigation efforts include those in Emergency Management, Facilities and Parks Services, and the Department of Health and Human Services. The Floodplain Manager is a part of the Department of Land Use and Transportation, Planning and Development Services Division.

4.2.3. Technical Capabilities

The County has many technical resources that have been used to assess or mitigate risk and could be used in future efforts.

Through Everbridge, the County and partner first response agencies can issue emergency alerts to the entire County or to specific, affected neighborhoods. Individuals who sign up will be alerted and receive critical information quickly in situations like severe weather, critical utility outages like boil water notices, missing persons, evacuations, and other public safety situations.

Washington County has extensive GIS capabilities, including multiple staff specializing in GIS analysis and mapmaking, and staff trained in Hazus analysis. Staff maintain GIS data on FEMA floodplains and other flood hazard areas.

Previous grant writing completed by Emergency Management has secured funding for this NHMP update and the seismic retrofit of the Public Services Building and Law Enforcement Center.

4.3. Education and Outreach Assessment

The Technical Committee assessed education and outreach capabilities that could be used to implement mitigation activities and communicate hazard-related information.

Washington County departments that regularly engage in public education and outreach activities include:

- Emergency Management
- Public Health Emergency Preparedness
- Environmental Health
- Department of Aging and Veterans Services
- Parks Services / Park Rangers

- Housing Services
- Land Use and Transportation

Additionally, there are many organizations in the County that focus on mitigation and resilience. These groups could assist in implementing future mitigation activities depending on the identification of potential activities, the ability to build relationships, and finding willing communities to partner with.

- Viva Village is a nonprofit that provides programs and services to assist older community members to connect with one another and live fulfilled lives while remaining in their homes and neighborhoods. The community they serve may have unique vulnerabilities to natural hazards.
- El Centro Cultural provides multigenerational and culturally specific services to improve the health and economic mobility of underserved communities in seven core program areas: K-12 Science, Technology, Engineering, Arts, and Mathematics (STEAM) education, workforce development, small business technical assistance, public engagement, civic advocacy, community health and wellness, transitional housing, and community-wide arts and cultural events. The community they serve may have unique vulnerabilities to natural hazards.
- The Korean American Coalition – Oregon works to foster a strong Korean American community in Oregon by promoting participation in civic, legislative, and community affairs through advocacy, community service, leadership development, and cultural education. The community they serve may have unique vulnerabilities to natural hazards.
- The Immigrant and Refugee Community Organization supports immigrants, refugees, and mainstream community members to become self-sufficient and fosters understanding, compassion, and communication between Oregon's established communities and newest arrivals. The community they serve may have unique vulnerabilities to natural hazards.
- The Muslim Educational Trust works to enrich the public's understanding of Islam and dispel common myths and stereotypes, while serving the Muslim community's educational, social, and spiritual needs. The community they serve may have unique vulnerabilities to natural hazards.
- The Tualatin River Watershed Council works to protect the Tualatin River and its tributaries. Protecting these ecosystems may mitigate flooding by providing natural floodplain storage and may mitigate extreme heat events through shade and cooling provided by tree cover.
- The Wetlands Conservancy works to protect wetlands. Protecting these ecosystems may mitigate flooding by providing natural floodplain storage and may mitigate extreme heat events through shade and cooling provided by tree cover.
- The Tualatin Riverkeepers protects and restores the Tualatin River watershed and builds watershed stewardship through engagement, advocacy, restoration, access, and education. Protecting these ecosystems may mitigate flooding by providing natural floodplain storage and may mitigate extreme heat events through shade and cooling provided by tree cover.
- Treekeepers of Washington County engages with local communities and advocates for the protection of mature trees. Protecting trees may mitigate extreme heat events through shade and cooling provided by tree cover.

Fire departments that serve the County participate in public education initiatives, including TVF&R. TVF&R publishes their *safetymatters* newsletter, which provides public education about reducing fire risks. The County could use this newsletter and a partnership with TVF&R to implement future public outreach mitigation actions if appropriate activities could be identified and the two organizations were willing and able to collaborate.

Jurisdictions and special districts within the County have natural disaster and safety-related school programs, including the two earthquake drills all Beaverton School District students and staff participate in each year. The County could use school-based programs to execute future mitigation activities,

depending on the identification of potential activities, the ability to build relationships, and finding willing communities to partner with.

Two homeowner associations in the unincorporated portion of the County have Firewise Community Certifications. This certification program could be used to assist in implementing future mitigation activities depending on the identification of potential activities, the ability to build relationships, and finding willing communities to partner with.

The Tualatin Watershed Enhancement Collaborative is a group of local governments working in partnership to mitigate flooding and erosion and enhance the health of the Cedar Mill/North Johnson Creek Basin. This public/private partnership initiative could not assist in implementing future mitigation actions, as implementation is the responsibility of member organizations; however, this group could be used as a mitigation collaboration and education opportunity for members.

4.4. Financial Assessment

The County has access to or is eligible for the following funding resources for hazard mitigation initiatives:

- **Capital improvements project funding.** Stormwater management measures, which reduce flooding impacts, are a required component of capital projects.
- **Authority to levy taxes for specific purposes.** Taxes have been used in the past to fund road maintenance and street lighting projects. Taxes could be levied for mitigation actions in the future, subject to legal requirements, including voter approval.
- **Incurrence of debt through general obligation bonds and/or special tax bonds.** Past transportation capital projects have been funded by the incurrence of debt. This funding source could be used for future mitigation projects, subject to legal requirements and County processes such as approval by the County Finance Officer and Board of Commissioners.
- **Federal funding sources,** including the Community Development Block Grant, Homeland Security Grant Program, Hazard Mitigation Assistance Grants, and transportation grants.
- **State funding programs,** although the availability of state monies for mitigation actions are limited.
- **Public or private partnership funding sources.** The County has previously partnered with Clean Water Services, the City of Hillsboro, and Tualatin Valley Water District to more efficiently construct infrastructure associated with road construction. Partnerships could be used as a funding resource for future mitigation actions depending on the mitigation project and the ability to identify partners with mutual interests.

4.5. Capability Expansion and Improvement

Actions that can expand and improve existing authorities, plans, policies, and resources for mitigation include:

- Continuing to update County plans as necessary to ensure they are current and reflect the needs of the community.
- Further development of warning systems and messaging.
- Increasing dedicated grant writing staff.

- Creating and implementing additional public education and outreach offerings and increasing the volume of translated materials.
- Ensuring grant opportunities are capitalized upon to meet goals.

5. Mitigation Strategy

(In compliance with 44 CFR §201.6(c)(3)(i), §201.6(c)(3)(ii), §201.6(c)(3)(iii), §201.6(c)(3)(iv), and §201.6(c)(4)(ii))

The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) and the above identified sections of 44 CFR require that local mitigation plans describe hazard mitigation actions a community will undertake to lessen the danger from hazards of concern and establish a strategy for implementing those actions. As such, all other requirements for a local hazard mitigation plan lead to and support the mitigation strategy.

5.1. Mitigation Goals

The Steering Committee reviewed and evaluated goals from the 2017 Washington County NHMP, 2020 City of Beaverton NHMP, 2011 Cities of Cornelius and Forest Grove NHMPs, and 2020 Oregon NHMP. The goals from each plan were grouped by topic and then synthesized to create the seven goals detailed in Volume I, Section 3. These goals are the basis of this NHMP and summarize what the Steering Committee will accomplish by implementing the plan.

5.2. Plan Incorporation and Integration into Existing Planning Mechanisms

Based on mitigation plan requirement 44 CFR §201.6(c)(4)(ii), the vulnerability and capabilities assessment for the County was carefully reviewed and considered when developing the mitigation actions for this plan. The County's Technical Committee has established a process by which the mitigation strategy, goals, objectives, and actions outlined in this plan will be incorporated into existing local planning strategies.

The committee will coordinate implementation with the responsible parties in the County and with external stakeholders as needed. The primary means for integrating mitigation strategies is through the revision, update, and implementation of current plans and regulations, such as comprehensive plans, capital improvement plans, and land development regulations, as feasible.

The members of the Washington County Technical Committee are charged with ensuring the goals and strategies of new and updated local planning documents for their jurisdictions and special districts are consistent with the goals and actions in the NHMP and will not contribute to increased hazard vulnerability.

5.2.1. Comprehensive Plan

Portions of Washington County's Comprehensive Plan include policies and regulations for development in hazard areas such as floodplains and steep slopes. In 2022, DOGAMI published new information about a variety of Washington County hazards. The information in this multi-hazard report may inform future updates to the County's Comprehensive Plan, including regulations in the Community Development Code.

The County will update regional landslide risk maps using lidar data and collaboration with DOGAMI. This updated information will support the County's work on landslide risk reduction efforts and help determine areas and buildings at risk if landslides were to occur. This information will be used to propose revisions to the County's Comprehensive Plan land use policies as necessary, and additional details about hazard mitigation will be added when applicable.

5.2.2. Public Engagement, Education, and Outreach

Washington County Emergency Management will continue to develop, enhance, and implement equitable education programs aimed at the mitigation of natural hazard impacts and reducing the risk to people and community members, private property owners, public agencies, businesses, and schools. Staff will also identify critical facilities and industries that may be affected by the natural hazards identified in this NHMP and collaborate with these facilities and industries on preparation and mitigation projects and recovery plans.

5.2.3. Day-to-Day Government Functions

County staff will assess and mitigate vulnerabilities on County roads leading into critical infrastructure, such as the Washington County Consolidated Communication Agency (WCCCA) 911 emergency communications tower site on Smoke Ranch Road, and others. Among other considerations, assessment may include limited accessibility for evacuation, integrity of access and susceptibility to landslides, and prerequisite actions to implement improvements.

The County will develop and/or participate in programs that provide advance warning to the public of imminent natural hazard events that could impact Washington County residents, such as National Weather Service's StormReady® program and the United States Geological Survey's ShakeAlert® program.

Emergency Management will develop a partnership strategy to foster natural hazard program coordination and collaboration with public and private utility providers and infrastructure owners in Washington County.

Personnel will continue to implement structural and non-structural retrofit projects of critical and essential facilities. Priority buildings include the Walnut Street Center.

Staff will evaluate County-owned parks and other County-owned properties for landscape and vegetation treatments to effectively address extreme heat islands to provide relief to persons where possible, to consider impacts of drought on landscape plans, and address other hazards as applicable. (e.g., dead/dying mature trees at County parks.)

Over the next five years, retrofit projects will be implemented on bridges identified as high priority on Washington County's bridge assessment list.

5.2.4. Floodplain Management Program and/or National Flood Insurance Program

The County will develop acquisition and management strategies to preserve open space in the floodplain, document property relocation, identify organizations in the County that manage floodplain open space (including inundation zones for dam failure), and consider combining resources into countywide projects.

Staff will partner with DOGAMI and FEMA Risk MAP to enhance data and mapping for floodplain information within the County and identify and map flood-prone areas (including inundation zones for dam failure) outside of designated floodplains.

County personnel will identify and map existing and planned critical public infrastructure and facilities located in special flood hazard areas (including inundation zones for dam failure) and highlight those facilities as a focus for mitigation and preparedness measures.

The County will ensure locations of repetitive and severe repetitive flood loss properties have been accurately registered with FEMA and work with affected property owners to remove, relocate, elevate, or otherwise mitigate non-conforming structures in flood hazard areas (including inundation zones for dam failure).

5.2.5. Emergency Plans That Address Evacuation and Sheltering

County staff will collaborate to support outreach to the public, especially to vulnerable populations, with information and resources to mitigate effects of extreme heat and cold events. Additionally, staff will provide shelter/center location support, coordinate and support efforts to deploy heating, cooling, and air filtration equipment, and increase access and transportation to these sites.

5.2.6. Other Incorporation and Integration Opportunities

County personnel will identify buildings and structures with a high-life hazard that do not meet current seismic life safety standards and would benefit from seismic retrofit projects or identification. Emphasis will be on identifying County-owned and non-County unreinforced masonry buildings, identified shelters, and other pre-seismic code assembly structures.

Staff will map, develop a GIS database, and provide signage for on-site water sources accessible by fire department apparatus and/or aircraft such as hydrants, underground storage tanks, and drafting or dipping sites on all ownerships across the County.

6. Action Items

Washington County's action items in the 2017 Washington County NHMP were determined by the 2017 planning team. The action items from the previous plan and the status of each action are provided in Section 6.1 below. The current status of these actions reflects the progress the County has made in its identified mitigation efforts and fulfills requirement 44 CFR §201.6(d)(3).

Action items for the 2023 NHMP were determined by the County's Technical Committee based on the review of its risk assessment, its existing capabilities, and the status of its previous action items. This comprehensive range of actions includes local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs. A summary of these actions and full action item planning worksheets are provided in Sections 6.2 and 6.3 below. Additional information about how these actions were developed, evaluated, and prioritized is in Volume I, Section 3.

6.1. Status of Washington County Action Items from the 2017 Washington County NHMP

Table 321: Status of Action Items from the 2017 NHMP

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Priority #1	Participate in the Federal Emergency Management Agency (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) discovery, multi-hazard risk assessment, and resilience meeting processes.	Multi-Hazard	The Oregon Department of Geology and Mineral Industries (DOGAMI) completed the Risk MAP and is making it available for the 2023 NHMP.	Completed

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Priority #2	Utilize the final multi-hazard risk report and assessment currently being developed by DOGAMI to update the Washington County hazard analysis.	Multi-Hazard	Incorporated the DOGAMI Tualatin River First Order Approximation Study and lidar-corrected floodplain data into the County's base flood elevation determinations and development of permit review for Approximate Zone A flood hazard areas.	Completed
Priority #3	Utilize the final multi-hazard risk report and assessment currently being developed by DOGAMI to inform an update to the Washington County Comprehensive Plan.	Multi-Hazard	The DOGAMI multi-hazard report will potentially inform updates to the Washington County Comprehensive Plan. A mitigation action item owner will be identified in the 2023 NHMP process.	In progress
Priority #4	Update County risk assessment maps for relevant hazards using available lidar topographic data in collaboration with DOGAMI.	Multi-Hazard		Completed
Priority #5	Over the next five years, implement retrofit projects on at least two bridges identified as high priority on Washington County's bridge assessment list.	Earthquake	The Land Use and Transportation Operations and Maintenance Division continuously maintains and upgrades bridges as identified and is engaged on a project to perform an assessment of remaining inventory to prioritize mitigation and replacement.	Completed
Priority #6	Expand and complete a seismic safety inventory of public buildings (particularly critical and essential facilities) that may be vulnerable to natural hazards (particularly earthquake).	Earthquake	This action item will be continued in the 2023 NHMP.	Retain
Priority #7	Continue to implement structural and non-structural retrofit projects of critical and essential County facilities. Priority buildings include the Law Enforcement Center and the Walnut Street Center.	Earthquake	Retrofit of Public Service Building and Law Enforcement Center completed. Washington County Facilities is planning to complete earthquake mitigation work in the future. This action item will move forward into the 2023 NHMP.	Retain

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Priority #8	Ensure that the locations of repetitive and severe repetitive flood loss properties have been accurately registered with FEMA, and work with affected property owners to remove, relocate, elevate, or otherwise mitigate non-conforming structures in flood hazard areas.	Flood	This action item will be continued in the 2023 NHMP.	Retain
Priority #8	Update the Washington County Community Wildfire Protection Plan (CWPP). Implement actions identified in the CWPP.	Wildfire	The wildland fire hazard risk and mitigation actions will be continued in the 2023 NHMP.	Retain
Action Item Pool #1	Develop public and private partnerships to foster natural hazard program coordination and collaboration in Washington County.	Multi-Hazard	Will reassess and rescope in 2023 review.	Retain
Action Item Pool #2	Develop, enhance, and implement education programs aimed at mitigating natural hazards and reducing the risk to citizens and private property owners, public agencies, businesses, and schools.	Multi-Hazard	No owner identified; goals and objectives unclear. Will reassess and rescope in 2023 review.	Retain
Action Item Pool #3	Enhance and maintain a geographic information system (GIS) inventory of all critical facilities, large employers, public assembly areas, lifelines, and mitigation successes.	Multi-Hazard	No owner was identified to compile the data. Will reassess and rescope in 2023 review.	Retain
Action Item Pool #4	Develop a drought impact assessment for Washington County.	Drought	The County faces drought conditions in 2023 that need to be researched and addressed. This mitigation will be reevaluated during the 2023 NHMP review and update process.	Retain

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Action Item Pool #5	Continue groundwater recharge (aquifer storage recovery) feasibility assessments, including preliminary cost-benefit analysis where applicable.	Drought	The County faces drought conditions that need to be researched and addressed. This mitigation will be reevaluated during the 2023 NHMP review and update process.	Retain
Action Item Pool #6	Complete storage, discharge, and recharge-curve analyses for the Hagg Lake Reservoir specific to El Niño-Southern Oscillation, climate change, or other seasonal variations.	Drought	Relevancy to be determined. This mitigation will be reevaluated during the 2023 NHMP review and update process.	Retain
Action Item Pool #7	Identify critical public infrastructure and facilities located in special flood hazard areas and highlight those facilities as a focus for mitigation and preparedness measures.	Flood	Determined that this will be addressed in the 2023 update project as a deliverable in the NHMP.	Retain
Action Item Pool #8	Develop acquisition and management strategies to preserve open space in the floodplain. Document property relocation. Identify organizations in the County that manage floodplain open space. Could consider combining resources into countywide projects.	Flood	Project in constant process. No specific projects or accomplishments to report for this period. There are ongoing efforts with various County projects aiding in the preservation and management of the floodplain.	Completed and continuous
Action Item Pool #9	Develop strategies and partnerships, including Clean Water Services flood restoration plans, to enhance the use of open space within the floodplain for flood mitigation, fish habitat, and water quality issues.	Flood	Relevancy to be determined. This mitigation will be reevaluated during the 2023 NHMP review and update process.	Retain
Action Item Pool #10	Partner with DOGAMI and FEMA Risk MAP to enhance data and mapping for floodplain information within the County and identify and map flood-prone areas outside of designated floodplains.	Flood	This mitigation will be reevaluated during the 2023 NHMP review and update process.	Retain

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Action Item Pool #11	Flood inundation mapping tied to current stream gauge data.	Flood	This mitigation will be reevaluated during the 2023 NHMP review and update process.	Retain
Action Item Pool #12	Coordinate with the National Weather Service to add additional forecast points to the Advanced Hydrologic Prediction Service system in the Tualatin River near Tualatin and model the Gales Creek Basin.	Flood	This mitigation action will be reevaluated during the 2023 NHMP review and update process.	Retain
Action Item Pool #13	Coordinate with the Oregon Department of Land Conservation and Development and DOGAMI to model the 25-year flood hazard area.	Flood	The County can provide flow data for the 25-year model on a project-by-project basis.	Completed
Action Item Pool #14	Update regional landslide risk maps, using available lidar data, and collaborate with DOGAMI to work on landslide risk reduction efforts; determine areas and buildings at risk to landslides and propose Comprehensive Plan land use policies accordingly.	Landslide	Delivery of Risk MAP was delayed due to technical problems at DOGAMI. Projected to be available for the 2023 NHMP project. It will be carried into the 2023 NHMP review to make appropriate updates and completion.	Retain
Action Item Pool #15	Stabilize Scoggins Valley Road, which exists on an active slide.	Landslide	Final engineering was performed during this period and the project will be ready to bid soon. Repairs were delayed until funds were available. Project is still relevant and is moving forward.	In progress
Action Item Pool #16	Assess road access vulnerability to the Washington County Consolidated Communication Agency 911 repeater site.	Landslide	New mitigation action was developed for 2023 NHMP.	In progress
Action Item Pool #17	Enhance hazard-resistant construction methods where possible to reduce damage to utilities, community water systems, and critical facilities.	Severe Weather**	No owner was identified.	No longer relevant

Action Item Number*	Action Item Description	Hazard(s) Addressed	Implementation Update	Current Status
Action Item Pool #18	Identify critical facilities and industries that may be affected by ashfalls and collaborate with them on ashfall emergency response.	Volcanic Eruption**	This mitigation will be reevaluated during the 2023 NHMP review and update process.	Retain

*Number given to action item in 2017 Washington County NHMP
**Not a hazard in the 2023 Washington County NHMP

6.2. Washington County Action Items: 2023 Washington County NHMP

Table 322: Washington County Action Items

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
1	Participate in programs that provide advance warning to the public of imminent natural hazard events that will impact the people of Washington County, such as the National Weather Service StormReady and U.S. Geological Survey ShakeAlert.	Dam failure, earthquake, extreme heat, flooding, volcanic ash, windstorm, including tornado, and winter storm	High
2	Develop acquisition and management strategies to preserve open space in the floodplain; document property relocation; identify organizations in the County that manage floodplain open space (including inundation zones for dam failure); and consider combining resources into countywide projects.	Dam failure and flooding	High
3	Partner with Oregon Department of Geology and Mineral Industries (DOGAMI) and the Federal Emergency Management Agency (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) to enhance data and mapping of the floodplain within the County and identify and map flood-prone areas (including inundation zones for dam failure) outside of designated floodplains.	Dam failure and flooding	High

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
4	Identify and map existing and planned critical public infrastructure and facilities located in special flood hazard areas (including inundation zone for dam failure) and focus mitigation and preparedness measures on those facilities. This includes public power, gas, roads and transportation, water, and communications infrastructure and facilities.	Dam failure and flooding	Medium
5	Fund a study to assess, with regular review and update, vulnerabilities in the solid waste system to various natural hazards.	Dam failure, earthquake, flooding, volcanic ash, wildland fire, windstorm, including tornado, and winter storm	Medium
6	Ensure locations of repetitive and severe repetitive flood loss properties have been accurately registered with FEMA, and work with affected property owners to remove, relocate, elevate, or otherwise mitigate non-conforming structures in flood hazard areas (including inundation zones from dam failure).	Dam failure and flooding	Medium
7	Evaluate County-owned parks and other County-owned properties for landscape and vegetation treatments that will effectively address extreme heat islands and provide relief to users where possible; consider impacts of drought on landscape plans and address other hazards as applicable (e.g., dead/dying mature trees at County parks).	Drought, extreme heat, and windstorm, including tornado	High
8	Continue to implement structural and non-structural retrofit projects of critical and essential County facilities. The Walnut Street Center is a priority building; additional buildings will be identified.	Earthquake	High
9	Complete a survey of County-owned bridges to determine which are seismically vulnerable and would benefit from retrofit projects; implement retrofit projects on bridges identified as high-priority as funds and time allow.	Earthquake	High

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
10	Develop an inventory and map of publicly owned buildings (schools, local government, emergency services, etc.), shelter buildings, and commercial buildings that may be particularly vulnerable to earthquake damage, including pre-1940s buildings, building with cripple wall foundations, and unreinforced masonry construction. Share with owners and assist with identifying potential projects and funding sources.	Earthquake	High
11	Assess and mitigate vulnerabilities of County roads leading to critical infrastructure, such as the Washington County Consolidated Communication Agency 911 emergency communications tower site on Buxton Lookout Road. Among other considerations, assessment can include accessibility for evacuation, integrity of access, landslide susceptibility, and prerequisite actions to implement improvements.	Earthquake, flooding, wildland fire, windstorm, including tornado, and winter storm	Medium
12	Coordinate outreach to the public, especially to vulnerable populations, with information and resources to mitigate effects of extreme heat, extreme cold, and hazardous air quality events. Coordinate support to cooling and severe winter weather shelters and centers and clean air spaces and coordinate access and transportation to these sites. Coordinate and support efforts to deploy heating, cooling, and air filtration equipment.	Extreme heat and winter storm	Medium
13	Utilize the 2022 multi-hazard risk report and assessment developed by DOGAMI to potentially inform updates to Washington County's Comprehensive Plan.	Earthquake, flooding, landslide, and wildland fire	High
14	Update regional landslide risk maps, using available lidar data, and collaborate with the DOGAMI to work on landslide risk reduction efforts; determine areas and buildings at risk to landslides; and propose revisions to the County's Comprehensive Plan and land use policies as necessary to reduce risks.	Landslide	High

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
15	Identify critical facilities and industries that may be affected by ashfall and collaborate with them on ashfall damage mitigation projects, recovery plans, and preparation projects. Include ashfall in list of hazards in public awareness and outreach materials.	Volcanic ash	Medium
16	Utilize the Broadband User Group Support for Emergency Planning, Response, and Recovery (BUG SEPRR) project to develop a GIS database of water sources in rural and wildland urban interface areas that are available for fire suppression and accessible by fire agency apparatus or aircraft, such as storage tanks and drafting or dipping sites. Sites may be publicly or privately owned. Provide data to fire service GIS providers.	Wildland fire	Low
17	Support the effort by the Oregon Department of Forestry to update the 2007 Washington County Community Wildfire Protection Plan with information and tasks within the County's authority.	Wildland fire	Low
18	Develop a partnership strategy for Washington County Emergency Management to foster natural hazard program coordination and collaboration with infrastructure owners, including public and private utility providers in Washington County.	All hazards	High
19	Develop, enhance, and implement equitable programs aimed at educating the public about mitigation of natural hazard impacts and reducing the risk to community members, private property owners, public agencies, businesses, and schools.	All hazards	High
20	Develop partnership strategy for Washington County Emergency Management to foster natural hazard program coordination and collaboration with public and private utility providers and infrastructure owners in Washington County.	All hazards	High

Action Item Number	Action Item Description	Hazard(s) Addressed	Priority
21	Provide support to develop a countywide project to coordinate GIS resources, giving the ability to all local participants to upload current and changing information regarding structures, critical facilities, water sites for fire use, vulnerable populations exposed to the elements, and support future reviews of this plan and mitigation actions.	All hazards	Medium

6.3. 2023 Mitigation Action Information Worksheets

Table 323: Advance Warning System Programs

Mitigation Action Information			
Title of action	Advance Warning System Programs (New 2023)		
Type of action	Plans/regulations ☒		Natural systems protection ☐
	Structure and infrastructure project ☐		Public education/awareness ☒
Action description	Participate in programs that provide advance warning to the public of imminent natural hazard events that will impact the people of Washington County, such as the National Weather Service's StormReady Program, USGS' ShakeAlert, and others.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☐	Landslide ☐	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	By participating in advance warning programs this action will help in identifying additional mitigation opportunities prior to the event occurring as well as providing early warning for responses.		
Area of action impact	Washington County at-large		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☒	
Integration into other initiatives	NWS early warning programs USGS early warning programs		
Alignment with existing plans and policies	WC EOC EOPs for earthquake, extreme heat/cooling shelter, and flood response		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Emergency Management		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
WC Department of Land Use and Transportation, WC Department of Health & Human Services	Regional Disaster Preparedness Organization, FEMA, WC Emergency Management Cooperative
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General budget	Not Applicable
Estimated Cost	$5,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Incorporates program elements into preparedness and response plans.	Supports public warning and alerting programs countywide.	$30,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	June 2023	December 2028

Implementation Benchmarks: How Will Success Be Measured?

- Continually monitor sources for advance warning programs and identify those with potential for implementation
- Maintain list of programs identified and indicate whether applicable or not
- Identify requirements of desired program (costs to participate, cost to implement, renewal requirements, ongoing engagement, etc.)
- Obtain County leadership buy-in and authorization
- Initiate application process to participate in desired program
- Implement desired program and incorporate into normal operations, plans and procedures
- Integrate into Everbridge EAS

Potential Challenges to Implementation

- Is the desired program applicable and beneficial?
- Is participation sustainable (interest, staffing, financially)?
- Integration into Everbridge EAS

Resources and References, if Applicable

- To be determined

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Identify and enroll in programs as applicable	$5,000	Participate in wide range of programs, incorporate into plans and procedures
Alternative #2	Identify and enroll in up to three programs	$5,000	Participate in specific programs, incorporate into plans and procedures
Alternative #3	Do not enroll in any programs	$0	Participate in no programs

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 324: Floodplain Management Strategy

Mitigation Action Information			
Title of action	Floodplain Management Strategy (2017 Pool 8)		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☐	Natural systems protection ☒ Public education/awareness ☐	
Action description	Develop acquisition and management strategies to preserve open space in the floodplain; document property relocation; identify organizations in the County that manage floodplain open space (including inundation zones for dam failure); consider combining resources into countywide projects.		
Hazard(s) addressed	Dam failure ☒ Drought ☐ Earthquake ☐ Extreme heat ☐	Flood ☒ Landslide ☐ Volcanic ash ☐ Wildland fire ☐	Windstorm, incl. tornado ☐ Winter storm ☐
How does the action address identified current or future risks and vulnerabilities?	Continues to develop a countywide strategy for reducing loss due to flooding from the Tualatin River and tributaries that traverses through many partner jurisdictions to coordinate mitigation efforts.		
Area of action impact	Flood inundation zones for the Tualatin River, Dairy Creek, Scoggins Creek, Beaverton Creek, Fanno Creek, and other lesser tributaries.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? To be determined along the waterways and inundation zones.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☒	Goal 4 ☒ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	FIRM		
Alignment with existing plans and policies	Washington County Urban Comprehensive Plan Framework Washington County Rural Comprehensive Plan Framework		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	LUT, PDS, Floodplain Manager		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Washington County Board of Commissioners LUT Director's Office LUT Planning and Development Services Division	Metro, Clean Water Services, Tualatin Hills Parks and Recreation District, Tualatin Soil and Water Conservation District, cities, others as identified
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Washington County General Fund Other jurisdiction general funds	FMA Grants
Estimated Cost	$50,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Builds a coordinated plan and program for mitigating impacts of flooding along known RL/SRL areas		$300,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2023	December 2028

Implementation Benchmarks: How Will Success Be Measured?

- Commitment in staff time and money to support development of the strategy.
- Identifying all stakeholders in the affected areas
- Drafting strategic plan

Potential Challenges to Implementation

- Available staff time and funding
- Identification and participation from stakeholders

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: F-2 Form Partnerships to Support Floodplain Management

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Fully fund staff to develop strategic plan	$20,000	A comprehensive plan is developed and adopted
Alternative #2	Hire contractor to manage project	$50,000	A comprehensive plan is developed and adopted
Alternative #3	Partially fund staff and add to workplan	$10,000	Incremental progress is made over 5 years
Implementation Progress Report for Plan Maintenance			
Date			
What progress in implementation has been made to date?			
What challenges in implementation have been experienced?			
What are the next steps in implementation?			

Table 325: Floodplain Map Update

Mitigation Action Information	
Title of action	Floodplain Map Update (2017 Pool 10)
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Partner with DOGAMI and FEMA Risk MAP to enhance data and mapping of the floodplain within the County and identify and map flood-prone areas (including inundation zones for dam failure) outside of designated floodplains.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Provides the most current information regarding known and unknown flood inundation zones, incorporates updated channel migration changes and projections. Will help to identify at-risk structures and infrastructure to evaluate mitigation actions such as buy-outs, raises, and relocations.
Area of action impact	At-risk inundation zones along rivers and creeks.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? To be identified with the project.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☐ Goal 4 ☒ Goal 7 ☐ Goal 2 ☒ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	FIRM
Alignment with existing plans and policies	WC Emergency Management Cooperative Support of Emergency Planning, Response and Recovery Project
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	LUT, PDS, Floodplain Manager

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
LUT GIS Staff	WC Emergency Management Cooperative, Oregon Department of Agriculture, Mining and Industries
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	FMA and BRIC Grants
Estimated Cost	$10,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Updates County data with the most current survey information to help with planning and other actions.	Influences building permit rule development and changes if new information is learned.	$60,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	January 2024	December 2024

Implementation Benchmarks: How Will Success Be Measured?

- New data is gathered, evaluated, and changes to any applicable County maps are made.
- Existing rules and regulations evaluated against new information and applicable updates adopted.
- New mitigation options are evaluated and proposed, accepted actions are initiated.

Potential Challenges to Implementation

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: F-5 Improve Stormwater Management Planning, F-7 Improve Flood Risk Assessment, F-22 Increase Awareness of Flood Risk and Safety
- DOGAMI 2022 Surveys

Three Alternatives Considered, Including No Action

	Action Description	Estimated Cost	Evaluation
Alternative #1	Update floodplain map with most current data	$10,000	Map updated; existing programs evaluated for changes
Alternative #2	No action	$1,000	N/A
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 326: Public Infrastructure Flood Risk Assessment

Mitigation Action Information			
Title of action	Public Infrastructure Flood Risk Assessment (2017 Pool 7)		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☒	Public education/awareness ☐	
Action description	Identify and map existing and planned critical public infrastructure and facilities* located in special flood hazard areas (including inundation zone for dam failure) and focus mitigation and preparedness measures on those facilities. *Power, gas, roads and transportation, water, communications		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Identifies at-risk infrastructure and begins the process of developing additional mitigation actions such as relocating, hardening, and raising.		
Area of action impact	Critical infrastructures at risk of flooding.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? To be determined with the project.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☒	
Integration into other initiatives	FIRM		
Alignment with existing plans and policies	WC Urban and Rural Comprehensive Plan Frameworks		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
LUT PDS, LUT O&M, WCEM	EMC's SEPRR Project, DOGAMI, FEMA, CWS, TVWD, TVID, TSWCD, ODOT, PGE, FGPL, WOE, Verizon, Century Link, others

Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund	FMA
Estimated Cost	$10,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
To identify critical infrastructure at risk of being flooded to then evaluate mitigation projects.		$60,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	January 2024	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Obtain most updated information on critical infrastructures in relation to flood inundation zones.
- Notify infrastructure owners and assist with finding funding opportunities for mitigation projects.

Potential Challenges to Implementation

Resources and References, if Applicable

- FEMA Mitigation Ideas Document: F-7 Improve Flood Risk Assessment, F-9 Manage the Floodplain Beyond Minimum Requirements

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Complete data gathering and communications with owners; identify funding sources	$10,000	A complete update of information and communications.
Alternative #2	No action	$1,000	N/A
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 327: Assess Natural Hazard Risk and Vulnerabilities to the Solid Waste System

Mitigation Action Information	
Title of action	Assess Natural Hazard Risk and Vulnerabilities to the Solid Waste System
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☒
Action description	Fund a study to assess, with regular review and update, vulnerabilities in the solid waste system to various natural hazards.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☒ Drought ☐ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	The assessment identifies vulnerabilities, allowing cities, the County, and Metro Regional Government to plan resilience investments in the system at collection, transfer and disposal levels. It allows periodic, regular review and updates to the assessment.
Area of action impact	Washington County and greater Metro region
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Forest Grove Transfer Station, Pride Transfer station, Hillsboro Garbage Disposal re-load facility, Hillsboro landfill, numerous equipment storage facilities, including truck 'barns'
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	This work should be included to reflect planned regional action to identify and reduce vulnerabilities in the system. It is currently absent from the NHMP
Alignment with existing plans and policies	Metro 2030 Regional Waste Plan, Goals 17, 18 and 19, in particular action 18.6. ORS 459.017(1)(b) declares that "local government unis have the primary responsibility for solid waste management."
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Washington County Department of Health and Human Services Solid Waste & Recycling division

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Emergency Management, Land Use and Transportation, Health and Human Services	Metro Regional Government, Washington County Cities, contracted solid waste collection companies and operators of solid waste facilities
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Metro Regional Government, local government franchise fee revenue, State materials management grants	BRIC and FMA FEMA grants
Estimated Cost	$125,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s)**
Identify and remove vulnerabilities.	Support regional resilience planning to maintain a functioning solid waste management system in the face of natural hazards.	More efficient response to event(s).

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	July 1, 2024	June 30, 2025

Implementation Benchmarks: How Will Success Be Measured?

- Development of a complete vulnerability assessment that identifies areas needed for improvement and responsible parties.

Potential Challenges to Implementation

- Regional coordination, alignment with other planning efforts at Metro and RDPO, staff bandwidth

Resources and References, if Applicable

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Rely on Metro/RDPO	$1,000	Less influence to ensure it's completed.
Alternative #2	No action	$1,000	Vulnerabilities remain
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 328: Repetitive and Severe Repetitive Loss Property Registration

Mitigation Action Information	
Title of action	Repetitive and Severe Repetitive Loss Property Registration (2017 Priority 8)
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Ensure the locations of repetitive and severe repetitive flood loss properties have been accurately registered with FEMA and work with affected property owners to remove, relocate, elevate, or otherwise mitigate non-conforming structures in flood hazard areas (including inundation zones from dam failure).
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	To be considered for mitigation opportunities, structures must be identified as having been significantly affected by past flood events. Developing an accurate list of these structures assists local government develop mitigation strategies with a higher chance of success in order to gain efficiencies and reduce unsuccessful efforts.
Area of action impact	Structures experiencing repetitive losses from flood events.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Applicable structures as identified.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☒ Goal 5 ☒ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	FMA, FIRM, and SL/RSL initiatives
Alignment with existing plans and policies	WC Comprehensive Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	LUT, PDS, Floodplain Manager

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
WC Facilities and Parks, WC Emergency Management	Public agencies and private property owners, DOGAMI, FEMA
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund	FEMA FMA Grant
Estimated Cost	$10,000–$50,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Identification of eligible properties helps identify applicable mitigations.	Identifying at-risk properties can support emergency response and evacuation plans. It can also make property owners aware of risk so they can take their mitigation actions (insurance).	$60,000–$300,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2023	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Over the course of five years, identifying and registering with FEMA 100% of RL/SRL properties.
- Mitigating in some way, over 20% of RL/SRL properties registered (insurance, relocation, elevation, buy-out, or other mitigation).

Potential Challenges to Implementation

- Political support to implement RL/SRL mitigation actions.
- Obtaining property owner buy-in to implement mitigation actions.
- Dedicating internal funding for staff and assigning staff time to accomplish.

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: F-7 Improve Flood Risk Assessment, F-8 Join or Improve Compliance with NFIP, F-9 Manage the Floodplain Beyond Minimum Requirements, F-22 Increase Awareness of Flood Risk and Safety, F-23 Educate Property Owners about Flood Mitigation Techniques

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Assign staff to accomplish MAI	$10,000	Fully identify and register properties, mitigate over 20%
Alternative #2	Assign staff to complete study and registration	$5,000	Fully identify and register properties
Alternative #3	Hire contractor to complete MAI	$50,000	Contractor completes MAI

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 329: Vegetation Treatments for Mitigation

Mitigation Action Information			
Title of action	Vegetation Treatments for Mitigation (New 2023)		
Type of action	Plans/regulations ☐	Natural systems protection ☒	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Evaluate County-owned parks and other County-owned properties for landscape and vegetation treatments that will effectively address extreme heat islands and provide relief to users where possible; consider impacts of drought on landscape plans and address other hazards as applicable (e.g., dead/dying mature trees at County parks).		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☒	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Since the 2017 NHMP, several mature trees have died at some County-owned parks. These trees are integral to providing shade (relief) to persons and animals who go to the parks. Ensuring the continuation of landscape planning will help mitigate the loss of and plan for replacement of such landscape to help support extreme heat response plans.		
Area of action impact	Parks and other properties owned and operated by Washington County, Oregon, Facilities and Parks Division		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Local, State, and Federal initiatives to be identified		
Alignment with existing plans and policies	WC Environmental Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Facilities & Parks Division		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
WC Facilities and Parks, WC Real Property Manager	Clean Water Services, partner cities, Tualatin Hills Parks and Recreation District
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
WC general budget	BRIC Grant
Estimated Cost	$10,000–$1,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
To address climate change effects of increasing heat, drought, and other impacts	Improves relationships with public to increase natural vegetation use in parks, potential cost savings on energy, potentially reduce heat islands	$60,000–$6,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2023	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Evaluation of damaged vegetation at parks and County buildings.
- Identify vegetation replacement and/or improvement projects.
- Document cost savings (energy, water conservation, etc.).

Potential Challenges to Implementation

- Prioritizing study and projects
- Funding projects

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: ET-1 Reduce Urban Heat Island Effect, D-3 Monitor Water Supply, D-4 Plan for Drought, D-7 Retrofit Water Supply Systems, D-8 Enhance Landscaping and Design Measures

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Complete evaluation of risk and needs, develop mitigation plan to resolve risks, implement mitigations on at least 20% of identified needs.	$1,000,000	Completion of objectives
Alternative #2	Completion evaluation of risks, complete mitigation on case-by-case basis of at least 50% of identified needs.	$500,000	Completion of objectives
Alternative #3	Address needs as they are identified.	$10,000	Completion of objectives

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 330: Seismic Retrofit of County Buildings

Mitigation Action Information			
Title of action	Seismic Retrofit of County Buildings (2017 Priority 7)		
Type of action	Plans/regulations ☐		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☐
Action description	Continue to implement structural and non-structural retrofit projects of critical and essential facilities. The Walnut Street Center is a priority building; additional buildings will be identified.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☒	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	The Walnut Street Center houses critical County services for the Road Operations & Maintenance Division, Fleet Services, and other divisions essential to recovery of County transportation systems after an earthquake and must be seismically retrofitted to be recovered. Other County structures housing staff and other services will be identified.		
Area of action impact	Any County building needing seismic retrofitting mitigations.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Walnut Street Center		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	FEMA		
Alignment with existing plans and policies	WC Facilities maintenance plans.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Facilities and Parks		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Emergency Management, various affected divisions	None
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund	BRIC Grant
Estimated Cost	$2,000,000–$10,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Upgrading buildings to life safety and protection minimum codes, increasing ability for post-quake recover and reconstitution		$12,000,000–$60,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2023	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Walnut Street Center seismic retrofit plan is completed.
- Full assessment of County structures completed to identify additional seismic retrofit projects.

Potential Challenges to Implementation

- Funding sources for retrofit and needs assessment.
- Prioritizing retrofit of Walnut Street Center compared to other priorities.

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: EQ-5 Protect Critical Facilities and Infrastructure, EQ-6 Implement Structural Mitigation Techniques

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Successful seismic retrofit of Walnut Street Center and complete evaluation of additional County structures	$2,005,000	Successful completion of retrofit and needs assessment of all other County structures
Alternative #2	Seismic retrofit of Walnut Street Center	$2,000,000	Successful retrofit of Walnut Street center
Alternative #3	Complete evaluation of seismic retrofit needs on all County structures	$5,000	Completion of needs assessment

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 331: Seismically Vulnerable Bridge Mitigation

Mitigation Action Information	
Title of action	Seismically Vulnerable Bridge Mitigation (2017 Priority 5)
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☒ Public education/awareness ☐
Action description	Complete a survey of County-owned bridges to determine which are seismically vulnerable and would benefit from retrofit projects; implement retrofit projects on bridges identified as high-priority resulting from the survey as funds and time allows.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Bridges in Washington County are vitally important to maintaining access using Emergency Transportation Routes, keeping emergency and essential service accessibility for the public, and keeping commerce flowing after an earthquake for response and recovery activities.
Area of action impact	Multiple bridges on emergency and non-emergency transportation routes.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Several seismically vulnerable bridges
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☒ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	
Alignment with existing plans and policies	WC LUT O&M Bridge Maintenance and Replacement Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	LUT Operations Division, Principal Engineer

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
LUT's Capital Project Services	Oregon Department of Transportation; other road-system owners (cities)
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
County Road Fund; State Road Fund	FEMA Building Resilient Communities and Infrastructure Grant; FHWA Grant Program
Estimated Cost	$50,000–$100,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Identification of all seismically vulnerable bridges, begin retrofits on most essential (emergency transportation routes)	Upgrades bridge infrastructure to maintain road transportation routes for response and recovery after an earthquake.	$300,000–$600,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☐ Ongoing ☒	January 2023	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Completion of bridge assessment study, identifying and prioritizing bridges needing seismic retrofit projects
- Identifying funding sources to make seismic retrofits
- Contracting to seismically retrofit bridges

Potential Challenges to Implementation

- Establishing a constant funding source to complete entirety of seismic retrofit needs

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: EQ-5 Protect Critical Facilities and Infrastructure, EQ-6 Implement Structural Mitigation Techniques

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Complete study, prioritize projects, fund projects, complete retrofit projects	$100,000,000	Completion of study, prioritization, funding, and more than 20% of retrofits within five years
Alternative #2	Complete study, prioritize projects, fund projects, complete retrofit projects	$75,000,000	Completion of study, prioritization, funding, and more than 10% of retrofits within five years
Alternative #3	Complete study, prioritize projects, fund projects complete retrofit projects	$50,000,000	Completion of study, prioritization, funding, and more than 5% of retrofits within five years

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 332: Inventory of Public Buildings Susceptible to Damage by Earthquake

Mitigation Action Information	
Title of action	Inventory of Public Buildings Susceptible to Damage by Earthquake (2017 Priority 6)
Type of action	Plans/regulations ☐ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Develop an inventory and map of publicly owned buildings (schools, local government, emergency services, etc.), shelter buildings, and commercial buildings that may be particularly vulnerable to earthquake damage, including pre-1940s buildings, building with cripple wall foundations, and unreinforced masonry construction. Share with owners and assist with identifying potential projects and funding sources.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Identifying buildings and structures with a high-life hazard that do not meet current seismic life safety standards that would benefit from seismic retrofit projects or identification, particularly unreinforced masonry (URM) buildings, identified shelters and other pre-seismic code assembly structures. County owned and non-County structures in both public and private sectors.
Area of action impact	All of Washington County
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? To be identified with project.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☒ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	
Alignment with existing plans and policies	WC EOP for shelters.
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Emergency Management

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
LUT-PDS/GIS, Facilities and Park Services, Assessment & Taxation	USGS, DOGAMI
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General budget	BRIC
Estimated Cost	$10,000–$100,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Identifying specific buildings to address and mitigate for life safety needs.	Adding shelters and commercial buildings to this MAI expands our knowledge and awareness of hazards when identifying shelters and buildings important to recovery.	$60,000–$600,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2023	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Successful engagement by partners in the Emergency Management Cooperative's Support for Emergency Planning, Response, and Recovery (SEPRR) Project.
- Successful contact made to owners to have discussions about mitigation needs, projects, and potential funding sources.

Potential Challenges to Implementation

- Funding for the SEPRR Project.
- Staff time to work on and develop project.
- Available information sources and studies.

Resources and References, if Applicable

- FEMA Mitigation Ideas Resource Publication: EQ-3 Map and Assess Community Vulnerability to Seismic Hazards

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Perform complete inventory and make contact with owners, identify potential needs and funding sources	$10,000	All four steps completed for 75% of identified structures
Alternative #2	Complete inventory and make results available to owners	$5,000	Both steps completed for unincorporated Washington County
Alternative #3	Hire consultant to perform all tasks	$100,000	Contractor hired to complete project.

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 333: County Road Access to Critical Infrastructure

Mitigation Action Information			
Title of action	County Road Access to Critical Infrastructure (2017 Pool 15)		
Type of action	Plans/regulations ☒ Structure and infrastructure project ☒	Natural systems protection ☐ Public education/awareness ☐	
Action description	Assess and mitigate vulnerabilities of County roads leading to critical infrastructure, such as the WCCCA 911 emergency communications tower site on Buxton Lookout Road. Among other considerations, assessment can include accessibility for evacuation, integrity of access, landslide susceptibility, and prerequisite actions to implement improvements.		
Hazard(s) addressed	Dam failure ☐ Drought ☐ Earthquake ☒ Extreme heat ☐	Flood ☒ Landslide ☒ Volcanic ash ☐ Wildland fire ☒	Windstorm, incl. tornado ☒ Winter storm ☒
How does the action address identified current or future risks and vulnerabilities?	Access to critical infrastructure during and after a natural hazard is essential to speed recovery and being more resilient. By ensuring critical infrastructure will have at least one point of access that can withstand various natural hazards, the risk of losing accessibility to critical infrastructure will be reduced.		
Area of action impact	Where critical infrastructure is accessed by a county road, e.g., communications towers, water supply sources, sewer system pump stations, power utility sites, etc.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Communications tower for 9-1-1 system, and TBD.		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒ Goal 2 ☒ Goal 3 ☐	Goal 4 ☐ Goal 5 ☐ Goal 6 ☐	Goal 7 ☐
Integration into other initiatives	Oregon's Resilience Plan		
Alignment with existing plans and policies	Seismic retrofit of bridges is an important part of this action since bridges may be a risk factor against access. A functioning transportation system is a key part of our existing plans and policies.		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	LUT Operations and Maintenance Division		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
LUT's Capital Project Services, and Planning and Development Services Divisions, WC Emergency Management	Washington County Consolidated Communications Agency (WCCCA); public and private utility providers as applicable.
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
County Road Fund (gas tax, registration fees)	Federal Lands Access Program, BLM BRIC Grant, FEMA
Estimated Cost	$300,000 to $100,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Access to critical infrastructure will be vital to resiliency and recovery.	If access to critical infrastructure is ensured, access to non-critical but important infrastructure may all be improved.	$1,800,000–$600,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☐ Ongoing ☒	01/1/2023	Ongoing

Implementation Benchmarks: How Will Success Be Measured?

- Identify impediments and significant hazards to accessing critical infrastructure from County-owned road systems.
- Develop a plan for mitigation and a funding strategy for any identified projects.
- Mitigation of any access problems on County-owned roads leading to critical infrastructure.

Potential Challenges to Implementation

- Funds may not be available to make all road more resilient.
- Critical infrastructure has been mapped but may be outdated.
- Making this work a priority over ongoing work.
- Review critical infrastructure and routes that access them.
- Restrictive land use regulations that may need to have an exemption or changes to the Comprehensive Plan to allow significant changes to road.

Resources and References, if Applicable

- To be identified as projects develop.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Upgrade bridges only	$50,000,000	All critical infrastructure has been evaluated for access needs and deficiencies.
Alternative #2	Upgrade all portions of roadway	$100,000,000	All critical infrastructure has been evaluated for access needs and deficiencies.
Alternative #3	No action	$5,000	N/A

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 334: Extreme Heat and Cold and Hazardous Air Quality Population Protection Program

Mitigation Action Information	
Title of action	Extreme Heat and Cold and Hazardous Air Quality Population Protection Program (New 2023)
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Coordinate outreach to the public, especially to vulnerable populations, with information and resources to mitigate effects of extreme heat, extreme cold, and hazardous air quality events. Coordinate support to extreme heat and cold shelters and centers and clean air spaces and coordinate access and transportation to these sites. Purchase and deploy heating, cooling, and air filtration equipment.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☒ Earthquake ☐ Volcanic ash ☐ Extreme heat ☒ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	This action prepares the County to intervene in life threating heat and cold conditions for vulnerable persons in a variety of ways, including enrolling and supporting more cooling centers and warming shelters, providing equipment for home-bound persons, and other actions.
Area of action impact	All of Washington County.
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☐ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☐ Goal 3 ☒ Goal 6 ☒
Integration into other initiatives	Oregon Senate Bill 762, Section 14: https://olis.oregonlegislature.gov/liz/2021R1/Downloads/MeasureDocument/SB762/Enrolled
Alignment with existing plans and policies	WC Emergency Operations Plans for Extreme Heat and Cold Weather Responses
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☒ High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
WC Health and Human Services Department, WC Housing Services	Cities in Washington County, Oregon Health Authority
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund, Oregon Health Authority (see SB762 S.14)	To be determined.
Estimated Cost	$10,000–$50,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Supports protecting vulnerable persons with providing cooling centers and equipment, and warming shelter needs.	Opens lines of communication with individual members of the public, volunteer and religious support centers, and others to utilize in other disaster needs.	$60,000–$300,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2023	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Develop strategic team to identify specific actions and purchases to consider.
- Identify internal and external funding sources for each action and purchase.
- Garner support and participation from city and community partners.
- Purchase heating/cooling equipment and develop deployment plan.

Potential Challenges to Implementation

- Finding funding sources to make purchases of equipment.
- Enlisting private sector partners to participate in program.

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: ET-3 Assist Vulnerable Populations

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Purchase equipment, enlist private partners, fund emergency transportation vouchers, improve access to information	$50,000	Enlist and support at least five private partners, establish cache of air conditioners and heaters, establish emergency transportation voucher pool, improve access
Alternative #2	Improve access to information, enlist private partners	$20,000	Establish and maintain website and public notifications, enlist at least five private partners
Alternative #3	Improve access to information and warning	$10,000	Establish and maintain website and notification process

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 335: Review of Washington County Comprehensive Plan

Mitigation Action Information	
Title of action	Review of New Hazard Data for Potential Washington County Comprehensive Plan (2017 Priority 3)
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Utilize the 2022 multi-hazard risk report and assessment developed by DOGAMI to potentially inform updates to Washington County's Comprehensive Plan.
Hazard(s) addressed	Dam failure ☐ Flood ☒ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☒ Winter storm ☐ Earthquake ☒ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Portions of the Washington County Comprehensive Plan contain policies and regulations for development in hazard areas such as flood zones and steep slopes. In 2022, DOGAMI published new information about a variety of Washington County hazards. This action will determine whether the new information identifies any needed updates to land use rules for protection of people and property.
Area of action impact	County-wide community development planning
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☐ Goal 4 ☒ Goal 7 ☐ Goal 2 ☒ Goal 5 ☐ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	Oregon Statewide Planning Goal 7, Areas Subject to Natural Hazards
Alignment with existing plans and policies	Washington County Comprehensive Framework Plan for the Urban Area, Policy 8, Natural Hazards; Washington County Rural/Natural Resource Plan, Policy 8, Natural Hazards; portions of the Community Development Code
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	LUT, Planning and Development Services

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Building Services Division; Flood Plain Manager in cooperation with Engineering	Clean Water Services
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund; Department of Land Conservation and Development Technical Assistance Grant	Not applicable
Estimated Cost	$10,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Determining whether new hazard information identifies needed updates to land use rules for protection of people and property .		$60,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2025	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Review and evaluation of DOGAMI report and identify whether Comprehensive Plan policies and/or regulations need changes. If so, identify the specific changes needed. If specific changes are needed, a future Mitigation Action Item would be development of proposed changes and their presentation to Planning Commission and County Commissioners.

Potential Challenges to Implementation

Board prioritization of this item as a Tier 1 task on Long Range Planning's Work Program would be necessary to authorize staff to begin work on this task. A potential challenge is if Board does not prioritize this item as a Tier 1 task (i.e., if they prioritize other projects and tasks ahead of this one).

Resources and References, if Applicable

Oregon Statewide Planning Goal 7 (Areas Subject to Natural Hazards); Washington County Comprehensive Plan, including Comprehensive Framework Plan for the Urban Area, Policy 8 (Natural Hazards); Rural/Natural Resource Plan, Policy 8 (Natural Hazards); and the Community Development Code.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Staff completes review of DOGAMI report and determines whether changes to Comprehensive Plan are warranted	$25,000	Review completed
Alternative #2	Third party is retained to complete review of DOGAMI report and Comprehensive Plan to determine if changes are warranted	$50,000	Any suggested changes are presented to staff for review
Alternative #3	No Action	N/A	N/A

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 336: Landslide Data and Mitigation Strategy

Mitigation Action Information	
Title of action	Landslide Data and Mitigation Strategy (2017 Pool 14)
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Update regional landslide risk maps, using available LIDAR data and collaborate with the Oregon Department of Geology and Mineral Industries to work on landslide risk reduction efforts; determine areas and buildings at risk to landslides and propose revisions to the County's Comprehensive Plan and land use policies necessary to reduce risks.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☒ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☐
How does the action address identified current or future risks and vulnerabilities?	Each landslide has very localized impacts. Some impact areas have potentially serious life safety risks, and some potentially have significant threats to County roadways and other infrastructure. This project will update data to identify potential landslide areas, can identify structures and infrastructure at risk, and can provide information to develop mitigation projects.
Area of action impact	The entire county will be evaluated, and specific landslide potential risks identified.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Potentially roadways and bridges. Others to be identified.
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☐ Goal 3 ☐ Goal 6 ☐
Integration into other initiatives	To be determined.
Alignment with existing plans and policies	Washington County Comprehensive Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	LUT, PDS

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Emergency Management, WC Department of Land Use and Transportation, WC Facilities and Parks.	DOGAMI, RDPO, additional cities and special districts.
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund, Regional Disaster Preparedness Organization managed grants	FEMA BRIC
Estimated Cost	$10,000–$5,000,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Identify and maps past landslides to project future potential. Identify at-risk properties. Identify mitigation options.		$60,000–$30,000,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2023	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Completion of hazard and risk assessments to identify specific prone areas and properties
- Formation of a mitigation strategy
- Initiate mitigation actions on at least 20% of identified properties at significant risk

Potential Challenges to Implementation

- Staff assigned to work on completion of hazard and risk assessments
- Forming a group to develop a landslide mitigation strategy
- Implementing mitigation actions on identified at-risk properties

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: LS-1 Map and Assess Vulnerability to Landslides, LS-2 Manage Development in Landslide Hazard Areas
- LS-3 Prevent Impacts to Roadways

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Complete hazard & risk assessments, form strategic plan, implement mitigation actions	$5,000,000	All objectives completed within life of plan
Alternative #2	Completion of hazard & risk assessments, form strategic plan	$20,000	Completion of assessments and form plan
Alternative #3	Complete hazard & risk assessments and publish results	$10,000	Completion of assessments and publishing results

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 337: Volcanic Ash Damage Mitigation Strategy

Mitigation Action Information			
Title of action	Volcanic Ash Damage Mitigation Strategy (2017 Pool 18)		
Type of action	Plans/regulations ☒		Natural systems protection ☐
	Structure and infrastructure project ☒		Public education/awareness ☒
Action description	Identify critical facilities and industries that may be affected by ash fallout and collaborate with them on ash fall damage mitigation projects, recovery plans, and preparation projects. Include ash fallout in list of hazards in public awareness and outreach materials.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☒	
	Extreme heat ☐	Wildland fire ☐	
How does the action address identified current or future risks and vulnerabilities?	Brings awareness of potential to property owners and may assist in preparation activities such as protection of HVAC and AHU systems.		
Area of action impact	All of Washington County is at risk of exposure to volcanic ash fallout.		
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? All critical structures/facilities are at risk		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	To be identified.		
Alignment with existing plans and policies	WC Emergency Operations Plan		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
WC Facilities and Parks, WC Health Services	
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund, private property owners	BRIC Grant
Estimated Cost	$10,000–$50,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Bring awareness to encourage preparation and mitigation actions by individual public and private property owners	Informs the public at large of risk and protective actions; can assist in developing early notification/warning and response plans	$60,000–$300,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	January 2023	December 2026

Implementation Benchmarks: How Will Success Be Measured?

- Research on risk volcanic ash poses to people and properties.
- Develop and publish public awareness information materials.
- Assist eligible parties in identifying funding for implementing mitigation actions.

Potential Challenges to Implementation

- Finding information relevant to ash fallout hazards.
- Identifying multiple mitigation actions relevant to ash fallout hazards.
- Obtaining buy-in from public and private sector property owners to implement mitigation actions.

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: MU-9 Create Local Funding Mechanisms for Hazard Mitigation, MU-14 Increase Hazard Education and Risk Awareness, MU-16 Promote Private Mitigation Efforts

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Develop and publish public awareness information, reach out to critical infrastructure owners, identify potential mitigation actions, identify potential funding sources	$50,000	Completion of all objectives within life of plan
Alternative #2	Develop and publish public awareness information	$10,000	Completion of objectives in safe harbor languages
Alternative #3	No action	$1,000	

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 338: WUI Fire Water Supply GIS Data Project

Mitigation Action Information	
Title of action	WUI Fire Water Supply GIS Data Project (New 2023)
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☐
Action description	Utilize the BUG SEPRR project to develop a GIS database of water sources in rural and wildland interface areas which are available for fire suppression and accessible by fire department apparatus or aircraft such as storage tanks and drafting or dipping sites. Sites may be publicly or privately owned. Provide data to fire service GIS provider.
Hazard(s) addressed	Dam failure ☐ Flood ☐ Windstorm, incl. tornado ☐ Drought ☐ Landslide ☐ Winter storm ☐ Earthquake ☐ Volcanic ash ☐ Extreme heat ☐ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	Supports wildfire suppression response by fire agencies. Supports wildfire response plans implemented by local fire districts and the Oregon Department of Forestry Fire Protection Program.
Area of action impact	Rural and Wildland Urban Interface areas of Washington County
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☐ Goal 2 ☐ Goal 5 ☒ Goal 3 ☐ Goal 6 ☒
Integration into other initiatives	2022 NHMP MAI Map Community Risk
Alignment with existing plans and policies	Fire response plans
Mitigation Action Implementation Plan	
Priority	Low ☒ Medium ☐ High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Facilities (Parks), EM, WCSO, WC Broadband User Group's Support of Emergency Response and Recovery (SEPRR) project	Fire officials/Local Fire Districts, Oregon Department of Forestry's Fire Protection Program
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General Fund, Oregon Department of Forestry	To be determined
Estimated Cost	$10,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Increase information available to fire-suppression agencies and improve access to water supply for fire suppression in response situations.	Reduce response time finding water supplies during fire responses, helps with pre-incident planning.	$60,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	January 2023	December 2025

Implementation Benchmarks: How Will Success Be Measured?

- Assess completeness of current mapping and identify remaining sites to be mapped.
- WC BUG SEPRR project coordinates obtaining and documenting site information and prepares data layers for fire district/department integration to the Intterra mapping software.
- Local fire districts/departments establish program to maintain information and access to sites.

Potential Challenges to Implementation

- Availability of BUG SEPRR person to work on project.
- Availability of fire district/department staff to work on project.
- Willingness of property owners to participate and allow use of sites.

Resources and References, if Applicable

- Fire department operating procedures.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Utilize SEPRR project to complete map, fire agencies participate, property owners participate	$10,000	Complete project objectives within five years (12/2027)
Alternative #2	Utilize SEPRR project to identify potential sites and turn information over to fire agencies to implement	$5,000	Complete objective and hand-off to fire agencies
Alternative #3	No action	$1,000	N/A

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 339: Wildland Urban Interface Plan CWPP

Mitigation Action Information			
Title of action	Wildland Urban Interface Plan CWPP (2017 Priority 9)		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Support the effort by the Oregon Department of Forestry to update the 2007 Community Wildfire Protection Plan (CWPP) with information and tasks within the County's authority.		
Hazard(s) addressed	Dam failure ☐	Flood ☐	Windstorm, incl. tornado ☐
	Drought ☐	Landslide ☐	Winter storm ☐
	Earthquake ☐	Volcanic ash ☐	
	Extreme heat ☐	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	This will identify communities and areas at risk in the wildland fire interface such as Cherry Grove, North Plains, Timber, etc.; meet requirements for additional grant funding for mitigation efforts such as land clearing for defensible space and establishing Firewise Communities.		
Area of action impact	Properties in and along the wildland urban interface.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☒	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☐	
	Goal 3 ☒	Goal 6 ☒	
Integration into other initiatives	Oregon Department of Forestry project to update the Washington County CWPP.		
Alignment with existing plans and policies	Update of the 2007 CWPP led by the Oregon Department of Forestry.		
Mitigation Action Implementation Plan			
Priority	Low ☒	Medium ☐	High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
Emergency Management, Land Use and Transportation	Oregon Department of Forestry, Tualatin Valley Fire & Rescue, Banks Fire District, Forest Grove Fire & Rescue
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Local general fund	USDA Community Wildfire Defense Grant, FEMA BRIC
Estimated Cost	$80,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Refines the WUI/CWPP mitigation needs and solutions, meets grant requirements	Successful projects may reduce fuel loading in at-risk areas; may improve community evacuation and access	$160,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☒ Long-term ☐ Ongoing ☐	January 1, 2023	December 31, 2025

Implementation Benchmarks: How Will Success Be Measured?

- Develop scope of County's authority and capability to support.
- Identify and develop any CWPP-specific implementable mitigation actions.
- Adopt CWPP for Washington County.

Potential Challenges to Implementation

- Funding for staff participation.
- Limited authority and jurisdiction of the County.
- Political support.

Resources and References, if Applicable

- USDA/USFS Community Wildfire Defense Grant criteria.
- DOGAMI/USGS study data.
- 2023 Washington County NHMP.
- 2007 Washington County CWPP.

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Assist/support ODF in updating the 2007 CWPP; implement County MAI for CWPP	$20,000	All goals met by 12/31/2025
Alternative #2	No action	$1,000	N/A
Alternative #3			

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 340: Develop Partnership Strategy for Public/Private Infrastructure Owners and Managers

Mitigation Action Information	
Title of action	Develop Partnership Strategy for Public/Private Infrastructure Owners and Managers (2017 Pool 1)
Type of action	Plans/regulations ☒ Natural systems protection ☐ Structure and infrastructure project ☐ Public education/awareness ☒
Action description	Develop partnership strategy for WC Emergency Management to foster natural hazard program coordination and collaboration with infrastructure owners including public and private utility providers in Washington County.
Hazard(s) addressed	Dam failure ☒ Flood ☒ Windstorm, incl. tornado ☒ Drought ☒ Landslide ☒ Winter storm ☒ Earthquake ☒ Volcanic ash ☒ Extreme heat ☒ Wildland fire ☒
How does the action address identified current or future risks and vulnerabilities?	This will improve the County's relationships with water providers, wastewater treatment agency, electrical service providers, communications providers, solid waste programs and others to connect them to funding sources for mitigation and infrastructure hardening and construction projects.
Area of action impact	This will focus on providers in unincorporated Washington County but will also assist utilities crossing multiple jurisdictions.
Is the action related to a critical facility or facilities?	Yes ☒ No ☐ If yes, what facility(ies)? Water systems, sewer and surface collection systems, electrical systems, solid waste haulers and facility owners, and others?
Mitigation Action Integration	
Alignment with NHMP goals	Goal 1 ☒ Goal 4 ☐ Goal 7 ☒ Goal 2 ☒ Goal 5 ☒ Goal 3 ☒ Goal 6 ☐
Integration into other initiatives	To be identified by the utilities that are assisted.
Alignment with existing plans and policies	Washington County Urban Comprehensive Framework Plan Washington County Rural Comprehensive Framework Plan
Mitigation Action Implementation Plan	
Priority	Low ☐ Medium ☐ High ☒
Lead position, office, department, or division responsible for implementation	Emergency Management

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
WC Planning and Development Services Division	Clean Water Services, Tualatin Valley Water District, other utilities as identified
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
WC General Fund	BRIC and FMA grants through FEMA Rural Development Assistance, USDA
Estimated Cost	$10,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Identifying funding resources for infrastructure projects; improving relationships for planning and emergency response	Greater awareness and making contacts	$60,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2024	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Establishing a point of contact with each utility provider in Washington County.
- Outlining goal of identifying mitigation and constructions projects needing funding.
- Assisting utilities with applying for and securing funding where applicable and desired.

Potential Challenges to Implementation

- Establishing relationships with utilities that will lead to collaborative work.
- Identifying applicable funding options and securing them.

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: MU-9 Create Local Funding Mechanisms for Hazard Mitigation.

Three Alternatives Considered, Including No Action

	Action Description	Estimated Cost	Evaluation
Alternative #1	Establishing relations with all utilities	$5,000	Complete contact list and needs assessment
Alternative #2	Establishing relations with only major utilities	$5,000	Contact list and needs assessment
Alternative #3	No action	$1,000	N/A

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 341: Public Education of Natural Hazard Mitigation

Mitigation Action Information			
Title of action	Public Education of Natural Hazard Mitigation (2017 Pool 2)		
Type of action	Plans/regulations ☐	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☒	
Action description	Develop, enhance, and implement equitable programs aimed at educating the public about mitigation of natural hazard impacts and reducing the risk to community members, private property owners, public agencies, businesses, and schools.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	This action addresses action addresses components of accessibility to education programs that have historically been barriers such as languages other than English, formats that are available in electronic/digital and hard copy, information that is shared through trusted community partners, cultural considerations, etc.		
Area of action impact	All persons in Washington County. Efforts will be made to develop information into safe-harbor languages for community inclusion goals.		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☐
	Goal 2 ☐	Goal 5 ☒	
	Goal 3 ☒	Goal 6 ☐	
Integration into other initiatives			
Alignment with existing plans and policies			
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☐	High ☒
Lead position, office, department, or division responsible for implementation	Emergency Management		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
WC Emergency Management, WC Public Affairs	WC Emergency Management Cooperative
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
General fund	
Estimated Cost	$10,000–$50,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Making hazards, mitigation efforts and resources known to all persons in Washington County	Greatly expands the messaging to languages other than English and Spanish to foster greater community awareness.	$60,000–$300,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2023	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Final NHMP developed into understandable sections
- NHM information is published on interactive website
- Essential information is offered in safe-harbor languages

Potential Challenges to Implementation

- Translation services and costs of translations

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication, multiple areas.
- Drought: D-9 Educate Residents on Water Saving Techniques, D-10 Educate Farmers on Soil and Water Conservation Practices
- Earthquake: EQ-7 Increase Earthquake Risk Awareness, EQ-9 Provide Information on Structural and Non-Structural Retrofitting
- Extreme Temperatures: ET-2 Increase Awareness of Extreme Temperature Risk and Safety, ET-4 Educate Property Owners About Freezing Pipes
- Flood: F-23 Educate Property Owners about Flood Mitigation Techniques
- Severe Wind: SW-7 Increase Severe Wind Risk Awareness
- Winter Weather: WW-5 Conduct Winter Weather Risk Awareness Activities
- Wildfire: WF-11 Increase Wildfire Risk Awareness, WF-12 Educate Property Owners about Wildfire Mitigation Techniques
- Multiple Hazards: MU-14 Increase Hazard Education and Risk Awareness, MU-15 Improve Household Disaster Preparedness, MU-16 Promote Private Mitigation Efforts

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Develop and publish web resource for information and surveys for most impactive hazards in multiple languages	$50,000	Completed all aspects of #1
Alternative #2	Develop and publish web resource for general hazards in to 50% of safe harbor languages	$25,000	Completed all aspects of #2
Alternative #3	Develop framework for MAI, publish web resources in English and Spanish	$10,000	Complete all aspects of #3

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Table 342: Map Community Risk

Mitigation Action Information			
Title of action	Map Community Risk		
Type of action	Plans/regulations ☒	Natural systems protection ☐	
	Structure and infrastructure project ☐	Public education/awareness ☐	
Action description	Provide support to develop a countywide project to coordinate GIS resources, giving the ability to all local participants to upload current and changing information regarding structures, critical facilities, water sites for fire use, vulnerable populations exposed to the elements, and support future reviews of this plan and mitigation actions.		
Hazard(s) addressed	Dam failure ☒	Flood ☒	Windstorm, incl. tornado ☒
	Drought ☒	Landslide ☒	Winter storm ☒
	Earthquake ☒	Volcanic ash ☒	
	Extreme heat ☒	Wildland fire ☒	
How does the action address identified current or future risks and vulnerabilities?	This MAI is to find financial resources to hire or contract someone to develop the countywide WC Broadband User Group's "Support of Emergency Planning, Response and Recovery (SEPRR) Project" to develop a centralized GIS place to update hazard, structure, and other GIS data.		
Area of action impact	All of Washington County		
Is the action related to a critical facility or facilities?	Yes ☐ No ☒ If yes, what facility(ies)?		
Mitigation Action Integration			
Alignment with NHMP goals	Goal 1 ☐	Goal 4 ☐	Goal 7 ☒
	Goal 2 ☒	Goal 5 ☒	
	Goal 3 ☐	Goal 6 ☐	
Integration into other initiatives	Washington County Broadband User Group's Support of Emergency Planning, Response and Recovery Project.		
Alignment with existing plans and policies	WC Multi-jurisdictional NHMP		
Mitigation Action Implementation Plan			
Priority	Low ☐	Medium ☒	High ☐
Lead position, office, department, or division responsible for implementation	Emergency Management		

Supporting Partners	
Internal Partners	**External Partners, Including Community Partners**
WC Emergency Management, WC Information Technical Services	Washington County, all WC cities, NHMP partners
Potential Funding Sources	
Non-Federal Funding Sources	**Federal Funding Sources**
Local government contributions	BRIC, SHSP
Estimated Cost	$600,000

Estimated Benefit		
Primary Benefit(s)	**Secondary Benefit(s)**	**Financial Benefit(s) (Est. Cost x 6)**
Provides a central location for all participants to update GIS data for mitigation, response and recovery planning projects.	Establishes common terminology, symbology, definitions and other GIS inconsistencies.	$3,600,000

Project Timeline		
Expected Timeline for Completion	**Potential Start Date**	**Potential Completion Date**
Short-term ☐ Mid-term ☐ Long-term ☒ Ongoing ☐	January 2024	December 2027

Implementation Benchmarks: How Will Success Be Measured?

- Successfully find financial sources to fund the project for four years to develop the GIS system, initially populate it, provide products identified in other 2022 Mitigation Action Items, and have it read to allow participating agencies to maintain it forward.

Potential Challenges to Implementation

- Finding non-local financial resources to fund
- Having locals dedicate funds to complete the project
- Managing obtaining agreement on technical aspects of GIS (terminology, symbology, etc.)
- Hiring person(s) to complete the project

Resources and References, if Applicable

- FEMA Mitigation Ideas Publication: MU-1 Assess Community Risk, MU-2 Map Community Risk

Three Alternatives Considered, Including No Action			
	Action Description	**Estimated Cost**	**Evaluation**
Alternative #1	Fund one ½-time person to work on the project	$300,000	Project is fully developed and handed off to agencies, training is prepared and presented
Alternative #2	Fund a contractor to work on the project	$600,000	Project is fully developed and handed off to agencies, training is prepared and presented
Alternative #3	BUG agencies continue to work on project as staff is available	$300,000	Incremental progress is made over five years to coordinate and develop GIS products

Implementation Progress Report for Plan Maintenance	
Date	
What progress in implementation has been made to date?	
What challenges in implementation have been experienced?	
What are the next steps in implementation?	

Appendix A: Planning Area Profile

1. Introduction

A complete profile of the planning area's characteristics is important to fully understand the area's vulnerability and resilience to natural hazards. The information in this appendix, along with the hazard assessments in Volume 1, Section 2, should be used as the basis and justification for the risk reduction mitigation actions identified in Volume 1, Section 3 and participant annexes.

The planning area for this plan is for Washington County and includes the following jurisdictions and special districts:

- City of Beaverton[550]
- City of Cornelius[551, 552]
- City of Forest Grove[2, 3]
- City of Hillsboro
- City of North Plains[2]
- City of Sherwood[2]
- City of Tigard
- Clean Water Services (CWS)[2]
- Tualatin Hills Park & Recreation District (THPRD)[2]
- Tualatin Valley Water District (TVWD)[2]
- Washington County

This appendix covers the following categories and provides a broad inventory of the following attributes of the planning area:

- Natural environment characteristics
- Social and demographic information
- Economic data
- Built environment capacity
- Community connectivity capacity
- Political capacity

[550] The City of Beaverton NHMP was adopted in 2020. This plan was updated and incorporated into the 2023 Washington County plan as the City's annex.
[551] Did not participate in the 2017 Washington County NHMP.
[552] The cities of Cornelius and Forest Grove had a joint NHMP that was adopted in September 2011. The 2011 plan was updated and incorporated into this plan as separate annexes for the cities.

1.1. Natural Environment Characteristics

The natural environment includes the geography, climate, and land cover of the planning area that maintains clean water and air and a stable climate.[553] Natural resources such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from weather-related hazards, such as flooding and landslides. However, natural systems are often impacted or depleted by human activities, adversely affecting community resilience.

1.1.1. Geography

Washington County is in northwestern Oregon, just west of the City of Portland. The County is primarily rural in the west and heavily developed with urban infrastructure in the east, and the central portion of the County is in the Tualatin Valley. Washington County is approximately 727 square miles and is part of the tri-County metro area comprised of Multnomah, Clackamas, and Washington Counties. It is bounded to the north by Columbia County, to the east by Multnomah and Clackamas Counties, to the south by Yamhill County, and to the west by Tillamook County. The western part of Washington County, where it meets the mountains of the Northern Oregon Coast Range, is forty miles from the Pacific Ocean. Dominant features of the County landscape are the Coast Range Mountains on the west, the Tualatin Mountains on the north, the West Hills of Portland on the east, and the Chehalem Mountains on the south. Also prominent are Cooper and Bull Mountains in the southeast and Bald Peak in the southwest. The agriculturally rich Tualatin Valley lies between the mountain ranges and hills.

The valley ranges from 120 to 300 feet above sea level. The topography is rolling and lacks dramatic changes in elevation except in the foothills and mountains surrounding the central valley. The foothills and the uplands range in elevation from 1,300 to 3,500 feet. The highest point in the County is Saddle Mountain in the Northern Oregon Coast Range near the border of Tillamook and Washington Counties, with an elevation of 3,464 feet.

[553] Mayunga, J. (2007). Understanding and Applying the Concept of Community Disaster Resilience: A capital-based approach. Summer Academy for Social Vulnerability and Resilience Building.

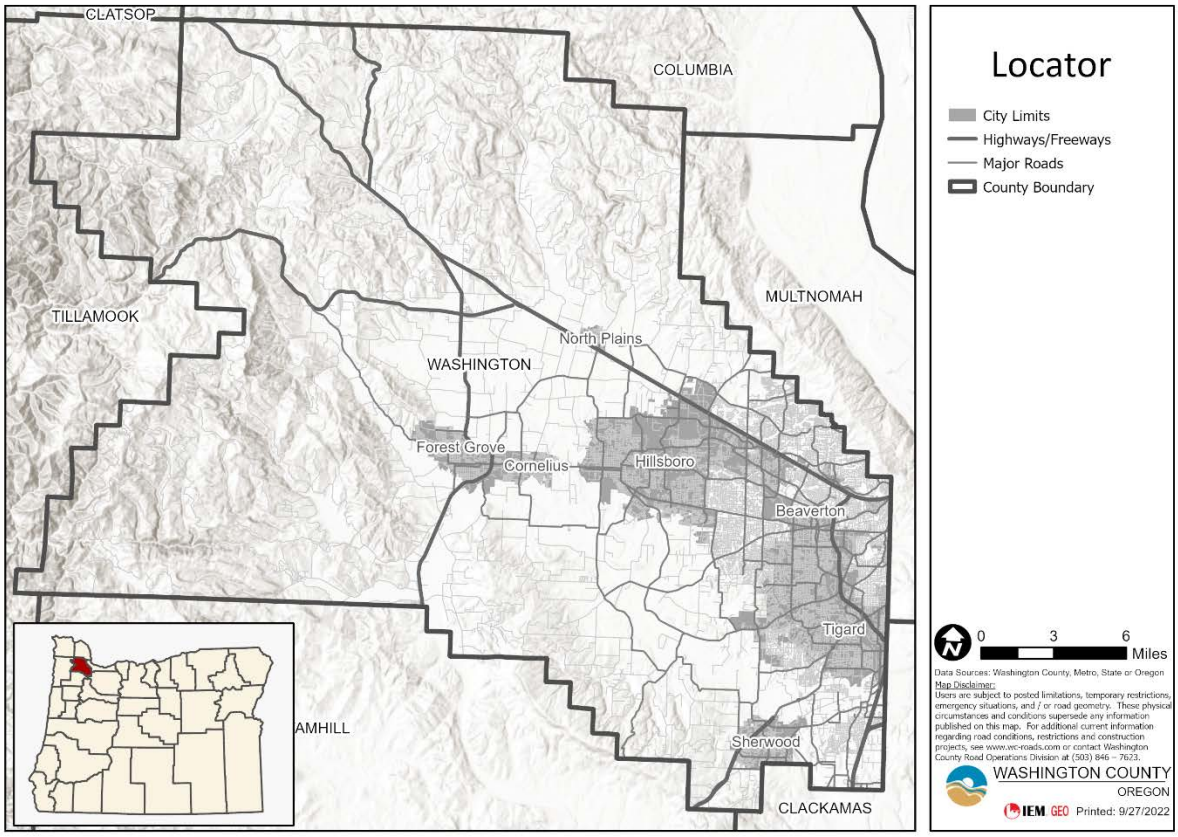


Figure 44: Washington County, Oregon

Washington County has a long growing season and mild temperatures, which lead to a wide range of agricultural activities. Seasonal flooding, high ground water, and soil erosion cause most of the non-urban drainage problems in the County. When maintained in their natural state, Washington County's wetlands control runoff and decrease soil erosion and water pollution while reducing potential damage from flooding and helping to recharge groundwater supplies.

1.1.1.1. Tualatin River

The Tualatin River, one of the many natural features of the County, starts in the northern Oregon Coast Range and flows to the Willamette River near the City of West Linn in Clackamas County. The Tualatin River is a major source of drinking water for the cities of Cornelius, Hillsboro, and Beaverton. It is also a source of irrigation water and provides aquaculture and recreation opportunities for many Washington County communities. The Tualatin River also serves as a channel for the discharge of treated wastewater.

In the southern portion of the County, Wapato Creek drains from the Chehalem Mountains. In the west, Scoggins and Gales Creeks drain part of the Coast Range; while McFee and Chicken Creeks drain the northeast slopes of the Chehalem Mountains, and Fanno Creek drains the valley floor and Portland's west hills. Dairy Creek with McKay Creek as a tributary drains portions of the Coast Range and Tualatin Mountains in the northwest of the County. In the north portion of the County, Beaverton Creek, a tributary to Rock Creek, drains a large portion of the valley and the Portland West Hills.

The Tualatin River and its tributaries flow through low foothills, terraces, and floodplains that naturally drain the area under normal circumstances. It is generally a slow-moving river draining and preventing flooding through the collection and flow of water from rain and snow melt in the Chehalem Mountains, Coast Mountain Range, Portland's West Hills, and the Tualatin Mountains.

Scoggins Dam, located near the town of Gaston in southwestern Washington County, stores runoff from the Scoggins Creek watershed upstream from its confluence with the Tualatin River. The dam forms a reservoir, Henry Hagg Lake, which provides active water storage capacity of about 59,910 acre-feet. The dam and reservoir are owned by the Bureau of Reclamation and operated by the Tualatin Valley Irrigation District. The facility provides flood control, irrigation water, municipal water supply, water quality benefits, and recreation.

1.1.1.2. Minerals and Soils

The characteristics of the minerals and soils present in Washington County indicate the potential types of hazards that may occur. Rock hardness and soil characteristics can determine if an area will be prone to geologic hazards such as landslides. The four mineral and soil types in Washington County are valley fill and semi-consolidated sedimentary rocks, basaltic lavas, marine sedimentary rocks, and Eocene age volcanic and sedimentary rocks.

The surface material includes unconsolidated, fine-grained deposits of Willamette silt, sand, and gravel, and recent floodplain deposits. Torrential flood events can lay down large deposits of sand and gravel. Sandy silt and silt containing clay are moderately dense and firm, and are primarily considered to be prone to liquefaction, an earthquake-related hazard. Basaltic lava consists mainly of weathered and non-weathered, dense, fine-grained basalt. Though the characteristic of this lava may offer solid foundation support, landslides are common in many of these areas where weathered residual soil overlies the basalt. Understanding the geologic characteristics of Washington County is an important step in hazard mitigation and avoiding at-risk development.

1.1.1.3. Geologic Faults

Washington County, like most of the Pacific Northwest, is within the shake zone of the Cascadia Subduction Zone (CSZ), where the Juan de Fuca and North American Plates meet under the earth's crust. The presence of crustal faults within Washington County also indicates potential seismic activity within the County. In addition to the CSZ, the Portland Hills and Gales Creek Fault Zones also run through the County. There are active volcanoes in the vicinity of the County, including Mount St. Helens in the south of Washington State, and Mount Hood, southeast of Portland.

Identifying risks posed by natural hazards and developing strategies to reduce the impact of a hazard event can assist in protecting the life and property of citizens and communities. Residents and businesses can work together with the County to create a natural hazards mitigation plan that addresses the potential impacts of hazard events.

1.1.2. Climate

Washington County's climate is moderate year-round. The western edge of the County is only 40 miles from the Pacific Ocean, which provides a modified marine climate. Extreme summer and winter temperatures are moderated by the airflow moving across the County from the Pacific Ocean. The Cascade Mountains to the east of the County act as a barrier that prevents the colder continental air masses originating in the artic areas of Canada from reaching the County. Occasionally, extreme temperatures can occur when the airflow comes in from the east flowing west through the Columbia Gorge and across the Cascade Mountains. If the east winds occur when rain is falling, the result can be freezing rain and snow in the County.

Much of Washington County is protected from severe wind and weather conditions by the surrounding mountain ranges. Snowfall is relatively rare, with only about five days of measurable snowfall each year. The few times that snow falls each year, it generally melts off within one to three days. Ice can occur more frequently in higher elevations in the County.

Washington County's rainy season happens between October and April. The County has an average annual precipitation of 47 inches, including 44 inches of rain and 3 inches of snow. Strong storm systems can develop at higher altitudes in the upper-level flow over the Pacific Ocean during the rainy season and bring rain to the lower elevations and snow to the higher elevations.

1.1.2.1. Climate Change

Washington County is experiencing a change in climate that is expected to continue for the foreseeable future. Observed and projected trends in climate include an increase in average temperature, increases in precipitation during the wet season and a decrease in precipitation during the summer, and decreased snow cover and snowpack.[554] Potential impacts of climate change on the frequency and magnitude of each hazard are in the hazard profiles in Volume 1, Section 2.

Established and emerging understanding of observed and projected climate change in the County, and knowledge of the opportunities and risks that climate change poses to natural and human systems, may serve as a resource for actions, including, but not limited to, planning for mitigation of climate-related natural hazards and implementation of Oregon's 2021 Climate Change Adaptation Framework.[555]

1.1.2.2. Environmental Assets

Planning participants identified the following areas as important environmental and natural resources and assets:

- 114th Avenue Wetlands Natural Area
- 155th Avenue Wetlands Natural Area
- A.M. Kennedy Park
- Adams Wetlands Natural Area
- Aspen Wetlands Natural Area
- Bales Wetlands Natural Area
- Bannister Creek Greenway
- Barney Reservoir
- Barsotti Park
- Bauman Woods Natural Area
- Beacon Hill Wetlands Natural Area
- Beaverton Creek Greenway
- Beaverton Creek Wetlands Natural Area

[554] Dalton, M., & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://blogs.oregonstate.edu/occri/oregon-climate-assessments/
[555] Dalton, M., & Fleishman, E. (Eds.). (2021). Fifth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. https://blogs.oregonstate.edu/occri/oregon-climate-assessments/

- Ben Graf Greenway
- Bethany Creek Greenway
- Bethany Creek Park
- Bethany Lake Park
- Bethany Wetlands Natural Area
- Bonny Slope Park
- Bronson Creek Greenway
- Bronson Creek Park
- Brookhaven Woods Natural Area
- Brookview Wetlands Natural Area
- Burton Wetlands Natural Area
- C.E. Mason Wetlands Natural Area
- Cedar Mill Creek Greenway
- Cedar Mill Woods Natural Area
- Cedars Wetlands Natural Area
- Center Street Wetlands
- Chehalem Ridge Nature Park
- City of Beaverton tree corridors and groves
- City of Beaverton Wetlands
- Cooper Mountain Nature Park
- David’s Windsor Wetlands Natural Area
- Deerfield Woods Natural Area
- Dirksen Nature Park
- Downing Greenway
- Dwight S. Parr Woods Natural Area
- Eagle Landing Park
- Elizabeth Meadows Wetlands Natural Area
- Fanno Creek Greenway
- Fernhill Wetlands
- Five Oaks Historic Site in the City of Hillsboro
- Forest Glen Woods Natural Area
- Forest Grove Watershed
- Future Park South Cooper Mountain – Gorman
- Gales Creek

- Granada Woods Natural Area
- Hagg Lake and Scoggins Valley Park
- Hartwood Hylands Woods Natural Area
- Hiteon Wetlands Natural Area
- Hubert Lee Cain Wetlands Natural Area
- Hyland Woods Natural Area
- Jackson Bottom Wetlands Preserve
- Jordan Woods Natural Area
- Kaiser Woods Natural Area
- Koll Center Wetlands Natural Area
- Lilly K. Johnson Woods Natural Area
- Lowami Hart Woods Natural Area
- Madrona Woods Natural Area
- Matrix Hill Woods Natural Area
- Merritt Woods Natural Area
- Metzger Park
- Millikan Wetlands Natural Area
- Moonshadow Woods Natural Area
- Morrison Woods Natural Area
- Moshofsky Woods Natural Area
- Mt. Williams Park
- Mullerleile Pond
- NE Neighborhood Park
- North Bethany Greenway
- Northridge Woods Natural Area
- Orenco Woods Nature Park
- Peppertree Wetlands Natural Area
- Porter Sequoias in the City of Hillsboro
- Quarry Woods Natural Area
- Raleighwood Wetlands Natural Area
- Ravine Woods Natural Area
- Rock Creek Greenway
- Roxie’s Wetlands Natural Area
- Scholls Wetlands Natural Area

- Scott Wetlands Natural Area
- Shadow Creek Wetlands Natural Area
- Shaughnessey Wetlands Natural Area
- Snyder Reservoir
- Starks Reservoir
- Steele Wetlands Natural Area
- Stoller Creek Greenway
- Summercrest Woods Natural Area
- Taylors Creek Wetlands Natural Area
- Tenax Woods Natural Area
- Thornbrook Woods Natural Area
- Tualatin Hills Nature Park
- Tualatin River
- Tualatin River Wildlife Refuge
- Vale Greenway
- Wake Robin Wetlands Natural Area
- Wapato Lake and Wetlands
- Warren Oak Trees in the City of Hillsboro
- West Fork Dairy Creek
- Whispering Woods Natural Area
- White Fox Wetlands Natural Area
- Williams DLC Oak Tree in the City of Hillsboro
- Willow Creek Greenway

1.2. Social and Demographic Information

Social and demographic capacity is a significant indicator of community hazard resilience. The characteristics and qualities of the community population, such as language, race and ethnicity, age, income, educational attainment, and health, are significant factors that can influence the community's ability to cope, adapt to, and recover from natural disasters. Population vulnerabilities can be reduced or eliminated with proper outreach and community mitigation planning.

1.2.1. Population

The County has experienced population growth since the adoption of the 2017 NHMP, with the cities of North Plains, Cornelius, and Forest Grove experiencing the largest percentage of population change. An increase in population can also bring an increase in the built environment and require additional infrastructure. Increases in the number of residents, the built environment footprint, and infrastructure can increase vulnerability to natural hazard events.

Table 343: Certified Population Estimates of Jurisdictions Participating in the NHMP[556]

Jurisdiction	2017 Population	2021 Population	Percentage of Population Change
City of Beaverton	95,685	97,782	2.19%
City of Cornelius	11,915	13,498	13.3%
City of Forest Grove	23,555	26,242	11.4%
City of Hillsboro	101,540	108,154	6.5%
City of North Plains	2,980	3,446	15.6%
City of Sherwood	19,350	20,496	5.9%
City of Tigard	50,985	55,854	9.6%
Washington County*	595,860	605,036	1.5%

*Includes all of Washington County, not only the unincorporated portion

Special districts participating in this NHMP have well-defined areas for which they provide water resource management and park and recreation facilities, programs, services, and natural areas. These agencies, except for THPRD, also serve populations outside of Washington County; however, many of the residents served are within the County.

Table 344: Service Area Populations of Special Districts Participating in the NHMP

Jurisdiction	Service Area Population
Clean Water Services	620,000*
Tualatin Hills Park & Recreation District	270,297
Tualatin Valley Water District	218,400

* Incudes entire Clean Water Services service area

1.2.1.1. Population Forecast

The Portland State University Population Research Center forecasts that Washington County will continue its strong and steady growth pattern, gaining over 200,000 residents by 2045.[557] The population will likely grow fastest in the City of North Plains due to its proximity to Washington County job centers.[558]

Specific forecasted service area populations for special district participants were not available; however, if the overall resident population in the County increases as projected, the service area population will also increase.

[556] Portland State University College of Urban and Public Affairs Population Research Center. (2021, December 15). https://www.pdx.edu/population-research/population-estimate-reports
[557] Portland State University College of Urban and Public Affairs Population Research Center. (2020, June 30). *Coordinated Population Forecast for Washington County, Its Urban Growth Boundaries (UBG), and Area Outside UGBs 2020–2070.* https://ondeck.pdx.edu/population-research/sites/g/files/znldhr3261/files/2020-07/Washington_Report_Final_2020.pdf
[558] Portland State University College of Urban and Public Affairs Population Research Center. (2020, June 30). *Coordinated Population Forecast for Washington County, Its Urban Growth Boundaries (UBG), and Area Outside UGBs 2020–2070.* https://ondeck.pdx.edu/population-research/sites/g/files/znldhr3261/files/2020-07/Washington_Report_Final_2020.pdf

Table 345: 2030 Forecasted Population Estimates of Jurisdictions Participating in the NHMP[559]

Jurisdiction	2021 Population	2030 Population Forecast*	Forecasted Percentage of Population Change
City of Beaverton	97,782	114,525	17.1%
City of Cornelius	13,498	14,606	8.2%
City of Forest Grove	26,242	30,702	17%
City of Hillsboro	108,154	122,598	13.4%
City of North Plains	3,446	5,194	50.7%
City of Sherwood	20,496	20,118	-1.8%
City of Tigard	55,854	63,813	14.3%
Washington County	605,036	718,412	18.9%

*Notes: 2020 city limits; all forecast figures prepared pre-COVID-19 pandemic; all forecast figures were prepared pre-2020 Census vintage population program release and include all of Washington County, not only the unincorporated portion

Table 346: 2045 Forecasted Population Estimates of Jurisdictions Participating in the NHMP[560]

Jurisdiction	2030 Population Forecast*	2045 Population Forecast*	Forecasted Percentage of Population Change
City of Beaverton	114,525	119,156	4%
City of Cornelius	14,606	17,322	18.6%
City of Forest Grove	30,702	33,592	9.4%
City of Hillsboro	122,598	128,270	4.6%
City of North Plains	5,194	5,860	12.8%
City of Sherwood	20,118	20,662	2.7%
City of Tigard	63,813	71,611	12.2%
Washington County	718,412	809,312	12.7%

*Notes: 2020 city limits; all forecast figures prepared pre-COVID-19 pandemic; all forecast figures were prepared pre-2020 Census vintage population program release and include all of Washington County, not only the unincorporated portion

[559] Metro. (2021, February 25). Portland-Area 2045 Population and Housing Forecasts by City and County. https://www.oregonmetro.gov/sites/default/files/2021/03/26/2045-regional-population-housing-forecast-by-city-County.pdf

[560] Metro. (2021, February 25). Portland-Area 2045 Population and Housing Forecasts by City and County. https://www.oregonmetro.gov/sites/default/files/2021/03/26/2045-regional-population-housing-forecast-by-city-County.pdf

Table 347: Forecasted Change in Population for Jurisdictions Participating in the NHMP, 2021–2045[561]

Jurisdiction	2021 Population	2045 Population Forecast*	Forecasted Percentage of Population Change
City of Beaverton	97,782	119,156	21.9%
City of Cornelius	13,498	17,322	28.3%
City of Forest Grove	26,242	33,592	28%
City of Hillsboro	108,154	128,270	18.6%
City of North Plains	3,446	5,860	70.1%
City of Sherwood	20,496	20,662	0.8%
City of Tigard	55,854	71,611	28.2%
Washington County	605,036	809,312	33.8%

*Notes: 2020 city limits; all forecast figures prepared pre-COVID-19 pandemic; all forecast figures were prepared pre-2020 Census vintage population program release and include all of Washington County, not only the unincorporated portion

1.2.1.2. Forecasted Age of Future Populations

Like most areas across Oregon, Washington County's population is aging. This means people 64 and older are an increasing share of the County's total population, as discussed in Section 1.2.7. The average age of the population should be considered when analyzing the population's overall vulnerability, because older adults may require an increased amount of support before, during, and after a natural hazard event.

1.2.1.3. Forecasted Race and Ethnicity of Future Populations

Racial and ethnic diversity is increasing within the County, as further discussed in section 1.2.4 and 1.2.5. The Latino/a/x population is growing, as are the Black, Asian, Pacific Islander populations, and individuals who identify as two or more races. Latino is often the preferred noun or adjective for a person who is from or whose family origins are from a Latin American country. Latina is the feminine form. The gender-neutral term is Latinx or Latine.[562] The increasing diversity among residents highlights the importance of equity and inclusion, including incorporating languages other than English in communications and warnings about natural hazards and mitigation strategies.

1.2.2. Tourists

Tourists are not counted in population statistics and are therefore considered separately in this analysis. The table below shows the estimated number of person-nights in private homes, hotels and motels, and other types of accommodations for the Portland Region, which includes Washington County. Statistics solely for the County were not available.

Tourists' lodging in private homes suggests these visitors are staying with family and friends. For hazard preparedness and mitigation purposes, outreach to residents in Washington County will likely be

[561] Metro. (2021, February 25). Portland-Area 2045 Population and Housing Forecasts by City and County. https://www.oregonmetro.gov/sites/default/files/2021/03/26/2045-regional-population-housing-forecast-by-city-County.pdf

[562] City of Portland Office of Equity and Human Rights. (October 2022). Inclusive Writing Guide. Inclusive Writing Guide (portland.gov)

transferred to these visitors in some capacity. Visitors staying at hotel or motels are less likely to benefit from local preparedness outreach efforts aimed at residents.

Table 348: Overnight Visitor Volume for the Portland Region, 2018–2020[563]

Lodging Type	Person-Nights		
	2018	2019	2020*
Hotel, Motel, or Short-Term Rental	9,948,490	10,193,430	5,685,240
Private Home	15,847,900	15,977,970	11,638,660
Other	790,620	805,040	548,560
Total	**26,587,010**	**26,976,440**	**17,872,460**

*2020 data shows COVID-19 pandemic impacts on travel.

Tourists are especially vulnerable due to the difficulty of locating or accounting for travelers within the County. Tourists are often at greater risk during a natural disaster because of unfamiliarity with evacuation routes, communication outlets, or even the types of hazards that may occur. Knowing whether the County's visitors are staying in friends' and relatives' homes, in hotels and motels, or elsewhere can be instructive when developing outreach efforts.[564]

1.2.3. Populations That May Be at Higher Risk

Populations that may need extra assistance before, during, and after a natural hazard event include, but are not limited to, older adults, children, people with disabilities, people with lower incomes, individuals who are undocumented, and unhoused populations. These people often experience the impacts of natural hazards and disasters more acutely.

Hazard mitigation efforts that target the specific needs of these and other higher risk populations has the potential to greatly reduce vulnerability. Examining the reach of hazard mitigation policies to certain populations may assist in increasing access to services and programs. FEMA's Office of Equal Rights addresses this need by suggesting that agencies and organizations planning for natural hazards identify populations that may be more susceptible, make evacuation operations, shelters, and recovery centers more accessible, and review practices and procedures to remedy any discrimination or bias in relief application or assistance.

Population size alone is not an indicator of vulnerability to natural hazards. More important is the location, composition, and capacity of the population within the community. Social science research demonstrates that human capital indices such as language, race, ethnicity, gender, age, income, education, and access to healthcare can affect a community's resilience. Therefore, these factors can impact community resilience to natural hazards.

1.2.4. Language

Special consideration should be given to populations who do not speak English as their primary language. When disseminating hazard planning and mitigation resources to the public, language barriers can be a challenge unless special attention is given to language and culturally appropriate outreach

[563] Travel Oregon. (2021, April 17). *The Economic Impact of Travel in Oregon.* https://industry.traveloregon.com/wp-content/uploads/2021/06/OR_2020_Final.pdf
[564] MDC Consultants. (n.d.). When Disaster Strikes – Promising Practices. https://www.mdcinc.org/wp-content/uploads/2017/11/When-Disaster-Strikes-Promising-Practices-Toursts-and-Newcomers.pdf

techniques. Outreach materials used to communicate with, plan for, and support non-English speaking populations should take the language needs of these populations into consideration.

There are various languages spoken across Washington County and the primary language is English. Overall, 5% of the total population in Washington County is not proficient in English.[565] The largest populations of residents who do not speak English "very well" include:[566]

- City of Cornelius: 19%
- City of Hillsboro: 7%
- City of Forest Grove: 6%
- City of Beaverton: 5%

Table 349: Languages Spoken in Washington County[567]

Language Spoken	Estimated Percent of Population Aged 5 Years and Over
English	75.2%
Spanish	11.9%
Asian and Pacific Island Language	6.8%
Indo-European Language	4.7%
Other	1.4%

1.2.5. Race and Ethnicity

The impact in terms of property and economic loss and the ability to recover from natural hazard events may also vary among population groups following a disaster. Studies have shown that racial and ethnic minorities can be more vulnerable to the negative impacts of natural disaster events. This is not reflective of individual characteristics; instead, historic patterns of inequality along racial or ethnic divides have often resulted in minority communities that are more likely to have less sturdy building stock, older infrastructure, or less access to public services.

According to the United States Census American Community Survey, 61% of respondents identified as White and Non-Hispanic, 18% of respondents identified as Hispanic or Latino/a/x of any race, and 11% of respondents identified as Asian and Non-Hispanic. The cities of Cornelius, Forest Grove, and Hillsboro had higher percentages of their populations report Hispanic or Latino/a/x ethnicity, compared to the County as a whole. The cities of Beaverton and Hillsboro and unincorporated Washington County had higher proportions of their populations report their race as Asian and Non-Hispanic, compared to the County as a whole.

The tables below describe Washington County's population by race and ethnicity. Due to how respondents identified and answered 2020 Census questions, there may be overlapping responses, and results may equal greater than 100% of the population.

[565] Washington County Oregon NHMP planning documentation.
[566] Washington County Oregon NHMP planning documentation.
[567] United States Census American Community Survey. (2015-2020). Language Spoken at Home. Accessed April 15, 2022, from https://data.census.gov/cedsci/table?q=language%20washington%20County%20oregon&tid=ACSST5Y2020.S1601

Table 350: Race Demographics in Washington County[568]

Race	Estimated Percent of Population
White Alone	60.8%
Asian	11.4%
Two or More Races	6.3%
Black or African American	2.1%
Native Hawaiian and Other Pacific Islander Alone	0.54%
Some Other Race Alone	0.52%
American Indian and Alaska Native Alone	0.40%

Table 351: Ethnicity Demographics in Washington County[569]

Ethnicity	Estimated Percent of Population
Not Hispanic or Latino/a/x	82.1%
Hispanic or Latino/a/x	17.9%

Identifying specific ways to support all portions of the community through hazard mitigation, preparedness, and response is important. Culturally appropriate and effective outreach can include methods and messaging that are targeted to diverse audiences. Connecting to historically disenfranchised populations through already trusted sources or providing preparedness materials and presentations in the languages spoken by the population will go a long way to increasing overall community resilience.

1.2.6. Gender

Washington County has slightly more people who identify as female than male (Female: 50.1%, Male: 49.9%).[570] The available data does not include information on other gender identities. It is important to recognize that people who identify as a gender other than cisgender male tend to have more institutionalized obstacles during natural hazard event recovery due to sector-specific employment, lower wages, and family care responsibilities.

[568] United States Census Decennial Census. (2020). Hispanic or Latino, and Not Hispanic or Latino by Race. Accessed April 15, 2022 from https://data.census.gov/cedsci/table?q=washington%20County%20oregon%20ethnicity&tid=DECENNIALPL2020.P2
[569] United States Census Decennial Census. (2020). Hispanic or Latino, and Not Hispanic or Latino by Race. Accessed April 15, 2022, from https://data.census.gov/cedsci/table?q=washington%20County%20oregon%20ethnicity&tid=DECENNIALPL2020.P2
[570] United States Census Bureau. (2021, July 1). QuickFacts Washington County, Oregon. Accessed April 15, 2022, from https://www.census.gov/quickfacts/washingtonCountyoregon

1.2.7. Age

Of the Washington County demographic factors influencing resilience ability, the most significant indicator may be age of the population. As of 2020, 18.5% of the County population is over the age of 65,[571] a percentage that is projected to rise to 18.9% by 2045.[572] The median age in the County is 36.9 years.[573]

Age dependency ratio (ADR) is a metric that compares the typically non-working population ages of 0–15 years and 65 years and older to the typically working population aged 16–64 years. Higher ADRs indicate higher numbers of younger and older residents, relative to the total population. The Washington County overall ADR is 56.7. This ADR indicates a higher percentage of dependent-aged (non-working) people to that of working age people.

The ratio is included in the U.S. Census Bureau's American Community Survey and is derived by dividing the population of under 15 years old and the population of those 65 years and older by the 15- to 64-year-old population and multiplying by 100. A ratio close to 50 indicates approximately twice as many people are of working age than non-working age. A ratio closer to 100 implies an equal number of working age population as non-working age population. A higher number indicates greater sensitivity to the impact of natural hazards.

Table 352: Age Demographics in Washington County

Age	Estimated Percent of Population[574]	Age Dependency Ratio[575]
Younger Than 15 Years Old	13%	35.8
65 Years Old and Older	18.5%	20.9

[571] United States Census American Community Survey. (2015–2020). Age and Sex. Accessed April 15, 2022, from https://data.census.gov/cedsci/table?q=Washington%20County,%20Oregon&tid=ACSST5Y2020.S0101
[572] Portland State University College of Urban and Public Affairs Population Research Center. (2020, June 30). *Coordinated Population Forecast for Washington County, Its Urban Growth Boundaries (UBG), and Area Outside UGBs 2020–2070.* https://ondeck.pdx.edu/population-research/sites/g/files/znldhr3261/files/2020-07/Washington_Report_Final_2020.pdf
[573] United States Census American Community Survey. (2015-2020). Age and Sex. Accessed April 15, 2022, from https://data.census.gov/cedsci/table?q=Washington%20County,%20Oregon&tid=ACSST5Y2020.S0101
[574] United States Census American Community Survey. (2015-2020). Age and Sex. Accessed April 15, 2022, from https://data.census.gov/cedsci/table?q=Washington%20County,%20Oregon&tid=ACSST5Y2020.S0101
[575] United States Census American Community Survey. (2015-2020). Age and Sex. Accessed April 15, 2022, from https://data.census.gov/cedsci/table?q=Washington%20County,%20Oregon&tid=ACSST5Y2020.S0101

Table 353: Age Demographic Projections for Washington County

Age	2025 Estimated Percent of Population[576] and Age Dependency Ratio	2030 Estimated Percent of Population[577] and Age Dependency Ratio	2035 Estimated Percent of Population[578] and Age Dependency Ratio	2040 Estimated Percent of Population[579] and Age Dependency Ratio	2045 Estimated Percent of Population[580] and Age Dependency Ratio
Younger Than 15 Years Old	16.9% 25.4	16.6% 25.2	16.9% 28.5	17% 29.2	16.8% 26
65 Years Old and Older	16.4% 24.7	17.8% 27	18.4% 28.5	18.8% 29.2	18.9% 29.2

The County's population forecast shows a steady increase in residents that are older than 64 years old. As the population ages, the County may need to consider different mitigation and preparedness actions to address the specific needs of this group. The age-dependent population is expected to consist of a greater share of older adults in the future. The overall age dependency ratio is expected to be 55.2 in 2045, however the ratio for adults 65 and older is expected to increase from 20.9 to 29.2.

An area's age profile has a direct impact on both what mitigation actions are prioritized and how responses to hazard incidents are carried out. People who are younger than 18 years of age rarely make decisions about mitigation and preparedness. Therefore, a larger youth population in an area will increase the importance of outreach to schools and parents on effective ways to teach children about fire safety, earthquake response, and evacuation plans. Furthermore, children are more vulnerable to the heat and cold, have few transportation options, and require assistance to access medical facilities. Older populations may also have special needs prior to, during, and after a natural disaster. Older populations may require assistance in evacuation due to limited mobility or health issues. Additionally, older populations may require special medical equipment or medications, and can lack the social and economic resources needed for post-disaster recovery.[581]

[576] Portland State University College of Urban and Public Affairs Population Research Center. (2020, June 30). *Coordinated Population Forecast for Washington County, Its Urban Growth Boundaries (UBG), and Area Outside UGBs 2020–2070.* https://ondeck.pdx.edu/population-research/sites/g/files/znldhr3261/files/2020-07/Washington_Report_Final_2020.pdf

[577] Portland State University College of Urban and Public Affairs Population Research Center. (2020, June 30). *Coordinated Population Forecast for Washington County, Its Urban Growth Boundaries (UBG), and Area Outside UGBs 2020–2070.* https://ondeck.pdx.edu/population-research/sites/g/files/znldhr3261/files/2020-07/Washington_Report_Final_2020.pdf

[578] Portland State University College of Urban and Public Affairs Population Research Center. (2020, June 30). *Coordinated Population Forecast for Washington County, Its Urban Growth Boundaries (UBG), and Area Outside UGBs 2020–2070.* https://ondeck.pdx.edu/population-research/sites/g/files/znldhr3261/files/2020-07/Washington_Report_Final_2020.pdf

[579] Portland State University College of Urban and Public Affairs Population Research Center. (2020, June 30). *Coordinated Population Forecast for Washington County, Its Urban Growth Boundaries (UBG), and Area Outside UGBs 2020–2070.* https://ondeck.pdx.edu/population-research/sites/g/files/znldhr3261/files/2020-07/Washington_Report_Final_2020.pdf

[580] Portland State University College of Urban and Public Affairs Population Research Center. (2020, June 30). *Coordinated Population Forecast for Washington County, Its Urban Growth Boundaries (UBG), and Area Outside UGBs 2020–2070.* https://ondeck.pdx.edu/population-research/sites/g/files/znldhr3261/files/2020-07/Washington_Report_Final_2020.pdf

[581] Wood, Nathan. Variations in City Exposure and Sensitivity to Tsunami Hazards in Oregon. U.S. Geological Survey, Reston, Virginia, 2007.

1.2.8. Households and Families

Two ways the Census defines households are by type of living arrangement and family structure. There are 223,040 total households in the County, with an average household size of 2.64 people.[582] People 65 years old and over account for 9.7% of householders living alone.[583]

Table 354: Household Types in Washington County[584]

Household Type	Estimated Percent of Population
Married Couple Household	53%
Householder Living Alone	23.8%
Cohabiting Couple Household	8.2%
Households with one or more people aged under 18 years	33.4%
Households with one or more people aged 65 years and over	25.4%

The table below shows the demographics of households with children. The category married couple includes opposite sex couples, same sex couples, and couples in common-law marriages. The male and female householder only categories include single parent households. Single parents may have a harder time gathering and accessing the resources to rebuild after a disaster.[585] These households may need additional support to mitigate, prepare, and recover.

Table 355: Demographics of Families with Children in Washington County[586]

Age of Children	Estimated Percent of Married Couple Households	Estimated Percent of Male Householder Only	Estimated Percent of Female Householder Only
Under 6 Years of Age Only	23.7%	23.5%	14.6%
Under 6 Years of Age and 6 to 17 Years Old	20.5%	11.2%	18.4%
6 to 17 Years Old Only	55.8%	65.3%	67%

[582] United States Census American Community Survey. (2015-2020). Selected Social Characteristics in the United States. Accessed April 15, 2022, from https://data.census.gov/cedsci/table?q=Washington%20County,%20Oregon%20dp02&tid=ACSDP5Y2020.DP02
[583] United States Census American Community Survey. (2015-2020). Selected Social Characteristics in the United States. Accessed April 15, 2022, from https://data.census.gov/cedsci/table?q=Washington%20County,%20Oregon%20dp02&tid=ACSDP5Y2020.DP02
[584] United States Census American Community Survey. (2015-2020). Selected Social Characteristics in the United States. Accessed April 15, 2022, from https://data.census.gov/cedsci/table?q=Washington%20County,%20Oregon%20dp02&tid=ACSDP5Y2020.DP02
[585] Center for Disaster Philanthropy. (2021, August 3). Parenting Alone – Single Parents in Disasters. https://disasterphilanthropy.org/blog/parenting-alone-single-parents-in-disasters/
[586] United States Census American Community Survey. (2015-2020). Family Type by Presence and Age of Own Children Under 18 Years. Accessed April 15, 2022, from https://data.census.gov/table?q=Washington+County,+Oregon+b11003&tid=ACSDT5Y2020.B11003&moe=false

1.2.8.1. Unhoused Populations

Unhoused and unsheltered populations have few resources to rely on, especially during an emergency. It will likely be the responsibility of the County, cities, and local nongovernmental entities to provide services such as shelter, food, and medical support. Therefore, it is critical to foster collaborative relationships with agencies that will provide additional relief, such as the American Red Cross and sheltering organizations. It is also important to identify how best to communicate with these populations, since traditional means of communication may not be appropriate or available.

The 2022 Point-in-Time Sheltered and Unsheltered Count in Washington County identified 808 people in this population.[587] This included 171 children under the age of 18, 44 people aged 18 to 24, and 593 people over the age of 24.[588]

1.2.9. Income

Household income and poverty status are indicators of resilience ability and the stability of the local economy. Household income can be used to compare the economic strength of areas at a high level.

Between 2010 and 2020 the share of households making more than $150,000 increased more than other income groups; the next largest group gain was for households earning between $100,000 and $149,999. Although the absolute number of households earning less than $25,000 increased, as a share of the population, it went down. The share of households making $25,000-$49,999 decreased in absolute and relative terms, as did the share making $50,000-$74,999.

Table 356: Household Income Change from 2010-2020 in Washington County*

Household Income	Estimated Percent of Households in 2010[589]	Estimated Percent of Households in 2020[590]	Percent Change Between 2010-2020
Less than $25,000	16%	10%	-6%
$25,000 to $49,999	23%	16%	-7%
$50,000 to $74,999	20%	17%	-3%
$75,000 to $99,999	14%	14%	0%
$100,000 to $149,999	16%	21%	5%
$150,000 to $199,999	11%	22%	11%

***Numbers are rounded to account for the margin of error. Incomes are in nominal dollars not adjusted for inflation.

[587] Washington County Housing Services. (2022, April 11). 2022 Point-in-Time Summary for OR-506CoC (Federal Only). https://www.co.washington.or.us/Housing/EndHomelessness/upload/01-26-2022-PIT-Final-Data-Submitted-to-HUD-04-11-2022.pdf
[588] Washington County Housing Services. (2022, April 11). 2022 Point-in-Time Summary for OR-506CoC (Federal Only). https://www.co.washington.or.us/Housing/EndHomelessness/upload/01-26-2022-PIT-Final-Data-Submitted-to-HUD-04-11-2022.pdf
[589] United States Census American Community Survey. (2006-2010). Financial Characteristics, Table S2503. Accessed April 15, 2022.
[590] United States Census American Community Survey. (2015-2020). Financial Characteristics, Table S2503. Accessed April 15, 2022.

Table 357: Estimated Median Household Income[591]*

Jurisdiction	Estimated Household Income
City of Beaverton	$78,000
City of Cornelius	$73,000
City of Forest Grove	$70,000
City of Hillsboro	$86,000
City of North Plains	$96,000
City of Sherwood	$108,000
City of Tigard	$87,000
Washington County	$87,000

*Numbers rounded to account for the margin of error.

The 2020 median household income across Washington County was $86,626; however, this does not reflect potential impact of the COVID-19 pandemic. Sherwood's median household income in 2020 was higher than in the County, while incomes in Beaverton and Forest Grove were lower. Median incomes have risen in all jurisdictions since 2010.

The table below identifies the percentage of individuals and cohort groups that were below the poverty level in 2020. It is estimated that 9% of individuals and 10% of children under 18 live below the poverty level across the County. While most cities have poverty rates similar to that of the County overall, the cities of North Plains and Sherwood have lower rates of poverty for the overall population and among children. The City of Forest Grove may have a higher rate of poverty among adults aged 65 or older, but this cannot be shown with full confidence, given the sampling variability.

Table 358: Poverty Status in the Past 12 Months[592]*

Jurisdiction	Total Population in Poverty		Children Under the Age of 18 in Poverty		Adults Aged 18 to 64 in Poverty		Adults 65 Years Old or Older in Poverty	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
City of Beaverton	10,000	10%	2,000	13%	6,000	10%	1,000	8%
City of Cornelius	13,000	10%	<1,000	6%	1,000	12%	<1,000	7%
City of Forest Grove	3,000	11%	1,000	12%	2,000	10%	<1,000	11%
City of Hillsboro	10,000	9%	3,000	13%	6,000	8%	1,000	9%
City of North Plains	<1,000	4%	<1,000	8%	<1,000	4%	<1,000	1%

[591] United States Census American Community Survey. (2015-2020). Financial Characteristics, Table S2503. Accessed April 15, 2022.
[592] United States Census American Community Survey. (2015-2020). Poverty Status in the Past 12 Months, Table S1701. Accessed April 15, 2022.

Jurisdiction	Total Population in Poverty		Children Under the Age of 18 in Poverty		Adults Aged 18 to 64 in Poverty		Adults 65 Years Old or Older in Poverty	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
City of Sherwood	1,000	4%	<1,000	3%	<1,000	3%	<1,000	8%
City of Tigard	4,000	8%	1,000	10%	3,000	8%	1,000	6%
Washington County	50,000	9%	14,000	10%	31,000	8%	5,000	7%

* Numbers rounded to account for sampling errors.

Research shows a lack of wealth contributes to social vulnerability because individual and community resources are not as readily available. Affluent communities are more likely to have the collective and individual capacity to rebound from a hazard event more quickly, while less wealthy communities and individuals may not have this capacity, leading to increased vulnerability. Wealthier individuals and communities may also have more resources to invest in mitigation activities, preventing or lessening impacts from hazards. Conversely, poverty, at both an individual and community level, can drastically alter recovery time and quality.[593]

Utilization of assistance programs are another indicator of poverty or lack of resource access in communities and among individuals. Statewide social assistance programs like the Supplemental Nutritional Assistance Program (SNAP) provide assistance to individuals and families. In Washington County, SNAP serves an average of 51,621 people in 28,243 households a month.[594] Yearly, an average of 620,000 people in 340,000 households have an approximant available allotment of $109,000,000 of SNAP.[595] Those who use assistance programs are more vulnerable in the wake of disaster because of a lack of personal financial resources and reserves, increasing reliance on government support.

1.2.10. Education

Educational attainment of community residents is also identified as an influencing factor in resiliency. Educational attainment often reflects higher income and therefore higher self-reliance. Widespread educational attainment is also beneficial for the County's economy and employment sectors as there are potential employees for workforces. An oversaturation of either high educational attainment or low educational attainment can have negative effects on the resiliency of the community.

According to the U.S. Census Bureau, approximately 93.0% of the Washington County population over 25 years of age has graduated from high school or received a high school equivalency, with around 45% going on to earn a bachelor's degree.[596] Cornelius has the highest share of population that has less than a high school diploma and the smallest share with an advanced college degree.

[593] Cutter, S. L. (2003, May 19). Social Vulnerability to Environmental Hazards. *Social Science Quarterly.* https://doi.org/10.1111/1540-6237.8402002
[594] Washington County NHMP planning documentation, SNAP County Tables by FIPS January 2020–December 2020.
[595] Washington County NHMP planning documentation, SNAP County Tables by FIPS January 2020–December 2020.
[596] United States Census. (2020). Educational Attainment, Table S1501. Accessed April 15, 2022.

Table 359: Highest Level of Educational Attainment, Population 25 Years and Older[597*]

Highest Level of Educational Attainment	City of Beaverton	City of Cornelius	City of Forest Grove	City of Hillsboro	City of North Plains	City of Sherwood	City of Tigard	Washington County
Less Than 9th Grade	3%	16%	4%	5%	1%	1%	3%	4%
Some High School, No Diploma	4%	9%	5%	5%	4%	2%	3%	4%
High School Graduate or GED	17%	23%	26%	19%	19%	13%	16%	18%
Some College, No Degree	22%	21%	28%	21%	28%	25%	24%	21%
Associate's Degree	8%	12%	6%	9%	8%	8%	10%	9%
Bachelor's Degree	31%	15%	19%	24%	25%	32%	29%	28%
Graduate or Professional Degree	17%	4%	12%	18%	15%	19%	15%	17%

* Numbers rounded to account for the margin of error.

[597] United States Census. (2020). Educational Attainment, Table S1501. Accessed April 15, 2022.

1.2.11. Disability Characteristics

The Resilience Capacity Index recognizes those with disabilities have higher vulnerability to hazards and will likely require additional community support and resources.

As of 2020, 11% of the total Washington County non-institutionalized population identifies as having one or more disabilities. Forest Grove has the highest percentage of its total population with a disability (17%). Forest Grove also has the highest percentage of individuals under 18 (10%) and 65 years and over with a disability (58%). The cites of Cornelius and Forest Grove have the highest percentage of adults aged 18 to 64 with one or more disabilities at 13%. Data was not available for the City of North Plains.

The table below describes the disability status of the civilian noninstitutionalized population.

Table 360: Disability Characteristics of the Civilian Noninstitutionalized Population[598]*

Jurisdiction	Civilian Noninstitutionalized Population with a Disability							
	Total		Children Under the Age of 18		Adults Aged 18 to 64		Adults 65 Years Old or Older	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
City of Beaverton	11,000	11%	1,000	6%	6,000	10%	2,000	35%
City of Cornelius	2,000	16%	<1,000	4%	1,000	13%	1,000	60%
City of Forest Grove	4,000	17%	<1,000	10%	2,000	13%	2,000	58%
City of Hillsboro	11,000	11%	1,000	7%	6,000	9%	4,000	40%
City of Sherwood	2,000	11%	<1,000	6%	1,000	10%	1,000	43%
City of Tigard	6,000	13%	1,000	8%	3,000	10%	2,000	34%
Washington County	61,000	11%	5,000	3%	30,000	8%	25,400	34%

* Numbers rounded to account for the margin of error. Data not available for the City of North Plains.

1.2.12. Access to Healthcare

Individual and community health play an integral role in community resiliency, as indicators such as health insurance, people with disabilities, and houselessness paint an overall picture of a community's well-being. These factors translate to a community's ability to prepare, respond to, and cope with the impacts of a disaster.

Of the larger cities in Washington County, Cornelius has the highest percentage of population without health insurance. Countywide, 88% of the people who lack health insurance are between the ages of 19

[598] United States Census 2015–2020 American Community Survey. (2021). Table DP02 for each jurisdiction. Accessed April 15, 2022.

and 64, 11% are children aged 18 and younger, and 1% are adults age 65 and older. The ability to provide services to uninsured populations may burden local providers following a natural disaster.

Table 361: Population Without Health Insurance[599]

Jurisdiction	Population Without Health Insurance							
	Total		Children Under the Age of 19		Adults Aged 19 to 64		Adults 65 Years Old or Older	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
City of Beaverton	7,000	8%	1,000	6%	6,000	11%	<1,000	1%
City of Cornelius	2,000	18%	<1,000	12%	1,000	13%	<1,000	2%
City of Forest Grove	1,000	6%	<1,000	2%	1,000	9%	<1,000	1%
City of Hillsboro	7,000	7%	1,000	4%	6,000	10%	<1,000	1%
City of North Plains	<1,000	4%	<1,000	4%	<1,000	5%	0	0%
City of Sherwood	<1,000	2%	<1,000	2%	<1,000	3%	<1,000	2%
City of Tigard	3,000	7%	<1,000	4%	3,000	9%	<1,000	1%
Washington County	33,000	5%	3,000	3%	29,000	8%	<1,000	1%

* Numbers rounded to account for the margin of error.

1.3. Economic Data

Economic capacity refers to the financial resources present, and revenue generated in the community to achieve a higher quality of life. Income equality, housing affordability, economic diversification, employment, and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the component parts of employment sectors, workforce, resources, and infrastructure are interconnected in the existing economic picture. Once any inherent strengths or systematic vulnerabilities become apparent, both the public and private sectors can take action to increase the resilience of the local economy.

1.3.1. Income Equality

Income equality is a measure of the distribution of economic resources, as measured by income, across a population. It is a statistic defining the degree to which all persons have a similar income. Income inequality is the difference in the distribution of income between individuals or populations.

The table below illustrates the County and cities' level of income equality. The Gini Index is a summary measure of income equality as is used by the United States Census Bureau. The Gini coefficient incorporates the detailed shares data into a single statistic, which summarizes the dispersion of income across the entire income distribution. The Gini coefficient ranges from 0, indicating perfect equality (where

[599] United States Census 2015–2020 American Community Survey. (2021). Tables S2701 and S2702. Accessed April 15, 2022.

everyone receives an equal share), to 1, perfect inequality (where only one recipient or group of recipients receives all the income).[600]

Table 362: Income Equality Coefficient in Washington County[601]*

Jurisdiction	Income Equality Coefficient
City of Beaverton	0.40–0.43%
City of Cornelius	0.34–0.43%
City of Forest Grove	0.39–0.44%
City of Hillsboro	0.38–0.41%
City of North Plains	0.30–0.36%
City of Sherwood	0.36–0.42%
City of Tigard	0.39–0.42%
Washington County	0.41–0.42%

* Gini Index; includes margin of error

The cities within the County have similar income equality scores. Smaller cities, including North Plains and Cornelius, have slightly greater income equality than do the larger cities and the County overall. Based on social science research, the region's cohesive response to a hazard event may be affected by the distribution of wealth in communities that have less income equality.[602]

1.3.2. Regional Affordability

The evaluation of regional affordability supplements the identification of social and demographic capacity indicators and is a critical analysis tool to understanding the economic status of a community. This information can capture the likelihood of an individuals' ability to prepare for hazards, through retrofitting homes or purchasing insurance. If the community reflects a high level of income inequality or housing cost burden, the potential for homeowners and renters to implement mitigation can be drastically reduced. Therefore, regional affordability is a mechanism for generalizing the abilities of community residents to get back on their feet without federal, state, or local assistance.

1.3.3. Housing Affordability

Housing affordability is a measure of economic security gauged by the percentage of an area's households paying less than 30% of their income on housing. Households spending more than 30% are considered housing cost burdened.[603] The table below displays the percentage of homeowners and renters reflecting housing cost burden in the County. Data was not available for the City of North Plains.

[600] United States Census Bureau. (2021, October 8). Gini Index. https://www.census.gov/topics/income-poverty/income-inequality/about/metrics/gini-index.html
[601] United States Census Bureau. (2020). 2016–2020 American Community Survey 5-Year Estimates, Gini Index of Income Inequality, Table B19083. Accessed April 15, 2022.
[602] Cutter, S., Burton, C.G., & Emrich, C.T. (2010, August 4). Disaster Resilience Indicators for Benchmarking Baseline Conditions. *Journal of Homeland Security and Emergency Management.* https://doi.org/10.2202/1547-7355.1732
[603] U.S. Department of Housing and Urban Development's Office of Policy Development and Research. (n.d.). Rental Burdens: Rethinking Affordability Measures. https://www.huduser.gov/portal/pdredge/pdr_edge_featd_article_092214.html#:~:text=HUD%20defines%20cost%2Dburdened%20families,of%20one's%20income%20on%20rent

Table 363: Percentage of Cost-Burdened Households in Washington County[604]

Jurisdiction	Owners		Renters
	With Mortgage	Without Mortgage	
City of Beaverton	24%–28%	14%–16%	42%–51%
City of Cornelius	22%–36%	18%–28%	46%–76%
City of Forest Grove	20%–32%	7%–10%	46%–59%
City of Hillsboro	22%–27%	12%–14%	37%–47%
City of North Plains			
City of Sherwood	23%–34%	4%–6%	42%–54%
City of Tigard	21%–27%	13%–16%	49%–54%
Washington County*	25%–27%	12%–14%	45%–48%

The City of Cornelius has the highest percentage of residents with a housing cost burden across all categories measured. In general, the population that spends more of their income on housing has proportionally fewer resources and less flexibility for alternative investments in times of crisis.[605] This disparity imposes challenges for a community recovering from a disaster as housing costs may exceed the ability of residents to repair property or move to a new location.

1.3.4. Economic Diversity

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times. Business activity in the Willamette Valley region is mostly homogeneous in that it consists mainly of small businesses.

While illustrative, economic diversity is not a guarantor of economic vitality or resilience. As of 2022, Washington County is classified as non-distressed by Business Oregon, the state's economic development agency.[606] The index used to determine whether an area is distressed or non-distressed includes relative unemployment rate, relative per capital personal income, average wage change, and employment change.[607]

As prescribed by State of Oregon law, Business Oregon gives priority when funding technical assistance, programs, and projects to geographic areas determined to be economically distressed.

[604] United States Census Bureau. (2020). American Community Survey, Table DP04. Accessed April 15, 2022.
[605] 2020–2023 Washington County Community Health Improvement Plan. (2021, March). Neighborhood and Built Environment – Housing. https://www.co.washington.or.us/HHS/upload/Washington-County-CHIP-2020-2023.pdf
[606] Business Oregon. (2022, March 31). Distressed Areas in Oregon. https://www.oregon.gov/biz/reports/Pages/DistressedAreas.aspx
[607] Business Oregon. (2022, March 31). Distressed Areas in Oregon. https://www.oregon.gov/biz/reports/Pages/DistressedAreas.aspx

1.3.5. Employment and Wages

According to the Oregon Employment Department, unemployment has been declining since 2006, except for the increases associated with the Great Recession and the COVID-19 pandemic. The County's unemployment rate is typically lower than the rate for Oregon.

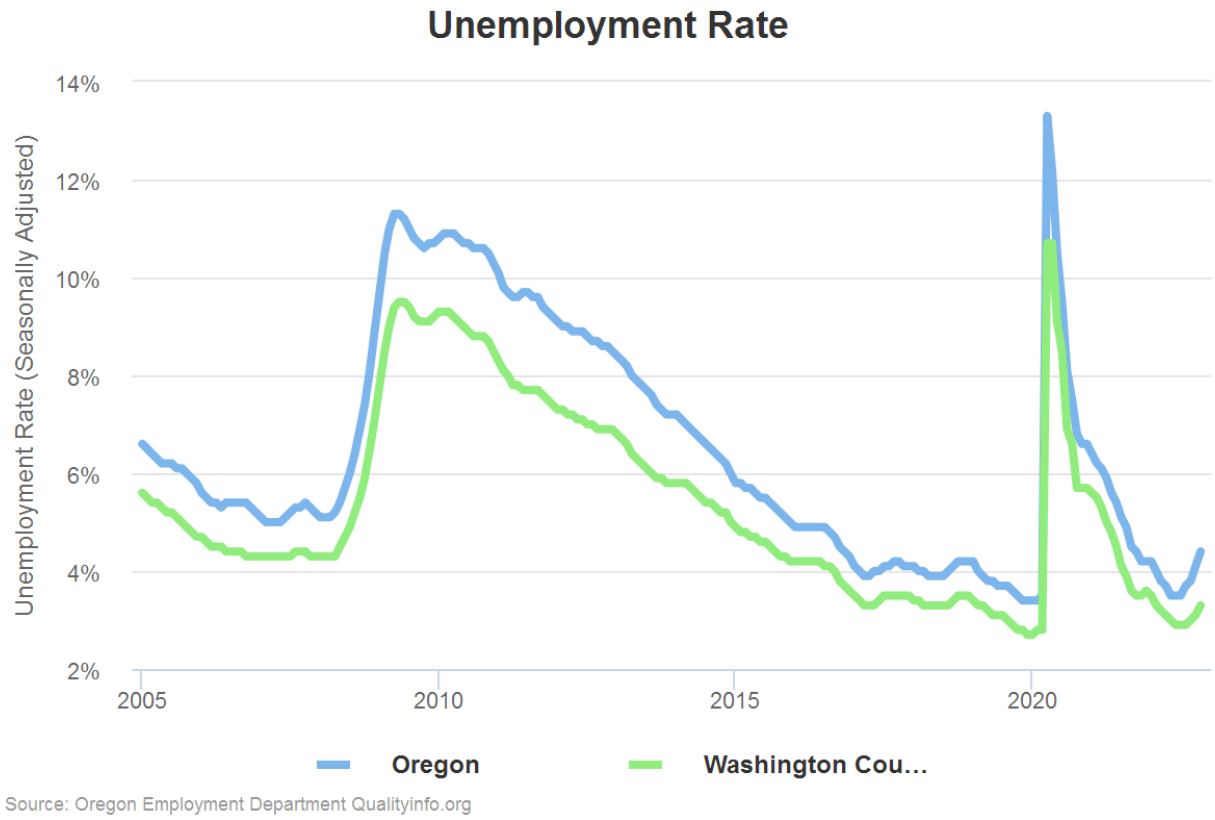


Figure 45: Seasonally Adjusted Unemployment Rate in Oregon and Washington County[608]

The median earnings for workers in Washington County are $42,586, with median earnings for full-time, year-round workers who identify as male being $67,505 and median earnings for full-time, year-round workers who identify as female being $51,768.[609] In June 2022, there were a total of 303,800 employees in the County.[610]

Washington County employers drew in 49% of their workers from outside the County, as of the 2019 data. The Washington County economy is a cornerstone of regional economic vitality. According to the Census Bureau's 2019 Longitudinal Employer-Household Dynamics dataset, 152,000 of the 314,000 jobs in Washington County are held by people commuting in from another county, and 161,000 are held by

[608] State of Oregon Employment Department. (July, 2022). Local Areas, Portland-Metro, Unemployment Rate. https://www.qualityinfo.org/portland-metro?region=4117000001~ces~00000000~false~true~true~false~true~false?region=4117000001~laus~false~true~true~false~true~false

[609] United States Census Bureau. (2020). Selected Economic Characteristics. Accessed April 15, 2022, from https://data.census.gov/cedsci/table?q=washington%20County%20oregon%20employment

[610] State of Oregon Employment Department. (2022, June). Washington County Economic Indicators July 2022. https://data.census.gov/cedsci/table?q=washington%20County%20oregon%20employment

people living in Washington County. Of the 297,000 employees living in Washington County, 136,000, or 46%, commute out of the County.[611]

Approximately 81% of commuters travel by car; 8 out of 9 of these individuals commute alone and 1 in 9 carpool.[612] Around 5% of commuters travel via public transportation and 2.5% walk. Ten percent of people worked from home; however, this percentage could be inflated due to modified work environments in response to the COVID-19 pandemic.

Increased commuting creates a greater dependency on roads, communications, accessibility, and, in the event of a hazard incident, emergency evacuation routes to reunite people with their families. Before a natural hazard event, large or small businesses can develop strategies to prepare for natural hazards, respond efficiently, and prevent loss of life and property.

Mitigation activities are needed at the business level to ensure the health and safety of workers and limit damage to industrial infrastructure. Employees are highly mobile, commuting from all over the surrounding area to industrial and business centers. As daily transit rises, there is an increased risk that a natural hazard event will disrupt the travel plans of residents across the County and seriously hinder the ability of the economy to meet the needs of Washington County residents and businesses.

1.3.6. Industry

Key industries are those that represent major employers and are significant revenue generators. Different industries face distinct vulnerabilities to natural hazards, as illustrated by the industry-specific discussions below. Identifying key industries in the County enables communities to target mitigation activities towards those industries' specific sensitivities. It is important to recognize that the impact a natural hazard event has on one industry can reverberate throughout the County's economy.

This is of specific concern when the businesses belong to the basic sector industry. Basic sector industries are those that are dependent on sales outside of the local community and bring money into a local community via employment. The farm and ranch, information, and wholesale trade industries are all examples of basic industries. Non-basic sector industries are those that are dependent on local sales for their business, such as retail trade, construction, and health services.

1.3.7. Employment by Industry

Economic resilience to natural disasters is particularly important for the major employment industries in the County. If these industries are negatively impacted by a natural hazard, such that employment is affected, the impact will be felt throughout the regional economy. Thus, understanding and addressing the sensitivities of these industries is a strategic way to increase the resiliency of the entire regional economy.

The table below identifies employment by industry. The top five industry sectors in Washington County with the most employees, as of 2021, are professional and business services, trade, transportation and utilities, manufacturing, education and health services, and healthcare and social assistance. While Washington County has some basic industries, such as manufacturing, four out of their five largest industrial sectors are of the non-basic nature and thus they rely on local sales and services. Trending towards basic industries can lead to higher community resilience.

[611] United States Census. (2019). Longitudinal Employer-Household Dynamics. Accessed April 15, 2022, from https://lehd.ces.census.gov/data/
[612] United States Census. (2019). Longitudinal Employer-Household Dynamics. Accessed April 15, 2022, from https://lehd.ces.census.gov/data/

Table 364: Seasonally Adjusted Unemployment Rate in Oregon and Washington County[613]

Industry Description*	2021				Change in Jobs from 2015–2021	Employment Forecast Growth from 2020–2030
	Firms or Units	Total Employees	Percent of Employees	Average Wage		
Total Payroll Employment	21,616	294,276	100%	$90,708	7%	17%
Total Private Employment	21,313	274,116	93%	$92,244	9%	18%
Natural Resources and Mining	230	3,667	1%	$42,512	17%	9%
Construction	1,856	18,159	6%	$79,908	38%	13%
Manufacturing	858	51,694	18%	$108,328	10%	11%
Trade, Transportation, and Utilities	3,315	52,713	18%	$61,216	10%	12%
Wholesale Trade	1,441	13,846	5%	$108,544	8%	11%
Retail Trade	1,548	31,549	11%	$42,924	2%	10%
Information	687	7,392	3%	$124,560	0%	15%
Financial Activities	1,913	14,824	5%	$77,768	6%	8%
Professional and Business Services	4,221	53,821	18%	$173,712	2%	19%
Education and Health Services	3,465	36,822	13%	$57,808	11%	19%
Healthcare and Social Assistance	3,137	31,778	11%	$59,992	14%	19%
Leisure and Hospitality	1,597	24,735	8%	$27,736	3%	46%
Accommodations and Food Services	1,348	21,035	7%	$27,780	4%	44%
Other Services	1,806	9,286	3%	$58,560	0%	20%

[613] State of Oregon Employment Department. (2022, July). Local Areas, Portland-Metro, Unemployment Rate. https://www.qualityinfo.org/portland-metro?region=4117000001~ces~00000000~false~true~true~false~true~false?region=4117000001~laus~false~true~true~false~true~false

Industry Description*	2021				Change in Jobs from 2015–2021	Employment Forecast Growth from 2020–2030
	Firms or Units	Total Employees	Percent of Employees	Average Wage		
Government	303	20,160	7%	$69,824	-11%	9%
Federal	27	896	<1%	$77,572	18%	1%
State	33	2,169	1%	$73,868	-33%	8%
Local	243	17,095	6%	$68,904	-8%	11%

* The sectors with the largest number of employees are in bold.

1.3.8. Key Resources

- **Commercial Facilities:** The Washington County Visitors Association boasts shopping as a major attraction. Oregon has no sales tax and the Metro Region is easily accessible by residents of Washington State. There are several well-developed shopping destinations in the County, including Washington Square Mall, Tanasbourne Town Center, Bridgeport Village Mall, and Cedar Hills Crossing.
- **Critical Manufacturing:** Washington County is home to a number of large technology companies, including Intel, Tektronix, and LAM Research. These campuses have both software development and manufacturing components.
- **Large Retail Employers:** The 400-acre world headquarters campus for Nike, Inc. is in unincorporated Washington County and employs over 11,000 people. Additionally, the headquarters for Columbia Sportswear Company is also in the unincorporated area of the County and employs approximately 9,000 people.

1.3.9. High Revenue Sectors

In 2017, the most recent year for which data is available, the three sectors with the highest revenue were manufacturing, wholesale trade, and retail trade.[614] The table below shows the revenue generated by each reported economic sector. In 2017, industries located in Washington County generated a total of almost $58 billion in revenue.

Table 365: Revenue of Top Economic Sectors in Washington County[615]

Economic Sector	Sector Revenue	Percent of Total Revenue
Manufacturing	$19,630,000,000	34%
Wholesale Trade	$12,095,000,000	21%
Retail Trade	$11,938,000,000	21%
Healthcare and Social Assistance	$4,422,000,000	8%
Professional, Scientific, and Technical Services	$2,523,000,000	4%
Administrative and Support, and Waste Management and Remediation Services	$2,332,000,000	4%
Accommodation and Food Services	$1,417,000,000	2%
Real Estate, Rental, and Leasing	$1,268,000,000	2%
Other Services (Except Public Administration)	$1,136,000,000	2%
Transportation and Warehousing	$808,000,000	1%
Arts, Entertainment, and Recreation	$248,000,000	0%
Educational Services	$133,000,000	0%
Total	**$57,950,000,000**	**100%**

Washington County relies on both basic and non-basic sector industries and it is important to consider the effects each may have on the economy following a disaster. Basic sector businesses have a multiplier effect on a local economy that can spur the creation of new jobs, some of which may be non-basic. The presence of basic sector jobs can help speed the local recovery; however, if basic sector production is hampered by a natural hazard event, the multiplier effect could be experienced in reverse. In this case, a decrease in basic sector purchasing power results in lower profits and potential job losses for the non-basic businesses that are dependent on them.

The manufacturing sector was the largest revenue generator, generating $19.6 billion in revenue in 2017, the most recent year for which data is available. It is highly dependent upon the transportation network in order to access supplies and send finished products to outside markets. As a base industry, manufacturers are not dependent on local markets for sales, which contribute to the economic resilience of this sector.

[614] United States Census Bureau. (2017). 2017 Economic Census Survey, Table EC1700BASIC. Accessed April 15, 2022.
[615] United States Census Bureau. (2017). 2017 Economic Census Survey, Table EC1700BASIC. Accessed April 15, 2022.

Wholesale trade generated nearly $12.1 billion. Wholesale Trade is closely linked with retail trade but it has a broader client base, with local and non-local businesses as the typical clientele. Local business spending will be likely to diminish after a natural disaster, as businesses repair their properties and wait for their own retail trades to increase. Distanced clients may have difficulty reaching the local wholesalers due to transportation disruptions from a natural disaster.

The Retail trade sector generated $11.9 billion, making it the third largest earning sector in Washington County. The Retail trade sector typically relies on local residents and tourists and their discretionary spending ability. Residents' discretionary spending diminishes after a natural disaster when they must pay to repair their homes and properties. In this situation, residents will likely concentrate their spending on essential items that would benefit some types of retail (e.g., grocery) but hurt others (e.g., gift shops). The potential income from tourists also diminishes after a natural disaster as people are deterred from visiting the impacted area. Retail trade is also largely dependent on wholesale trade and the transportation network for the delivery of goods for sale. Disruption of the transportation system could have severe consequences for retail businesses. In summary, depending on the type and scale, a disaster could affect specific segments of retail trade, or all segments.

In the event that any of these primary sectors are impacted by a disaster, Washington County may experience a significant disruption of economic productivity.

1.3.10. Future Employment in Industry

Between 2015 and 2021 the sector that experienced the largest percent growth was Construction, which was rebounding from the Great Recession. Other key growth sectors were federal government and natural resource and mining, though each of these were starting from relatively small bases. Education and health services—led by the healthcare and social assistance subsector—was the other sector with large growth over the last six years. The Manufacturing and Trade, transportation and utilities, sectors also grew by 10%. Some of these sectors often require more training and education, while others require less education and have lower wages.

Sectors that are anticipated to be major employers in the future also warrant special attention in the hazard mitigation planning process. Between 2020 and 2030, the largest employment growth is anticipated within leisure and hospitality, accommodations and food services, other services, healthcare and social assistance, education and health services, and professional and business services.

1.4. Built Environment Capacity

The built environment refers to the physical features that provide spaces for living, working and recreating in a community, such as buildings, roads, parks and open spaces, and utilities. The amount and quality of the built environment contributes significantly to the resiliency of the community to withstand and respond to hazards. Physical infrastructures, including utility and transportation lifelines, are critical during a disaster and are essential for proper functioning and response. The lack or poor condition of infrastructure can negatively affect a community's ability to cope, respond, and recover from a natural disaster. Following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions force communities to rely on local and immediately available resources.

1.4.1. Land Use and Development Patterns

One significant way in which Washington County residents can increase or decrease their vulnerability to natural hazards is through development patterns. The way in which land is used (e.g., is it a parking lot or maintained as an open space?) will determine how closely the man-made systems of transportation, economy, etc., interact with the natural environment. All patterns of development, density as well as sprawl, bring separate sets of challenges for hazard mitigation. Current land use in unincorporated

Washington County includes urban development, high-tech industries, agriculture and farming activities, forests, rural residential, and recreational uses.

1.4.1.1. Regulatory Context

Since 1973, Oregon has maintained a strong statewide program for land use planning. The foundation of that program is a set of 19 statewide planning goals that express the state's policies on land use and on related topics, such as citizen involvement, land use planning, and natural resources.

Oregon's statewide planning goals are achieved through local comprehensive planning. State law requires each city and county to adopt a comprehensive plan and the zoning and land division ordinances needed to put the plan into effect. The local comprehensive plans must be consistent with the statewide planning goals. Plans are reviewed for such consistency by the state's Land Conservation and Development Commission (LCDC).

Oregon's statewide planning goals and land use laws require the majority of rural land outside Urban Growth Boundaries (UGBs) to be protected for farm, forest, and aggregate resource values. State and local policies currently direct growth away from rural lands into UGBs, and, to a lesser extent, into rural communities.

If development follows historical development trends, urban areas will expand their UGBs, rural unincorporated communities will continue to grow, and overall rural residential density will increase slightly with the bulk of rural lands kept in farm and forest use. The existing pattern of development in the rural areas, that of radiating out from the urban areas along rivers and streams, is likely to continue. Most of the "easy to develop" land in unincorporated Washington County is already developed, in general leaving more constrained land, such as land in the floodplains or on steep slopes, for potential development in the future, perhaps increasing the rate at which development occurs in natural hazard-prone areas.

1.4.1.2. Statewide Planning Goal 7

Statewide Planning Goal 7, Areas Subject to Natural Disasters and Hazards, has the overriding purpose to "protect people and property from natural hazards." Goal 7 states "local governments shall adopt comprehensive plans (inventories, policies, and implementing measures) to reduce risk to people and property from natural hazards."[616] Natural hazards include floods, landslides, earthquakes, tsunamis, coastal erosion, and wildfires.

When federal or state agencies provide new natural hazard information, the state's Department of Land Conservation and Development (DLCD) directs local jurisdictions to evaluate the hazard risk and assess the:

- Frequency, severity, and location of the hazard;
- Effects of the hazard on existing and future development;
- Potential for development in the hazard area to increase the frequency and severity of the hazard; and
- Types and intensities of land uses to be allowed in the hazard area.

Based on the evaluation of risk, local governments must adopt or amend plan policies and implementing measures consistent with the following principles:

[616] Oregon Department of Land Conservation and Development. (2001 September 28). Oregon's Statewide Planning Goals and Guidelines Goal 7: Areas Subject to Natural Hazards. https://www.oregon.gov/lcd/OP/Documents/goal7.pdf

- Avoiding development in hazard areas where the risk to people and property cannot be mitigated
- Prohibiting the siting of essential facilities, major structures, hazardous facilities, and special occupancy structures in identified hazard areas where the risk to public safety cannot be mitigated

Local governments will be in compliance with State requirements with Goal 7 for coastal and riverine hazards through the adoption and implementation of local floodplain regulations meeting minimum National Flood Insurance Program (NFIP) requirements. Local jurisdictions adopting plan policies and implementing measures to protect people and property from natural hazards should consider:

- The benefits of maintaining natural hazard areas as open space, recreation, and other low density uses;
- The beneficial effects that natural hazards can have on natural resources and the environment; and
- The effects of development and mitigation measures in identified hazard areas on the management of natural resources.

Local governments should coordinate their land use plans and decisions with emergency preparedness, response, recovery, and mitigation programs.

Goal 7 recommends that local governments follow these implementation guidelines:

- Give special attention to emergency access when considering development in identified hazard areas.
- Consider programs to manage stormwater runoff as a means to address flood and landslide hazards.
- Consider non-regulatory approaches to help implement the goal.
- When reviewing development requests in high hazard areas, require site specific reports, appropriate for the level and type of hazards. Site specific reports should evaluate the risk to the site, as well as the risk the proposed development may pose to other properties.
- Consider measures exceeding the National Flood Insurance Program.

1.4.1.3. Metro Regional Planning

Urban development in the County is not only regulated by state law and County ordinance, but also by the long-range planning conducted at the regional level by the elected regional government, Metro. Metro manages the regional tri-County Urban Growth Boundary (UGB) that separates urban development in Washington County from rural resource land in the western portions of the County. (Note: the cities of North Plains, Banks, and Gaston in western Washington County maintain their own individual UGBs and are not subject to Metro oversight.) Metro's regional UGB is expanded periodically to provide a 20-year supply of employment, industrial, and residential land based on population and employment projections.

1.4.2. Future Development Areas

The most recent expansions of the Metro regional UGB in Washington County occurred in 2018. These recent expansion areas are Witch Hazel Village South (being master planned by City of Hillsboro), Cooper Mountain (being master planned by City of Beaverton), and Beef Bend South (being master planned by City of King City).

Current and future residential development in unincorporated Washington County will be largely contained in two 2002 additions to the regional UGB: North Bethany and Bonny Slope West. The County

has completed master plans, including development code standards, for these two areas. While the areas remain in unincorporated Washington County and are not likely to incorporate in the foreseeable future, they will house a large portion of the County's future growth in mixed-use communities as the population grows. The County proactively addressed natural hazard risk in these planning processes and identified steep slopes, floodplains, and other risks. Concept planning accounted for these risks and restricted development from occurring in areas of known risk. More detail on areas likely to experience future growth follows:

- **North Bethany** was added into the regional UGB in 2002. The area underwent concept planning and in 2009, the County began developing ordinances and identifying funding strategies to implement the plans for parks, open space, schools, infrastructure, and neighborhood services. The North Bethany Subarea Plan was adopted in 2010. As of 2022, the majority of the developable area in North Bethany has received development entitlements and/or has been built out.
- **Bonny Slope West** was added into the regional UGB in 2002 and was transferred from Multnomah County to Washington County in 2013. The area underwent concept planning starting in 2014, and the Bonny Slope West Subarea Plan was adopted in 2015. As of 2022, approximately half of the developable area in Bonny Slope West has received development entitlements and/or has been built out.
- **Urban and Rural Reserves** have been designated throughout the Metro region. The three County governments and the Metro Regional government agreed to set aside land for either: (1) incorporation into the UGB in the future, or (2) preservation as agricultural, forest, or natural land. The areas are shown in Figure 46.
    - **Urban reserve** means lands outside a UGB that will provide for: (a) future expansion over a long-term period; and (b) the cost-effective provision of public facilities and services within the area when the lands are included within the UGB.
    - **Rural reserve** means land reserved to provide long-term protection for agriculture, forestry, or important natural landscape features that limit urban development or help define appropriate natural boundaries of urbanization, including plant, fish and wildlife habitat, steep slopes, and floodplains.

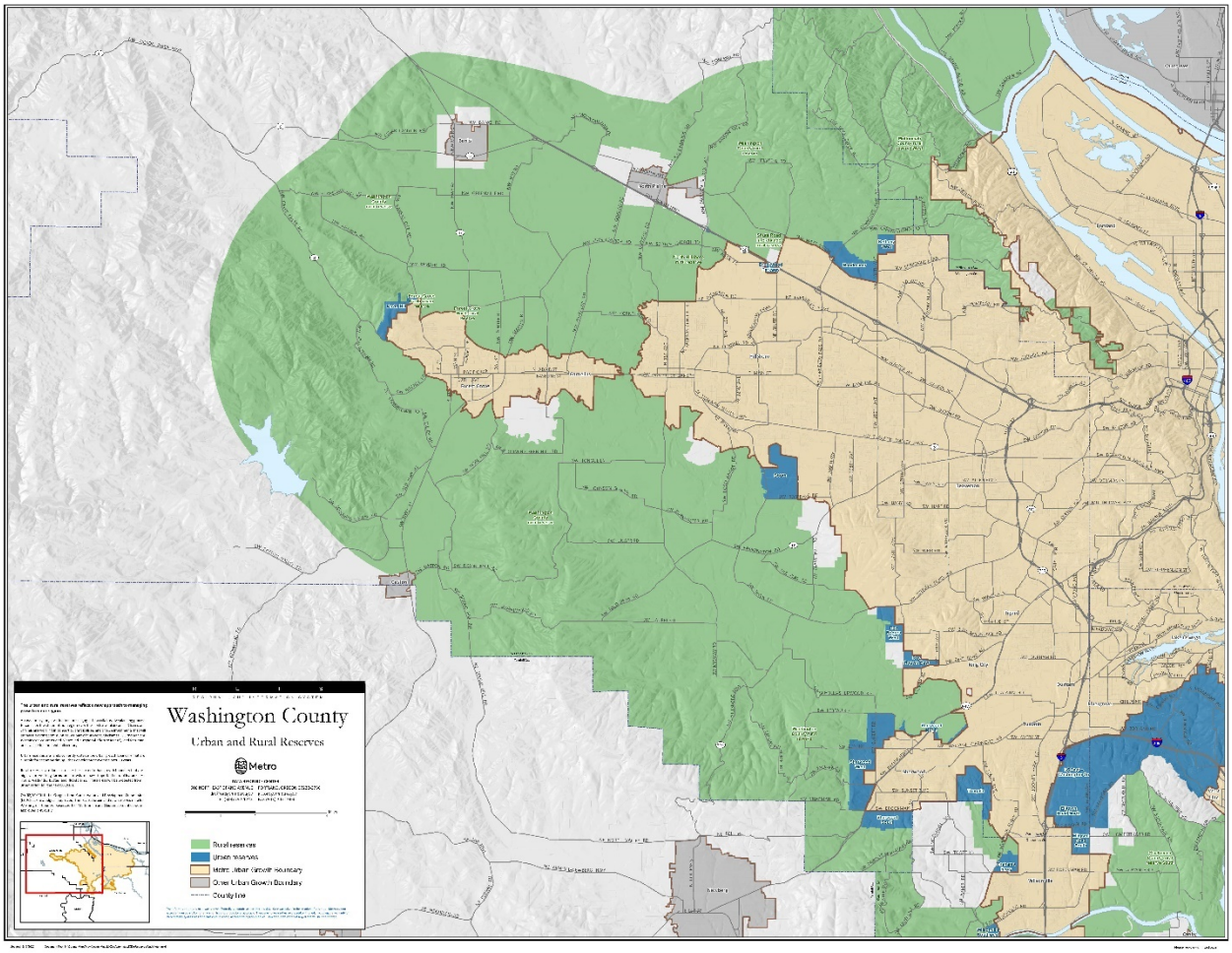


Figure 46: Urban and Rural Reserves in Washington County[617]

1.4.3. Housing

In addition to location, the characteristics of the housing stock affect the level of risk posed by natural hazards. The table below identifies the types of housing most common throughout the County. Of particular interest are manufactured homes, which account for about 2% of the housing in Washington County. Manufactured homes are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing the structures because they are more prone to wind damage than wood-frame construction. In other natural hazard events, such as earthquakes and floods, moveable structures like manufactured homes are more likely to shift on their foundations and create hazardous conditions for occupants.

[617] Metro. (2020, February 24). Regional Urban and Rural Reserves Map. https://www.oregonmetro.gov/urban-and-rural-reserves

Table 366: Housing Profile of Washington County[618]

Jurisdiction	Total Housing Units	Single Family		Multi-Family		Manufactured Homes	
		Number	Percent	Number	Percent	Number	Percent
City of Beaverton	42,000	23,000	56%	19,000	32%	1,000	1%
City of Cornelius	4,000	3,000	90%	1,000	17%	<1,000	10%
City of Forest Grove	9,000	6,000	68%	3,000	35%	<1,000	6%
City of Hillsboro	41,000	25,000	64%	15,000	38%	1,000	2%
City of Sherwood	7,000	6,000	84%	1,000	23%	<1,000	2%
City of Tigard	22,000	15,000	68%	7,000	37%	<1,000	2%
Washington County	232,000	155,000	68%	71,000	32%	5,000	2%

* Numbers rounded to account for the margin of error.

The percentages listed in the table above are total units counts. This table does not evaluate how many of these housing units might be located within special flood hazard areas, or that are at increased risk of seismic damage. Data was not available for the City of North Plains.

Aside from location and type of housing, the year structures were built has implications. Seismic building standards were codified in Oregon building code starting in 1974; more rigorous building code standards were passed in 1993 that accounted for the Cascadia earthquake fault.[619] Therefore, homes built before 1993 are more vulnerable to seismic events. Also in the 1970s, FEMA began assisting communities with floodplain mapping as a response to administer the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Upon receipt of floodplain maps, communities started to develop floodplain management ordinances to protect people and property from flood loss and damage.

Roughly 16%–18% of the housing stock in Washington County was built prior to 1970, before the implementation of floodplain management ordinances; however, Forest Grove has between 28% and 36% of its housing units built prior to 1970. Countywide, about 50%–52% of the housing stock was built before 1993 and the codification of seismic building standards. Approximately half of the County's housing stock was built after 1990; Hillsboro (61%–66%) and Sherwood (76%–87%) have the highest percentage of housing units built after 1990. Data was not available for the City of North Plains.

Table 367: Year Housing Structures Built[620]

Jurisdiction	Total Housing Units	Built Prior to 1970		Built Between 1970 to 1989		Built 1990 or Later	
		Number	Percent	Number	Percent	Number	Percent
City of Beaverton	42,000	8,000	20%	19,000	42%	18,000	44%
City of Cornelius	4,000	<1,000	17%	1,000	49%	2,000	58%

[618] United States Census Bureau. (2020). American Community Survey, Table DP04. Accessed April 15, 2022.
[619] State of Oregon Building Codes Division. *Earthquake Design History: A Summary of Requirements in the State of Oregon*, February 7, 2012. http://www.oregon.gov/OMD/OEM/osspac/docs/history_seismic_codes_or.pdf
[620] United States Census Bureau. (2020). American Community Survey, Table DP04. Accessed April 15, 2022.

Jurisdiction	Total Housing Units	Built Prior to 1970		Built Between 1970 to 1989		Built 1990 or Later	
		Number	Percent	Number	Percent	Number	Percent
City of Forest Grove	9,000	3,000	36%	3,000	30%	4,000	46%
City of Hillsboro	41,000	5,000	14%	15,000	26%	26,000	66%
City of Sherwood	7,000	<1,000	7%	1,000	18%	6,000	87%
City of Tigard	22,000	4,000	18%	7,000	45%	9,000	45
Washington County	232,000	41,000	18%	71,000	34%	114,000	50%

* Numbers rounded to account for the margin of error.

1.4.4. Infrastructure Profile

Infrastructure and critical facilities are vital to the continued delivery of key governmental and private services as well as recovery efforts. The loss of these services may cause serious secondary impact as well as significantly hamper the public's ability to recover from a disaster event. Homeland Security Presidential Directive 7 calls out sixteen sectors as Critical Infrastructure and Key Resources that are "essential to the nation's security, public health and safety, economic vitality, and way of life." This section identifies critical infrastructure and key resources in Washington County and includes resources emphasized in the survey of County residents. The sectors include:

Agriculture and Food

This is a primarily private sector industry but includes both imported/exported food as well and what is grown in the County.

Banking and Finance

For Washington County, this sector would include not only accounts payable/receivable and payroll, but social services provided to residents through community welfare programs.

Chemical

Manufacturing and agricultural processes can often require the use of chemicals and substances that could harm residents if air or water resources were to become contaminated.

Communications and Information Technology

Phone lines, cell towers, broadcast internet, and radio and television signals are mediums for interpersonal connection, economic vitality, and emergency communications in the County. Survey respondents highlighted TV and radio as primary modes of communication. Additionally, and of importance to the region as much as to the County, weather stations, such as the Doppler Radar site near the northern County border, can be quickly cut off by fire or earthquake. In the case of a crisis, the ability to transmit information between responders and to residents can mean the difference between life and death.

Defense Industrial Base

The Oregon Military Department maintains armories in Washington County, and the Oregon Army National Guard has units based in Tigard, Hillsboro, and Forest Grove.

Emergency Services

911 call centers and police and fire stations dispatch first responders for most hazard events and often become the base of response operations during prolonged hazard events. Population distribution and

service areas as well as the availability and duplication of resources at each station can play a role in determining how, where, and when response and recovery are effective.

- **911 Call Center**
  - Washington County Consolidated Communications Agency (WCCCA)
- **Law Enforcement**
  - Washington County Sheriff's Office Headquarters, jail, and youth detention facilities
  - Sheriff's Office – East Precinct
  - Sheriff's Office – City of Cornelius
  - Hillsboro Police Department
  - Beaverton Police Department
  - Tigard Police Department
- **Fire Districts**
  - Tualatin Valley Fire and Rescue: 29 stations
  - Banks Fire District: 3 stations
  - Cornelius Fire District: 1 station
  - Forest Grove Fire and Rescue: 2 stations
  - Gaston Rural Fire District: 1 station
  - Hillsboro Fire and Rescue: 5 stations

Energy

In Washington County, electrical and gas utilities are provided by both private companies and some smaller cooperatives. Coordinating mitigation across these diverse organizational structures and philosophies will ensure that services are provided equitably, even if a hazard incident stresses the supply or demand. Critical infrastructure includes power substations, gas lines, and both underground and aboveground transmission lines.

Utility Lifelines

Utility lifelines are the resources that the public relies on daily, (i.e., fuel and communication lines). If these lines fail or are disrupted, the essential functions of the community can become severely impaired. Utility lifelines are closely related to physical infrastructure, (i.e., dams and power plants) as they transmit the power generated from these facilities.

Washington County receives oil and gas from Alaska by way of the Puget Sound through pipelines and tankers. Most of the natural gas Oregon uses originates in Alberta, Canada. Northwest Natural Gas owns the main natural gas transmission pipeline. The network of transmission lines running through the County may be vulnerable to severe but infrequent natural hazards, such as windstorm, winter storms, and earthquakes.

Governmental Facilities

Every day, community leaders and residents rely on the buildings that house essential governmental functions: City Halls, Court Houses, public works buildings, and more. Protecting and reinforcing these facilities will facilitate the return to "business as usual" after a hazard event.

Schools

Schools are occupied by vulnerable younger populations and may also be used as emergency shelters during hazard events. The following school districts are within the County:

- Banks School District: 3 schools
- Beaverton School District: 53 schools
- Forest Grove School District: 12 schools
- Gaston School District: 2 schools
- Hillsboro School District: 37 schools
- Portland Public Schools: 2 schools
- Sherwood School District: 6 schools
- Tigard–Tualatin School District: 16 schools
- Northwest Regional Educational Service District: 1 school
- 47 private schools

Healthcare and Public Health

Hospitals, clinics, and shelters often play a critical role in the immediate aftermath of a hazard incident in saving lives and keeping residents safe. Additionally, satellite clinics, doctors' offices, and urgent care facilities are vital components of a healthcare system.

- **Hospitals**
  - Cedar Hills Hospital (10300 SW Eastridge Street, Portland)
  - Kaiser Westside Medical Center (19301 NW Venetian Drive, Hillsboro)
  - Legacy Meridian Park Hospital (19300 SW 65th Avenue, Tualatin)
  - Providence St. Vincent Medical Center (9205 SW Barnes Road, Beaverton)
  - Primary Care Forest Grove (1825 Maple Street, Forest Grove)
  - Oregon Health & Science University Hillsboro Medical Center (335 SE 8th Avenue, Hillsboro)
- **Medical Transport**
  - Metro West Ambulance
- **Assisted Living Facilities**
  - Beaverton: 11 facilities
  - Forest Grove: 8 facilities (1 memory care facility)
  - Hillsboro: 9 facilities
  - Sherwood: 3 facilities
  - Tigard: 6 facilities
  - Tualatin: 5 facilities
  - Wilsonville: 4 facilities

Transportation Systems

Urban Washington County meets its current transportation needs through a mixture of municipal road systems, County roads, state and federal highways, and a regional transit system (TriMet). Major highways in the County include Interstate 5, State Highway 26, which runs from southeast to northwest, linking Portland to the coast, and State Highway 6, which branches off 26 and runs west to the coast. State Highway 217 is a bypass route that links Interstate 5 to Highway 26. State Highway 47 runs north–south and links the western cities of Banks, Forest Grove, and Gaston to Columbia and Yamhill Counties. TriMet provides both bus and light rail service to the County and to the larger Portland metropolitan area. Cycling and pedestrian paths are used both for commuting and recreation and their bridges and overpasses connect communities in crucial ways.

The Washington County MAX (Metropolitan Area Express) Light Rail provides rail transit connections between Hillsboro and the east Portland suburb of Gresham and is aligned in an east and west direction following Highways 26, 217, and 8. TriMet's WES (Westside Express Service) is a commuter rail line oriented north–south and serves Beaverton, Tigard, Tualatin, and Wilsonville.

- It is important to identify bottleneck points or parts of the transportation system that are more vulnerable to failure than others. Survey respondents voiced a concern about limited egress and access in some more rural parts of the County that could be cut off from emergency services with the loss of a single road or bridge.
- In Washington County, rail lines and bridges are more vulnerable to impacts from flood and earthquake as even minor shifts in their alignment can render them unusable and stop the flow of civilian and emergency service traffic on either side of the affected area.

Seismic lifeline routes help maintain transportation facilities for public safety and resilience in the case of natural disasters. Following a major earthquake, it is important for response and recovery agencies to know which roadways are most prepared for a major seismic event. The Oregon Department of Transportation has identified lifeline routes to provide a secure lifeline network of streets, highways, and bridges to facilitate emergency services response after a disaster.[621]

System connectivity and key geographical features were used to identify a three-tiered seismic lifeline system. Routes identified as Tier 1 are considered to be the most significant and necessary to ensure a functioning statewide transportation network. The Tier 2 system provides additional connectivity to the Tier 1 system; it allows for direct access to more locations and increased traffic volume capacity. The Tier 3 lifeline routes provide additional connectivity to the systems provided by Tiers 1 and 2.

The Lifeline Routes in the Portland Metro Geographic Zone consist of the following:

- Tier I: Interstate 5 (excluding the section between the northern and southern I-405 interchanges), I-405, I-205, and OR 99W from I-5 to OR 217
- Tier II: I-84, I-5 between the northern and southern I-405 interchanges, US 26 from OR 217 to I-405
- Tier III: OR 217, US 26 from I-5 to I-205, OR 43

Bridges

Because of earthquake risk, the seismic vulnerability of the County's bridges is an important issue. Non-functional bridges can disrupt emergency operations, sever lifelines, and disrupt local and freight traffic. These disruptions may exacerbate local economic losses if industries are unable to transport goods. The County's bridges are part of the state and interstate highway system that is maintained by the Oregon Department of Transportation (ODOT) or that are part of regional and local systems that are maintained by the region's counties and cities.

[621] CH2MHILL, Prepared for Oregon Department of Transportation. (2012, May 15). Oregon Seismic Lifeline Routes Identification Project, *Lifeline Selection Summary Report*.

The bridges in Washington County require ongoing management and maintenance due to the age and types of bridges. Modern bridges, which require minimum maintenance and are designed to withstand earthquakes, consist of pre-stressed reinforced concrete structures set on deep steel piling foundations. ODOT has identified seismically vulnerable bridges across Oregon. Records indicate that there are two seismically vulnerable County-owned bridges: #1211 and #1331.[622] Bridge # 1211 is on SW 65th Avenue, crossing Nyberg Creek, and is on a primary access to Meridian Park Hospital. Bridge #1331 is on SW 185th Avenue crossing Beaverton Creek, which is a major north-south transportation route.

Airports

The Port of Portland operates the Hillsboro Airport, which is the second busiest airport in Oregon and the busiest "general aviation" airport in Oregon. It is a 900-acre executive airport with three runways (6,600 feet, 3,821 feet, and 3,600 feet) and four full-service fixed-base operators, and it provides all the facilities necessary to support jet and propeller-driven aircraft and helicopters. The airport is home to local corporate flight departments, aircraft charter services, air ambulance services, flight schools, aircraft maintenance and repair operations, corporate air shuttle service, and a U.S. Customs and Border Protection office for international flights. In all, more than 25 businesses operate on-airport.

Water

In Washington County, water resources are abundant yet fragile and can even be dangerous. Water resources are susceptible to pollution from runoff or toxic spills. Low rain years can increase the risk of drought in the summer while intense periods of rain can bring floods or landslides. Rivers and their tributaries can only be managed so much by dams and culverts. Responsible development in the floodplain and throughout the County that maintains and supports natural drainage systems can help protect water resources.

- Physical infrastructure such as dams, levees, roads, bridges, railways and airports support Washington County communities and economies. Due to the fundamental role that physical infrastructure plays both in pre- and post-disaster, they deserve special attention in the context of creating resilient communities.
- Utility systems such as potable water, wastewater, natural gas, telecommunications, and electric power are all networked systems. That is, they consist of nodes and links. Nodes are centers where something happens–such as a pumping plant, a treatment plant, a substation, a switching office, and the like. Links are the connections (pipes or lines) between nodes.

Dams

Oregon follows national guidance for assigning hazard ratings to dams and for the contents of Emergency Action Plans, which are now required for all dams rated as "high hazard." Each dam is rated according to the anticipated impacts of its potential failure. The state has adopted these definitions for state-regulated dams:

- **High hazard:** Loss of life is expected if the dam fails.
- **Significant Hazard: L**oss of life is not expected if the dam fails, but extensive damage to property or public infrastructure is.
- **Low hazard: A**ssigned to all other state-regulated dams.

There are 3 high hazard, 15 significant hazard, and 59 low hazard dams in Washington County.[623]

[622] Oregon Department of Transportation. (2021). Bridge Condition Report 2021 Dashboard Interactive Report. Accessed November 18, 2022, from https://www.oregon.gov/ODOT/Bridge/Pages/BCR.aspx
[623] U.S. Army Corps of Engineers. (2022). National Inventory of Dams. https://nid.sec.usace.army.mil/#/

Table 368: Dams Located in Washington County[624]

Name	Classification	Regulator
Scoggins Dam	High	Federal
Barney Dam	High	State
Kay Lake Dam	High	State
Burkhalter #2 Dam	Significant	State
Cook Reservoir Dam	Significant	State
Raymond Dierickx Dam	Significant	State
Dober Reservoir Dam	Significant	State
Ettinger Pond Dam	Significant	State
Hoefer–Pierson Reservoir Dam	Significant	State
Jesse Enlargement Dam	Significant	State
Lind Reservoir Dam	Significant	State
Maple Headquarters Reservoir Dam	Significant	State
Paul Chobin Dam	Significant	State
Pierson–Upper Dam	Significant	State
Tualatin Park Dam	Significant	State
Unger–Bill Dam	Significant	State
Walters, Glenn #1 - Large Dam	Significant	State
Walters, Glenn #5 Dam	Significant	State

This hazard classification is solely a measure of the probable impacts if a dam fails. Thus, a dam classified as high hazard does not mean that the dam is unsafe or likely to fail. The level of risk, or probability of failure, of a given dam is not even considered in this classification scheme. Rather, the high hazard classification simply means that there are people at risk downstream from the dam in the inundation area if the dam were to fail.

Dams assigned to the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life. Failure of dams in the high classification will generally also result in economic, environmental, or lifeline losses, but the classification is based solely on probable loss of life.

Dams assigned to the significant hazard classification are those where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities. Significant hazard potential dams are often located in predominantly rural or agricultural areas.

Dam failures can occur at any time in a dam's life; however, failures are most common when water storage for the dam is at or near design capacity. At high water levels, the water force on the dam is higher and several of the most common failure modes are more likely to occur. Correspondingly, for any dam, the probability of failure is much lower when water levels are substantially below the design capacity for the reservoir.

[624] U.S. Army Corps of Engineers. (2022). National Inventory of Dams. https://nid.sec.usace.army.mil/#/

1.5. Community Connectivity

Community connectivity is the interaction of human, organizational, and social connections existing within a community that can be used to solve collective problems and improve or maintain the well-being of the community. It may operate through informal social processes and/or organized efforts by individuals and organizations.

Community connectivity places strong emphasis on social structure, trust, norms, and cultural resources within a community. In terms of community resilience, these connections and networks can be drawn upon to stabilize recovery of the community. These elements of social and cultural capital are present in all communities; however, they may be dramatically different from one community to the next as these elements reflect the specific needs and composition of the community residents.

Social Systems and Service Providers

Social systems include community organizations, service providers and programs that provide social and community-based services, such as employment, health, senior, and disabled services, professional associations, and veterans' affairs for the public. In planning for natural hazard mitigation, it is important to know what social systems and service providers exist within the community because of their existing connections to the public. Often, actions identified by the plan involve communicating with the public or specific subgroups within the population (e.g., elderly, children, low income, etc.). Since existing social systems and service providers already work directly with the public on a number of issues, the County could use them to communicate with the public about natural hazard preparedness and mitigation. These service providers are predominantly located in urbanized areas of the County.

Principles of effective communication to a target audience are outlined below and illustrated in Figure 47. The community's existing social service providers could use these communication principles to provide natural hazard related messages to their clients.

The five essential elements for communicating effectively to a target audience are:

- The source of the message must be credible.
- The message must be appropriately designed.
- The channel for communicating the message must be carefully selected.
- The audience must be clearly defined.
- The recommended action must be clearly stated and a feedback channel established for questions, comments, and suggestions.

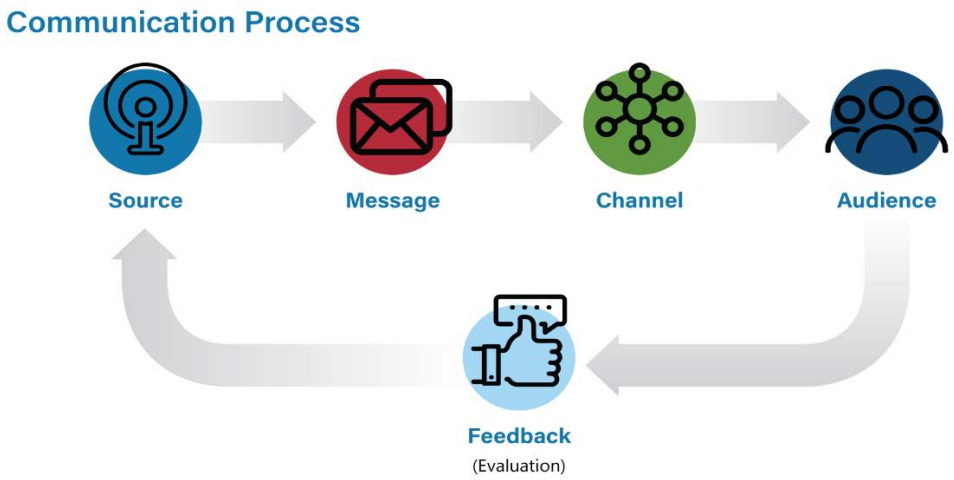


Figure 47: Communication Process[625]

1.5.1. Community Engagement

Communities have a vital role to play in managing the risks associated with natural hazards. As such, their strengths, opportunities for mitigation, and priority concerns should be factored into policy decisions to ensure local recovery efforts reflect community needs. Regular engagement with community members provides opportunities for the county, cities, and special districts to tap into a reservoir of local knowledge to build a shared understanding of how to foster local preparedness and help communities reduce the impact of natural hazards. Not all communities are alike. Needs can differ for a variety of reasons and can help determine the best ways to inspire a response from each specific community. The methods of engagement should be tailored to ensure communities are willing and able to participate in the types of interactions plan participants wish to initiate.[626]

Civic engagement and involvement in local, state, and national politics are important indicators of community connectivity and engagement. Civic engagement is a key ingredient to success when facing issues like hazard mitigation that can have a large-scale impact on communities. In addition, leveraging inclusive resident engagement could lead to a greater social network of creativity and innovation and to the adoption of ideas and solutions for mitigating the common problems presented by natural hazards. This could increase resilience and perhaps help craft policy priorities to mitigate the funding gap that can hinder implementation of mitigation strategies, particularly in the most vulnerable areas.[627]

1.5.2. Cultural Resources

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the County for generations and new residents alike, it is the unique places, stories, and annual events that make Washington County an appealing place to live.

[625] Source: Adapted from the U.S. Environmental Protection Agency Radon Division's outreach program
[626] Saum-Manning, L. (2021). Best Practices and Lessons Learned from Community Engagement and Data Collection Strategies in Post-Hurricane Maria Puerto Rico. *Journal of Homeland Security and Emergency Management*, *18*(3), 225-250. https://doi.org/10.1515/jhsem-2020-0075
[627] Inguane, A. (2019, December 13). Opinion: Civic Engagement, Innovation Needed in Disaster-Recovery and Reconstruction Process. Devex. https://www.devex.com/news/opinion-civic-engagement-innovation-needed-in-disaster-recovery-and-reconstruction-process-96188

The cultural and historic assets in the County are both intangible benefits and obvious quality-of-life-enhancing amenities. Mitigation actions to protect these assets span many of the other systems already discussed. Some examples of that overlap could be seismic retrofit (preserving historic buildings and ensuring safety) or expanding protection of wetlands (protect water resources and beautify the County).

1.5.3. Community Stability

1.5.3.1. Residential Geographic Stability

Community stability is a measure of rootedness in place. It is hypothesized that resilience to disasters stem in part from familiarity with place, not only for navigating the community during a crisis, but also accessing services and other supports for economic or social challenges.[628] The table below estimates residential stability across the region. It is calculated by the number of people who have lived in the same house and those who have moved within the same County a year ago, compared to the percentage of people who have migrated into the region. Washington County overall has a geographic stability rating of about 93% (i.e., 93% of the population lived in the same house or moved within the County). The figures of community stability are relatively consistent across the region, with the smaller cities having generally greater geographic stability. Countywide 4% of residents in 2019 lived in a different Oregon County one year before; 5% lived outside of Oregon one year before. Data was not available for the City of North Plains.

[628] Cutter, S.L., Burton, C.G., and Emrich, C.T. (2010). Disaster Resilience Indicators for Benchmarking Baseline Conditions. *Journal of Homeland Security and Emergency Management*. https://www.researchgate.net/publication/250147250_Disaster_Resilience_Indicators_for_Benchmarking_Baseline_Conditions

Table 369: Population by Residence a Year Ago[629]

Jurisdiction	Population Aged 1 and Older	Same House as Last Year	Elsewhere in Washington County	Other County in Oregon	Another State	Another Nation
City of Beaverton	41,000	83%	12%	4%	5%	1%
City of Cornelius	4,000	93%	13%	2%	3%	2%
City of Forest Grove	9,000	87%	12%	4%	3%	1%
City of Hillsboro	39,000	83%	13%	2%	6%	1%
City of Sherwood	7,000	89%	9%	4%	3%	1%
City of Tigard	21,000	88%	9%	4%	3%	1%
Washington County	223,000	84%	9%	4%	4%	1%

1.5.3.2. Homeownership

Housing tenure describes whether residents rent or own the housing units they occupy. Homeowners are typically more financially stable but are at risk of greater property loss in a post-disaster situation. People may rent because they choose not to own, they do not have the financial resources for home ownership, or they are transient.

Collectively, about 60% of the occupied housing units in Washington County are owner-occupied; about 38% are renter-occupied. Beaverton and Hillsboro have the highest rate of renter-occupied households. Forest Grove has the highest vacancy rates within the County. Data was not available for the City of North Plains.

Table 370: Housing Tenure and Vacancy[630]

Jurisdiction	Total Housing Units	Owner-Occupied Units		Renter-Occupied Units		Vacant Units	
		Number	Percent	Number	Percent	Number	Percent
City of Beaverton	42,000	21,000	51%	20,000	50%	1,000	4%
City of Cornelius	4,000	3,000	83%	1,000	31%	<1,000	3%
City of Forest Grove	9,000	5,000	62%	3,000	41%	<1,000	6%

[629] United States Census Bureau. (2015-2020). American Community Survey, Table DP02. Accessed April 15, 2022.
[630] United States Census Bureau. (2015-2020). American Community Survey, Table DP04. Accessed April 15, 2022.

Jurisdiction	Total Housing Units	Owner-Occupied Units		Renter-Occupied Units		Vacant Units	
		Number	Percent	Number	Percent	Number	Percent
City of Hillsboro	41,000	20,000	52%	18,000	47%	2,000	5%
City of Sherwood	7,000	5,000	76%	2,000	28%	<1,000	5%
City of Tigard	22,000	13,000	63%	8,000	38%	1,000	5%
Washington County	232,000	137,000	60%	86,000	38%	9,000	4%

* Numbers rounded to account for the margin of error.

Wealth typically increases resiliency and recovery from disasters. Renters often do not have personal financial resources or insurance to assist them post-disaster. On the other hand, renters tend to be more mobile and have fewer assets at risk of natural hazards. In some cases, renters lack sufficient shelter options when lodging becomes uninhabitable or unaffordable post-disaster.

1.6. Political Capacity

Political capacity is recognized as the government and planning structures established within the community. In terms of hazard resilience, it is essential for political capacity to encompass diverse government and non-government entities in collaboration, as disaster losses stem from a predictable result of interactions between the physical environment, social and demographic characteristics, and the built environment.[631] Resilient political capacity seeks to involve various stakeholders in hazard planning. It also aims to integrate the Natural Hazard Mitigation Plan with other community plans, so that all planning approaches are consistent.

1.6.1. Existing Plans and Policies

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports or studies. Plans and policies already in existence have support from local residents, businesses and policy makers. Updates to these plans provide an opportunity to adapt to changing conditions and needs.

The Washington County NHMP includes a range of recommended action items that, when implemented, will reduce vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives in plans and policies already adopted by Plan participants. Linking existing plans and policies to the NHMP helps identify what resources already exist within each participating jurisdiction or special district that can be used to implement the action items identified in the Plan. Implementing the natural hazards mitigation plan's action items through existing plans and policies increases their likelihood of being supported and getting updated and maximizes the resources of Plan participants.

In addition to the plans listed below, the County and incorporated cities also have zoning ordinances (including floodplain development regulations) and building regulations.

Existing plans that can incorporate mitigation actions include:

- Comprehensive Land Use Plans
- Transportation System Plans

[631] Mileti, D. (1999). *Disaster by Design: A Reassessment of Natural Hazards in the United States.* Washington D.C.: Joseph Henry Press.

- Facility Plans
- Emergency Operations Plans

Appendix B: Planning Process and Public Engagement

Code of Federal Regulations (CFR) Title 44, Part 201.6 (44 CFR §201.6) Requirements

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

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

- **§201.6(c)(1):** [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.
- **§201.6(c)(5):** [The plan shall include…] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan. For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

1.1. Collaborative Process

During the planning process, participants were encouraged to work with neighboring jurisdictions and special districts, local and regional agencies, and other mitigation partners to develop a unified approach to mitigation and to address hazards that could affect one another.

The 2023 Washington County Natural Hazard Mitigation Plan (NHMP) development process was led by the Washington County Project Manager and driven by the Steering Committee. This plan update was facilitated, written, and completed in collaboration with the contracting firm IEM. Each participating jurisdiction or special district had a representative on the Steering Committee who contributed data and maps and reviewed and updated the community profile, risk assessment, action items, and implementation and maintenance plan.

Table 1: NHMP Steering Committee Members

Jurisdiction or Special District	Job Title
City of Beaverton	Emergency Management Officer
City of Beaverton	Emergency Manager
Cities of Cornelius and Forest Grove*	Forest Grove Fire Chief/Emergency Management Coordinator
Cities of Cornelius and Forest Grove*	Forest Grove Fire Division Chief–Fire and Life Safety
City of Hillsboro	Emergency Manager
City of Hillsboro	Emergency Management Officer
City of North Plains	City Manager
City of Sherwood	Emergency Management Coordinator

Jurisdiction or Special District	Job Title
City of Tigard	Emergency Services Coordinator
Clean Water Services	Senior Water Resources Program Manager
Tualatin Hills Park and Recreation District	Safety Services Manager
Tualatin Valley Water District	Emergency Management and Security Manager
Washington County	Emergency Management Coordinator (and 2023 Washington County NHMP Project Manager)
Washington County	Emergency Management Supervisor

*Note: The cities of Cornelius and Forest Grove shared Steering Committee members.

Each participating entity had a Technical Committee made up of subject matter experts and leaders within the jurisdiction or special district. These committee members were actively engaged in the planning process and provided local hazard information, created mitigation action items, and identified local ordinances, plans, and policies that may be used to implement mitigation actions. Members of each participant's committee are detailed in the participant annexes.

1.2. Stakeholder Engagement

Internal and external stakeholders are an integral part of the mitigation planning process. These stakeholders were identified by NHMP participants for their knowledge, skills, abilities, and insights. Internal stakeholders were invited by Steering Committee members to participate in the plan update. External stakeholders were invited to participate in the process via email. Both sets of stakeholders were encouraged to review the plan and provide relevant information and feedback.

1.2.1. Internal Stakeholders

Internal stakeholders were identified and engaged by participants to enhance the planning process and the update of the NHMP. These stakeholders are subject matter experts within the participating jurisdictions or special districts who impact or may be impacted by a mitigation action or policy. This included people in positions who had the authority to regulate development of the plan. These stakeholders informed the Technical Committees and Steering Committee about specific topics and offered different points of view while providing data, reviewing the NHMP draft, attending planning workshops, and advocating for mitigation measures.

Table 2: Internal Stakeholders

Jurisdiction or Special District	Title
City of Beaverton	Planning Division Manager, Community Development Division
City of Beaverton	City Engineer, Public Works Department–Engineering Management Services
City of Beaverton	Utility Manager, Public Works Department, Storm–Sewer–Street Division
City of Beaverton	Sustainability Analyst, City Services and Engagement
City of Beaverton	Project Engineer, Community Development Department, Site Development Division
City of Beaverton	City Building Official, Community Development Department, Building Administration

Jurisdiction or Special District	Title
City of Beaverton	Emergency Manager
City of Beaverton	Geographic Information System (GIS) Manager, Information Services Division
City of Beaverton	Economic Development Manager, Community Development Department
City of Beaverton	Emergency Management Officer
City of Hillsboro	Management Analyst, City Manager's Office
City of Hillsboro	Parks Director, Parks and Recreation Department
City of Hillsboro	Information Services Director, Information Services Department
City of Hillsboro	Police Chief
City of Hillsboro	Library Manager
City of Hillsboro	Finance Director
City of Sherwood	Public Works Director
City of Tigard	Assistant City Manager–Infrastructure
City of Tigard	City Councilor
Clean Water Services	Natural Systems Enhancement and Stewardship Director
Clean Water Services	Chief Executive Officer
Clean Water Services	Chief Strategy Officer
Clean Water Services	Enterprise Assets Technology Services Director
Clean Water Services	Chief Utility Relations Officer
Clean Water Services	Public Affairs Manager
Clean Water Services	Water Resources Recovery Services Manager
Clean Water Services	Building and Facilities Services Manager
Clean Water Services	Chief of Staff
Clean Water Services	Chief Operating Officer
Clean Water Services	Operations Manager, Durham Plant
Clean Water Services	Strategic Risk Manager
Clean Water Services	Board Members
Tualatin Hills Park and Recreation District	Park Services Director
Tualatin Hills Park and Recreation District	General Manager
Tualatin Hills Park and Recreation District	Communications Director
Tualatin Valley Water District	Willamette Water Supply Program Design and Construction Manager
Washington County	Fleet Services Manager
Washington County	Board of County Commissioners
Washington County	Director, Emergency Management

Jurisdiction or Special District	Title
Washington County	Facilities Superintendent
Washington County	Economic Development Manager
Washington County	Building Official
Washington County	Senior Planner, Land Use & Transportation Planning Long Range Planning
Washington County	Principal Planner–Supervisor, Land Use & Transportation Planning and Development Services
Washington County	Office of Equity, Inclusion, and Community Involvement
Washington County	Parks Superintendent

1.2.2. External Stakeholders

NHMP participants identified external stakeholders outside their jurisdiction or special district who impact or can be impacted by a mitigation action or policy. These stakeholders were not necessarily involved in all stages of the planning process, but as subject matter experts, they informed the Technical and Steering Committees on specific topics and offered different points of view while providing data, reviewing the NHMP draft, and advocating for mitigation measures.

Table 3: External Stakeholders

Jurisdiction or Special District	Title
Banks Fire District	Fire Chief
Beaverton School District	Executive Administrator for Long Range Planning
U.S. Bureau of Reclamation	Bend Field Office Manager
Bureau of Reclamation	Native American Affairs Program Manager, Columbia–Pacific Northwest Region
Bureau of Reclamation	Safety of Dams Project Manager
Tualatin Watershed Enhancement Collaborative and Cedar Mill Creek Flood Remediation Collaborative	Watershed Navigator
City of Lake Oswego	City Engineer
City of Rivergrove	City Manager
City of Tualatin	Community Development Director
City of Tualatin	Emergency Management Coordinator
City of Wilsonville	Director of Public Works
Clackamas County	Clackamas County Resilience Coordinator
Clackamas County	Interim Director (Emergency Management), Program Manager
Clatsop County	Emergency Manager
Columbia County	Director of Emergency Management
Oregon Department of State Lands	Aquatic Resource Planner

Jurisdiction or Special District	Title
U.S. Environmental Protection Agency	Wetland Ecologist
Joint Water Commission	General Manager
Metro Parks and Nature	Natural Areas Land Manager
Metro Parks and Nature	Deputy Director
Metro Parks and Nature	Deputy Director's Assistant
Multnomah County	Senior Emergency Management Planner
Multnomah County	Director, Office of Emergency Management
National Marine Fisheries Services	Willamette Branch Chief
National Weather Service	Meteorologist in Charge
Oregon Department of Emergency Management	Plan Reviewer
Oregon Department of Emergency Management	Regional Liaison
Oregon Department of Emergency Management	Finance/Grant Management
Oregon Department of Emergency Management	Regional Mitigation & Recovery Coordinator, Portland Metro Office
Oregon Department of Environmental Quality	Tualatin Basin Total Maximum Daily Load Program Coordinator
Oregon Department of Forestry	Forester
Oregon Department of Geology and Mineral Industries	Geologist
Oregon Department of Land Conservation and Development	Manager
Oregon Department of State Lands	Aquatic Resources Coordinator and Washington County Permitting Liaison
Oregon Department of State Lands	Wetland Ecologist, Washington, Multnomah, Clackamas, and Hood River Counties
Oregon Health Authority	Drinking Water Technical Services and Emergency Preparedness Coordinator
Oregon Office of the State Fire Marshal	Fire Risk Reduction Specialist, Serving Washington County
Oregon Water Resources Department	State Engineer for Water Resources, Dam Safety Lead
Oregon Water Resources Department	Watermaster, District 18
Oregon Water Resources Department	GIS Coordinator, Dams
Oregon Water Resources Department	GIS Developer
Regional Water Providers	Managing Director, Regional Water Providers Consortium, and Intergovernmental Coordination Group Manager, Portland Water Bureau
The Wetlands Conservancy	Executive Director
Tigard–Tualatin School District	Operations Administrator
Tillamook County	Emergency Management Director
TriMet	Manager, Emergency Management & Training

Jurisdiction or Special District	Title
Tualatin River Watershed Council	Executive Director
Tualatin Riverkeepers	Executive Director
Tualatin Riverkeepers	Staff Attorney
Tualatin Riverkeepers	Watershed Resilience Coordinator
Tualatin Soil and Water Conservation District	Executive Director
Tualatin Soil and Water Conservation District	Forest Conservation Specialist
Tualatin Valley Fire & Rescue	Fire Captain and Emergency Coordinator
Tualatin Valley Irrigation District	District Manager
Tualatin Valley Water District	Emergency Management and Security Manager
U.S. Army Corps of Engineers	Regulatory Project Manager, and Washington County Permitting Liaison, Portland District Regulatory Branch
U.S. Fish and Wildlife Service	Project Leader, Tualatin National Wildfire Refuge
Washington County	Environmental Health Program Manager, Public Health Department
Willamette Partnership	Executive Director
Yamhill County	Manager, Emergency Management Department
The Wetlands Conservancy	Development & Communications Manager

1.2.3. Summary of Stakeholder Feedback

A virtual Stakeholder Engagement and Education Workshop was held July 26, 2022, and was attended by internal and external stakeholders. During this workshop, stakeholders were asked to contribute ideas and information relating to mitigation action items, hazard data sources, and mitigation collaboration opportunities. These stakeholders were also asked to review the draft NHMP and provide feedback before it was submitted to the Oregon Department of Emergency Management (OEM) and Federal Emergency Management Agency (FEMA) for review and approval.

The following comments were received during the virtual Stakeholder Engagement and Education Workshop on July 26, 2022.

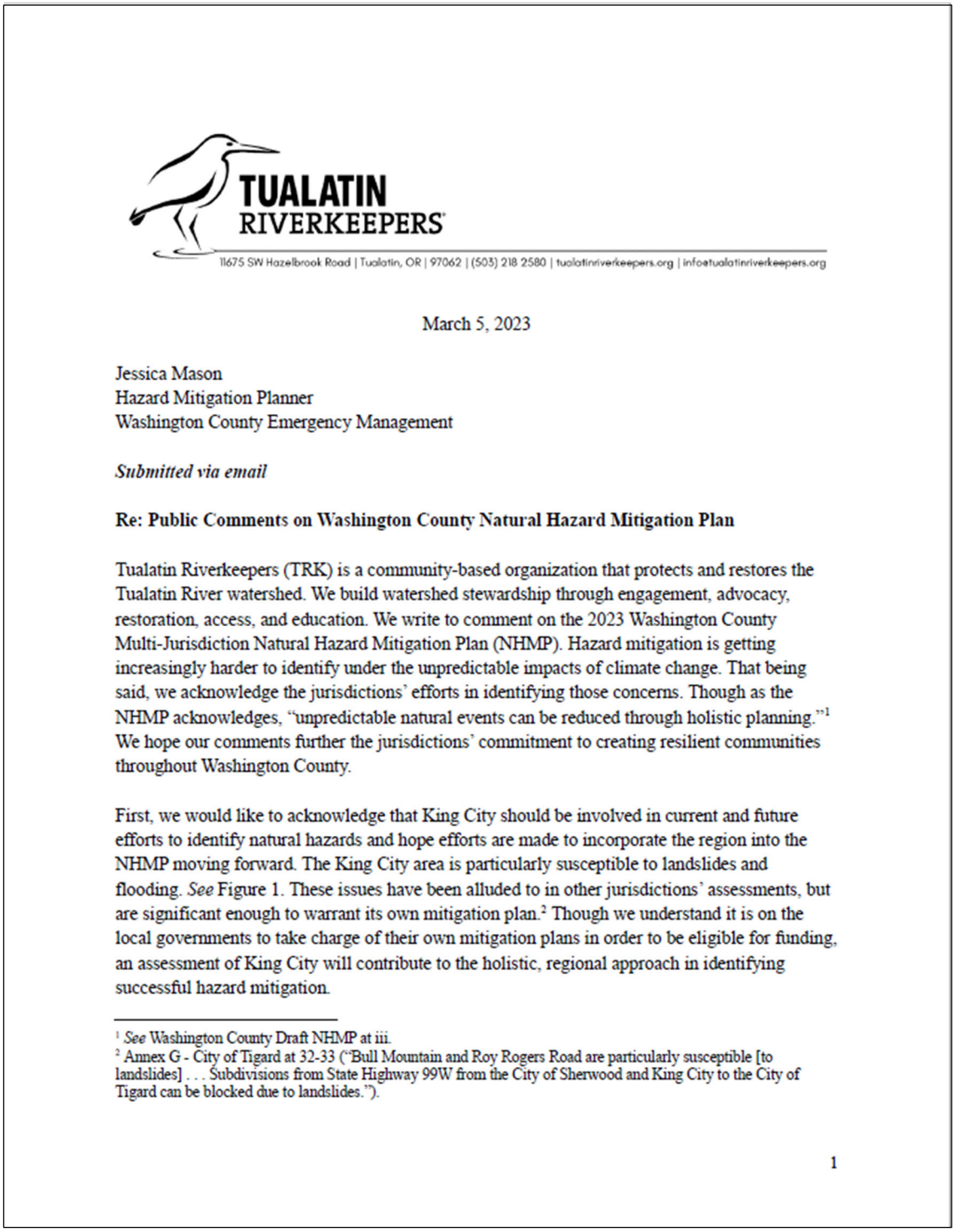
- The proposed “Watershed Navigator” project involving Clean Water Services and Tualatin Soil and Water Conservation District could be an action item.
- Forest sensitivity is a topic that could be explored.
- Consider the potential impact of the emerald ash borer beetle on wildfire risk. The invasive species can infest trees, killing them, and increasing wildland fire fuel load. The discovery of the beetle in Oregon is the first discovery of the insect on the west coast.
- Oregon Occupational Safety and Health recently passed rules protecting workers in high heat and poor air quality conditions due to wildland fire smoke.

The draft of the NHMP was made available to internal and external stakeholders for review and comment via a digital, online open house hosted by Washington County and direct email notification requesting feedback from February 10, 2023, to March 5, 2023.

The following comments were received by stakeholders in response to the draft plan review request:

- Seismic assessments completed for the Beaverton School District in 2019 were recommended as a source for additional information about seismic structural deficiencies identified in school buildings and on school property. Information from these assessments was incorporated into the Beaverton annex.
- The damage estimates from a Cascadia Subduction Zone magnitude 9.0 earthquake in “dry” soil conditions in the Beaverton annex had a misprint. This amount was corrected to the accurate amount of $1,230,000,000.
- The Emergency Coordinator for the Beaverton School District commented that the Portland Hills Fault is classified as an “inactive fault” and does not warrant the level of consideration it received in the NHMP. The level of detail about this fault was kept as it was, as it was the Steering Committee’s choice to include this information.
- In-depth feedback was received from Tualatin Riverkeepers, and Washington County is developing a direct response to the organization. The Riverkeepers will be invited to participate as mitigation actions from the NHMP are implemented. See the letter in Figure 1 for additional information about the comments from Tualatin Riverkeepers.

Figure 1: Letter from Tualatin Riverkeepers



TUALATIN RIVERKEEPERS

11675 SW Hazelbrook Road | Tualatin, OR | 97062 | (503) 218 2580 | tualatinriverkeepers.org | info@tualatinriverkeepers.org

March 5, 2023

Jessica Mason
Hazard Mitigation Planner
Washington County Emergency Management

Submitted via email

Re: Public Comments on Washington County Natural Hazard Mitigation Plan

Tualatin Riverkeepers (TRK) is a community-based organization that protects and restores the Tualatin River watershed. We build watershed stewardship through engagement, advocacy, restoration, access, and education. We write to comment on the 2023 Washington County Multi-Jurisdiction Natural Hazard Mitigation Plan (NHMP). Hazard mitigation is getting increasingly harder to identify under the unpredictable impacts of climate change. That being said, we acknowledge the jurisdictions' efforts in identifying those concerns. Though as the NHMP acknowledges, "unpredictable natural events can be reduced through holistic planning."[1] We hope our comments further the jurisdictions' commitment to creating resilient communities throughout Washington County.

First, we would like to acknowledge that King City should be involved in current and future efforts to identify natural hazards and hope efforts are made to incorporate the region into the NHMP moving forward. The King City area is particularly susceptible to landslides and flooding. *See* Figure 1. These issues have been alluded to in other jurisdictions' assessments, but are significant enough to warrant its own mitigation plan.[2] Though we understand it is on the local governments to take charge of their own mitigation plans in order to be eligible for funding, an assessment of King City will contribute to the holistic, regional approach in identifying successful hazard mitigation.

[1] *See* Washington County Draft NHMP at iii.
[2] Annex G - City of Tigard at 32-33 ("Bull Mountain and Roy Rogers Road are particularly susceptible [to landslides] . . . Subdivisions from State Highway 99W from the City of Sherwood and King City to the City of Tigard can be blocked due to landslides.").

1

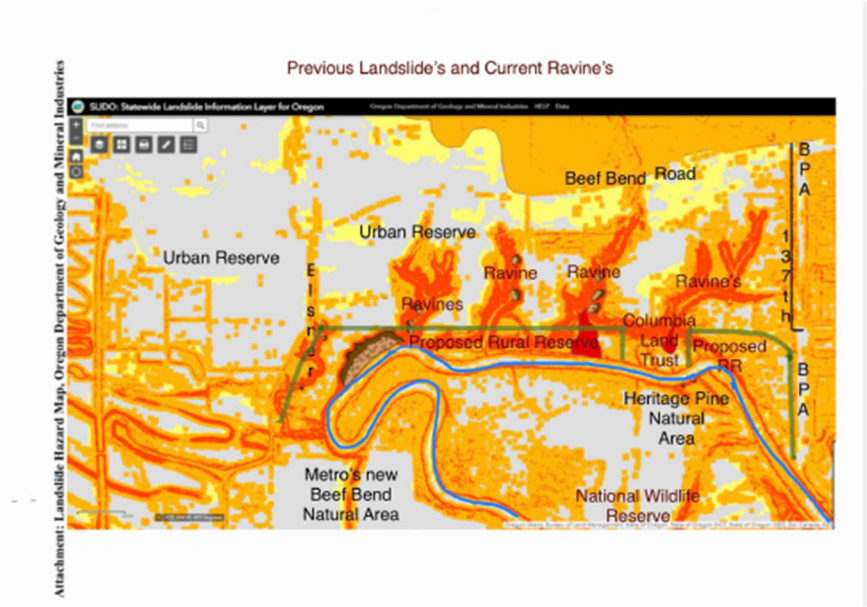


FIGURE 1. King City landslide hazard areas south of Beef Bend Road.

Next, the NHMP should include two additional goals: (1) enhancing the ability of *communities* to rebound from natural hazard events, and (2) enhancing the ability of the *natural environment* to rebound from natural hazard events. An environmental justice lens must be applied in identifying how natural hazards impact different communities. Some jurisdictions and communities may have the resources readily available to mitigate, and adapt to, a natural hazard event. Therefore, the impacts and costs must be adjusted to account for those varying capacities to recover. Goal 7 of the NHMP does recognize fund allocation to support communities disproportionately impacted by natural hazards,[3] but a separate goal standard would address impacts to communities beyond financial stability and is therefore worthy of its own goal.

The second goal suggestion should be expanded further to directly address mitigating impacts to the Tualatin River and its tributaries. Water is a vital resource. The Tualatin watershed makes up all of Washington County (and then some) and provides drinking water to over half a million residents. Without access to clean water, all other mitigation priorities fall short. As the NHMP notes, all Washington County jurisdictions are at high risk of drought. This further shows the

[3] NHMP at 4.

2

need to prioritize a sustainable watershed system, by encouraging pollution filtration, water reuse, and green infrastructure that retains water. Furthermore, the NHMP recognizes resiliency needs in other parts of its mitigation goals.[4] It only follows that emphasizing community and environmental resilience will alleviate some of the known stressors following a natural hazard event. The NHMP includes environmental impacts as part of its vulnerability assessments and has identified the Tualatin watershed within its natural environment characteristics, but we would like to see environmental mitigation explicitly stated in its mitigation goals.

Additionally, since dam failure is included as a natural hazard event that needs to be mitigated, it only makes sense that bridge failure should also be included in the NHMP. Bridge failure can occur at any point, and many of what threatens structural stability of dams, such as earthquakes and engineering failures, are also applicable to bridges. Several major roadways cross over the Tualatin River, such as I-5, I-205, and 99W, and the Oregon Department of Transportation has identified the need for seismic upgrades for some of these crossings.[5] If any of these were to fail, it would pose devastating results to the human and natural environment. As the area develops further, even more bridges are proposed to meet demand. Therefore, including these crossings as possible hazard events would require a mitigation plan in the event of a collapse.

Finally, we have several comments and clarifying questions we would like to direct at specific jurisdictions regarding their supporting mitigation plans:

Appendix A: Planning Area Profile

- Conservation easements should be included as important environmental and natural resource assets.[6] Additionally, the Beef Bend Natural Area should also be included on the asset list.[7]

Washington County Appendix

- When discussing critical infrastructure assessment and protection from flooding, "hardening" is mentioned as an option.[8] Is this used as a method to create more

---

[4] *See* NHMP at 4 ("Enhance the ability of the economies of Washington County and its jurisdiction to rebound quickly from natural hazard events . . . .").
[5] ODOT has just released their environmental assessment for the I-205 tolling project. A significant portion of this project is to include seismic upgrades. While the I-205 bridge resides outside Washington County, similar heavy trafficked bridges are well within the County and could need the same much-needed seismic upgrades. *See* https://www.oregon.gov/odot/tolling/Pages/I-205-Toll-Project-Environmental-Assessment.aspx.
[6] NHMP Appendix A at 5-8 .
[7] The Beef Bend Natural Area and the Bankston Conservation Easement both reside in the Tualatin floodplain that stretches into King City.
[8] *See* Annex K - Washington County at 68, Table 15.

impermeable surfaces to deter high water flows? Or is this used more in the sense of "strengthening resistance to disturbance?"

- Is the County considering impacts of steep slope harvesting on private and public lands when assessing high risk landslide areas via DOGAMI and lidar maps?[9] Steep slope timber activities greatly exacerbate slide impacts in already high risk areas.
- Action Item #16 requires identification of rural and wildland water sources to be used in wildfire situations via aircraft and apparatus.[10] Are their strategic plans developed for these types of uses where they would not devastate water accessibility, quality, and habitat?

Tigard Appendix

- Action Item # 11 (Study areas where riparian landslides may occur…) and Action Item #12 (Regulate development in landslide hazard areas) should be a higher priority listing given the extensive urban growth Tigard will be seeing within the next decade.[11] By making these Action Items higher priorities, the completion timeline will be shortened and thereby fall in step as the City develops components of their Master Plan.

Clean Water Services Appendix

- CWS mentioned using "real-time controls" for flooding/erosion concerns as more impervious surfaces are created and storm intensity increases.[12] What are some examples of real-time controls?

Thank you for your time and consideration. Please feel free to contact me if you have any questions regarding these comments.

Sincerely,



Victoria Frankeny [she/her]
Riverkeeper & Staff Attorney

[9] *See* Annex K - Washington County at 98, Table 25.
[10] *Id.* at 57.
[11] Annex G - City of Tigard at 55.
[12] Annex H - Clean Water Services at 48.

Tualatin Riverkeepers
victoria@tualatinriverkeepers.org

1.3. Public Engagement

Public participation is an important component of this NHMP. Public participation offers community members the chance to voice their ideas, interests, and opinions. A survey regarding community perceptions of natural hazards and priorities was administered and used to help the Steering and Technical Committees update their risk assessments and mitigation strategies. Community members were also provided an opportunity to comment on a draft of the NHMP.

Each public engagement strategy was designed and implemented with guidance from public outreach subject matter experts identified by participants. These subject matter experts ensured engagement aligned with diversity, equity, and inclusion best practices by using inclusive and equity-centered designs, data sovereignty and equity, and strategy co-creation. The public engagement strategies were designed to provide greater opportunities for all residents and communities in the planning area to have a voice in creating mitigation policies and solutions that impact them.

Two public engagement strategy workshops were held during the NHMP planning process on May 18, 2022, and June 3, 2022. These workshops were attended by Steering Committee members and public outreach experts from participating jurisdictions and special districts. Questions for the public survey were determined, as was a unified outreach strategy among participants.

The public survey was available in English and Spanish and was posted on the Washington County Emergency Management Cooperative website and on participants' social media accounts and websites. The survey was promoted at the Washington County fair at the county booth, the City of Cornelius Farmers Market, and during National Preparedness Month with postcards and bookmarks that were distributed to residents by participants. The survey was also promoted in special district newsletters and mailers. The survey was open for completion and hosted by IEM via SurveyMonkey from July 25, 2022, to October 6, 2022. Public comments were incorporated into the NHMP as appropriate and applicable.

It is the intention of the Steering Committee to take over hosting the survey and continue to utilize it on a regular basis as a tool to gauge public sentiment toward mitigation throughout the five-year NHMP implementation process.

A draft of the NHMP was available for public comment on the Washington County Emergency Management Cooperative website from February 3, 2023 to March 5, 2023. Participants posted the feedback opportunity on their social media accounts and websites. Public feedback about the draft plan were incorporated into the NHMP as appropriate and applicable.

1.3.1. Promotion of Public Survey and Draft Plan Comment Opportunities

Each planning participant publicized the NHMP public survey and draft plan. Publicity methods utilized included posting on the Washington County Emergency Management Cooperative website, engagements on participant social media channels, email campaigns, special district mailers and newsletters, and in-person outreach efforts. The public comment opportunities provided by each participant are below.

The Washington County Emergency Management Cooperative website, hosted by the County, acted as a central location to which each participant could direct people to take the survey. This allowed for a streamlined and collaborative public survey promotional effort. The County also hosted the draft plan for public feedback via a digital, online open house. Plan participants directed the public to this single website, creating a unified promotional effort. Washington County's Local Planning Team executed a public outreach campaign that reached residents in all jurisdictions and special districts participating in the NHMP. Some plan participants did additional outreach about the draft plan in addition to the County's efforts. Promotional materials were in English and Spanish.

EMC
Washington County, Oregon
Emergency Management Cooperative
Prepare | Respond | Recover

EMC Home Page | Contacts | Current Conditions | Prepare for Disaster | Plans and Training

We want your feedback to make our community safer!

Disasters can happen any time, any place. The Washington County Natural Hazard Mitigation Plan is being updated. The information you provide will help shape the plan.

Click the link to take the survey: https://www.surveymonkey.com/r/NaturalHazardMitigationAwarenessSurvey

The plan covers all areas of:

- Unincorporated Washington County
- City of Beaverton
- City of Cornelius
- City of Forest Grove
- City of Hillsboro
- City of North Plains
- City of Sherwood
- City of Tigard
- Service area of Clean Water Services
- Service area of Tualatin Hills Park and Recreation District
- Service area of Tualatin Valley Water District

Hazards covered:

- Dam failure
- Drought
- Earthquake
- Extreme heat
- Flood
- Landslide
- Volcanic ash
- Wildland fire
- Windstorm, including tornados
- Winter storm

This survey is voluntary and will take about 15 minutes.



Figure 2: Washington County Emergency Management Cooperative Website NHMP Public Survey Posting in English

¡Queremos tu opinión para hacer nuestra comunidad más segura!

Los desastres pueden ocurrir en calquier tiempo y en cualquier lugar. El plan de mitigación de riesgos para el Condado de Washington está siendo actualizado. La información que provea ayudará a dar forma al plan.

Haga clic para realizar la encuesta: https://www.surveymonkey.com/r/LaMitigaciondePeligrosNaturales

El plan cubre todas las áreas de:

- Condado de Washington no incorporado
- Ciudad de Beaverton
- Ciudad de Cornelius
- Ciudad de Forest Grove
- Ciudad de Hillsboro
- Ciudad de North Plains
- Ciudad de Sherwood
- Ciudad de Tigard
- Áreas servidas por Clean Water Services
- Áreas servida por el Distrito de Parque y Recreación de Tualatin Hills
- Áreas servidas por el Distrito de Aguas del Valle de Tualatin

Riesgos cubiertos:

- Fallas en represas
- Sequía
- Terremotos
- Calor extremo
- Inundaciones
- Deslizamiento de tierra
- Ceniza volcánica
- Incendios forestales
- Tormentas de viento, incluyendo tornados
- Tormentas invierno

Esta encuesta es voluntaria y durará unos 15 minutos.



Figure 3: Washington County Emergency Management Cooperative Website NHMP Public Survey Posting in Spanish

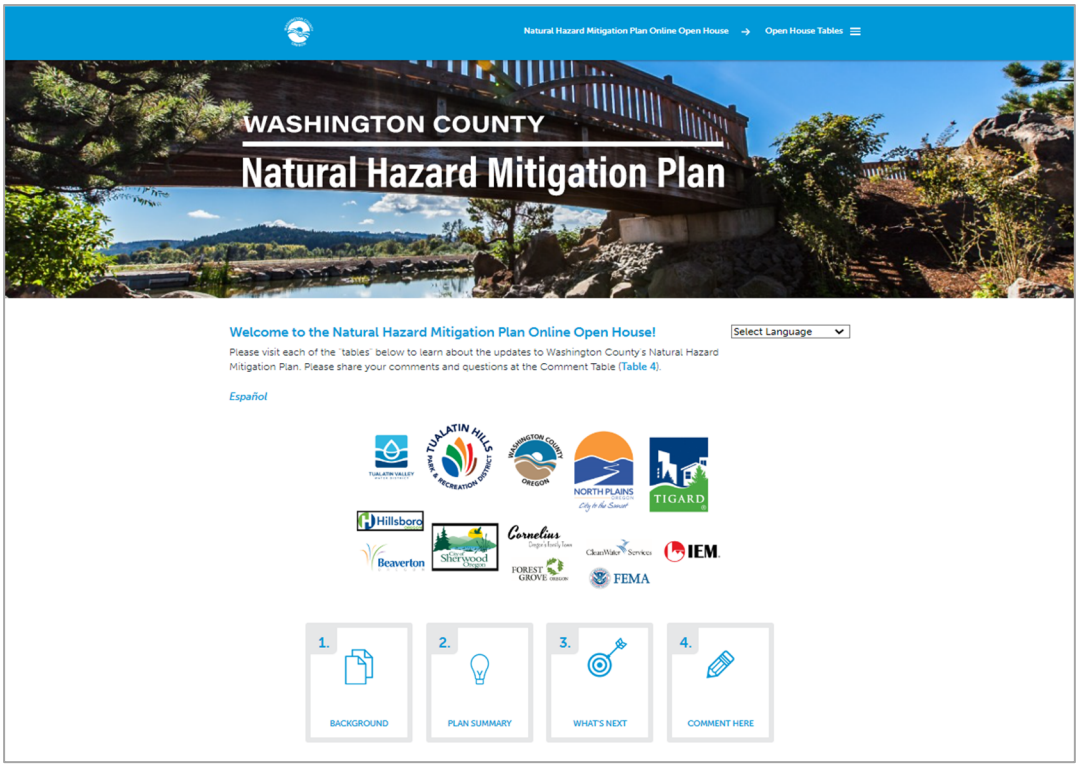


Figure 4: Online Open House for Public and Stakeholder Review of NHMP Draft Hosted by Washington County

1.3.1.1. City of Beaverton

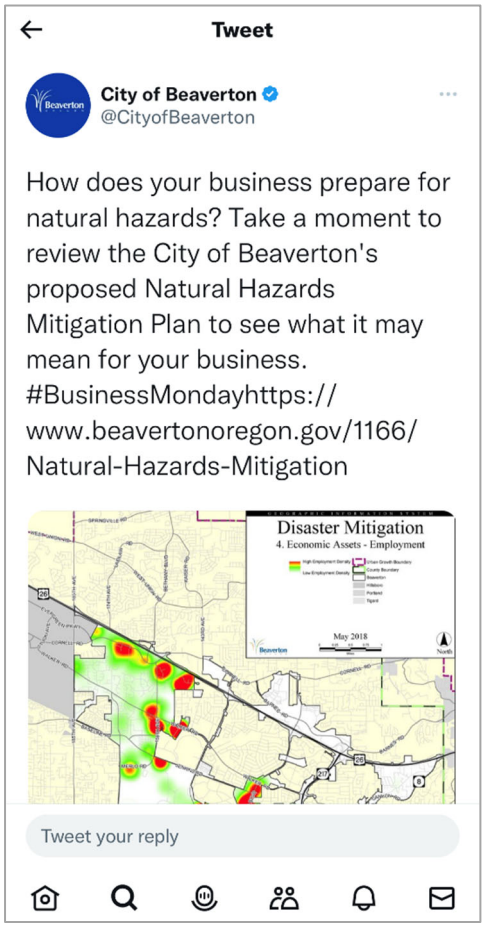


Figure 5: NHMP Public Survey Promotional Post on the City of Beaverton's Twitter Page



Figure 6: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the City of Beaverton's Facebook Page in English and Spanish



Figure 7: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the City of Beaverton's Twitter Page



Figure 8: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the City of Beaverton's Twitter Page



Figure 9: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the City of Beaverton's Twitter Page in Spanish



City Update

February | 2023

Beaverton OREGON

A monthly digest of news, highlights and upcoming events for city employees and sharing in the community.

Beaverton Hot Topics...

Partner Agency News:

Natural Hazard Mitigation Plan is being updated. Review the ways many public agencies and cities within Washington County plan to reduce the impacts of natural disasters by participating in an online open house happening now through Mar. 5. Hazard mitigation is work we do before disaster strikes to help lessen impacts to life, property and the environment. Visit the Natural Hazard Mitigation Plan online open house to learn more.

Figure 10: Promotional Information for Online Open House for Public and Stakeholder Review of NHMP Draft in the City of Beaverton's City Update Newsletter

1.3.1.2. Cities of Cornelius and Forest Grove

Washington County Emergency Management completed public survey publicity on behalf of the cities of Cornelius and Forest Grove in person at the City of Cornelius Farmers Market.



Figure 11: Washington County Emergency Management Table, Including NHMP Public Survey Promotion, at City of Cornelius Farmers Market

1.3.1.3. City of Hillsboro

Printed promotional material was placed at Brookwood Public Library, Shute Park Aquatic & Recreation Center, and the City's Parks & Recreation building.



Figure 12: NHMP Public Survey Promotional Materials Posted in Brookwood Public Library



Figure 13: NHMP Public Survey Promotional Materials Posted in Brookwood Public Library

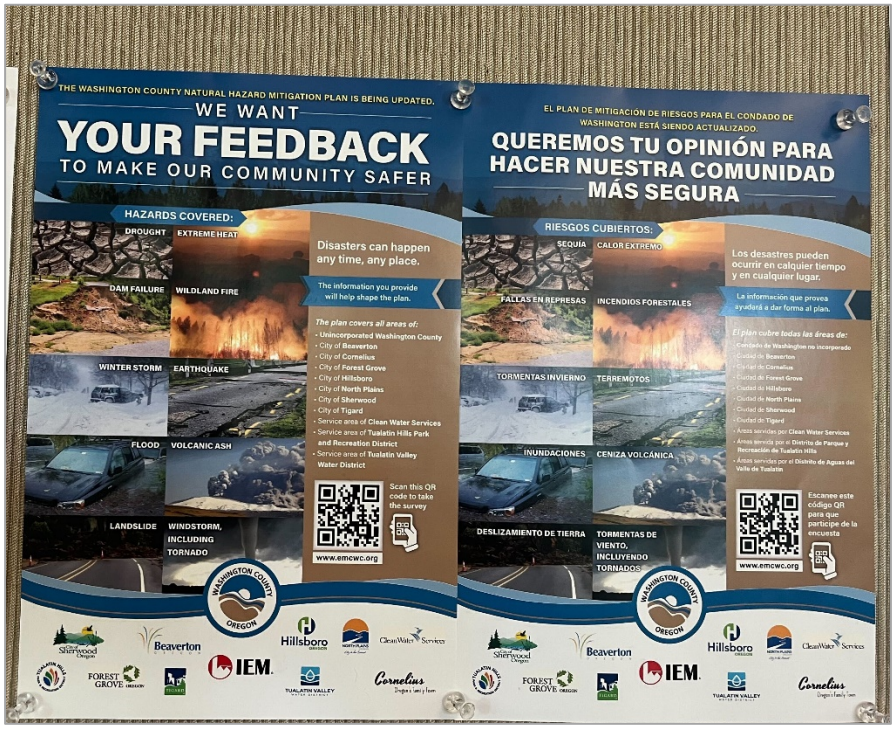


Figure 14: NHMP Public Survey Promotional Materials Posted in Brookwood Public Library



Figure 15: NHMP Public Survey Promotional Materials Posted in the Shute Park Aquatic & Recreation Center



Figure 16: NHMP Public Survey Promotional Materials Posted in the City's Parks & Recreation Building

Digital outreach was performed by the City's public information officer using the City website, the Hillsboro Fire & Rescue main website carousel, Facebook, Twitter, Instagram, Nextdoor, and the Engage Hillsboro platform. An email blast was also sent to subscribers of the Hillsboro Community Emergency Response Team newsletter.

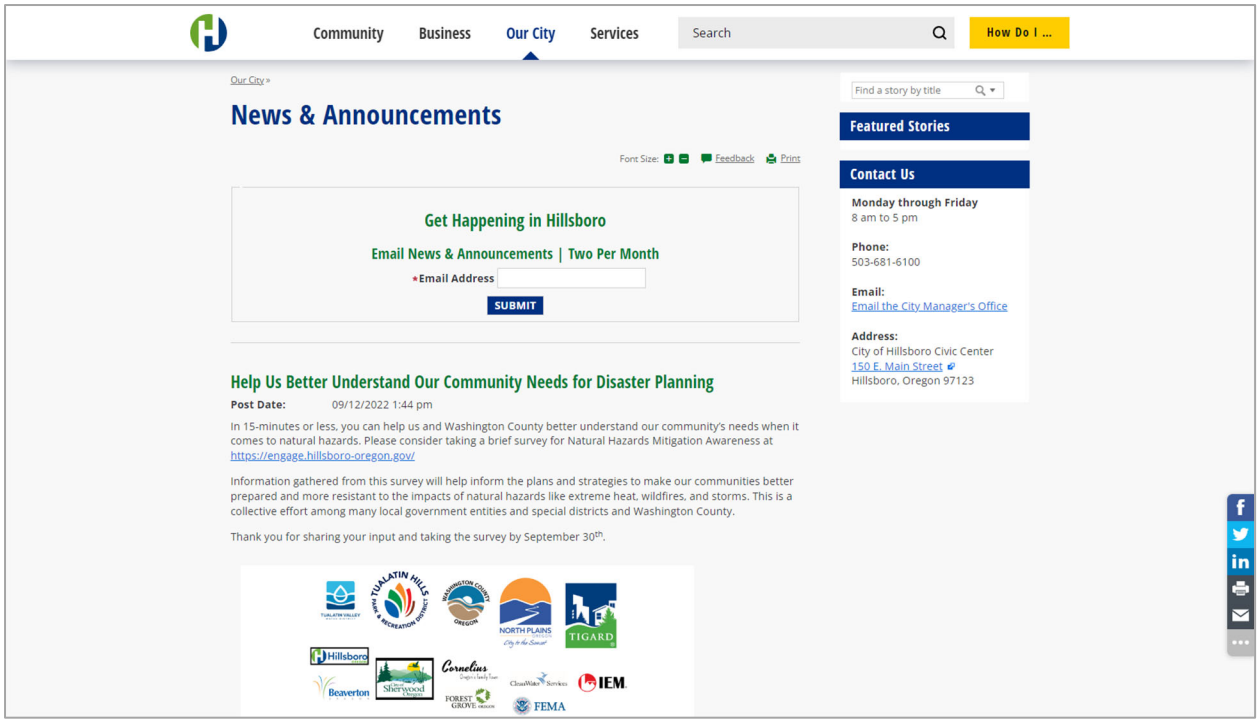


Figure 17: NHMP Public Survey Promotional Post on the City's Website

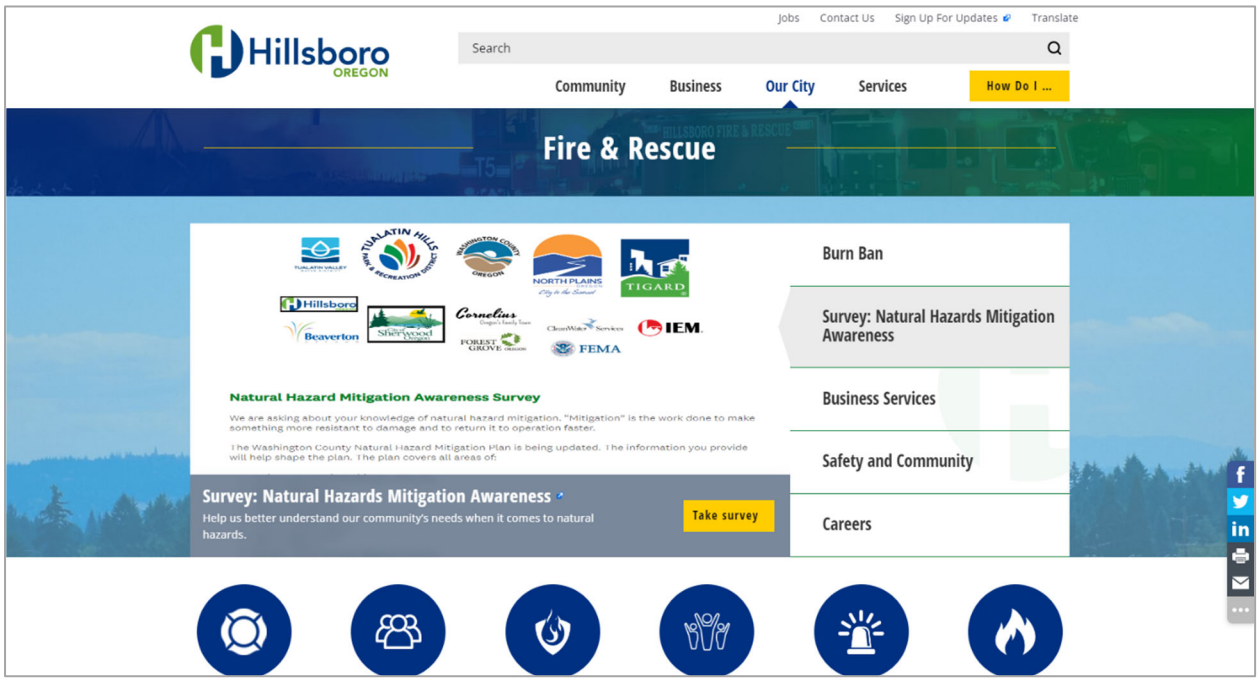


Figure 18: NHMP Public Survey Promotional Post on Hillsboro Fire & Rescue's Website

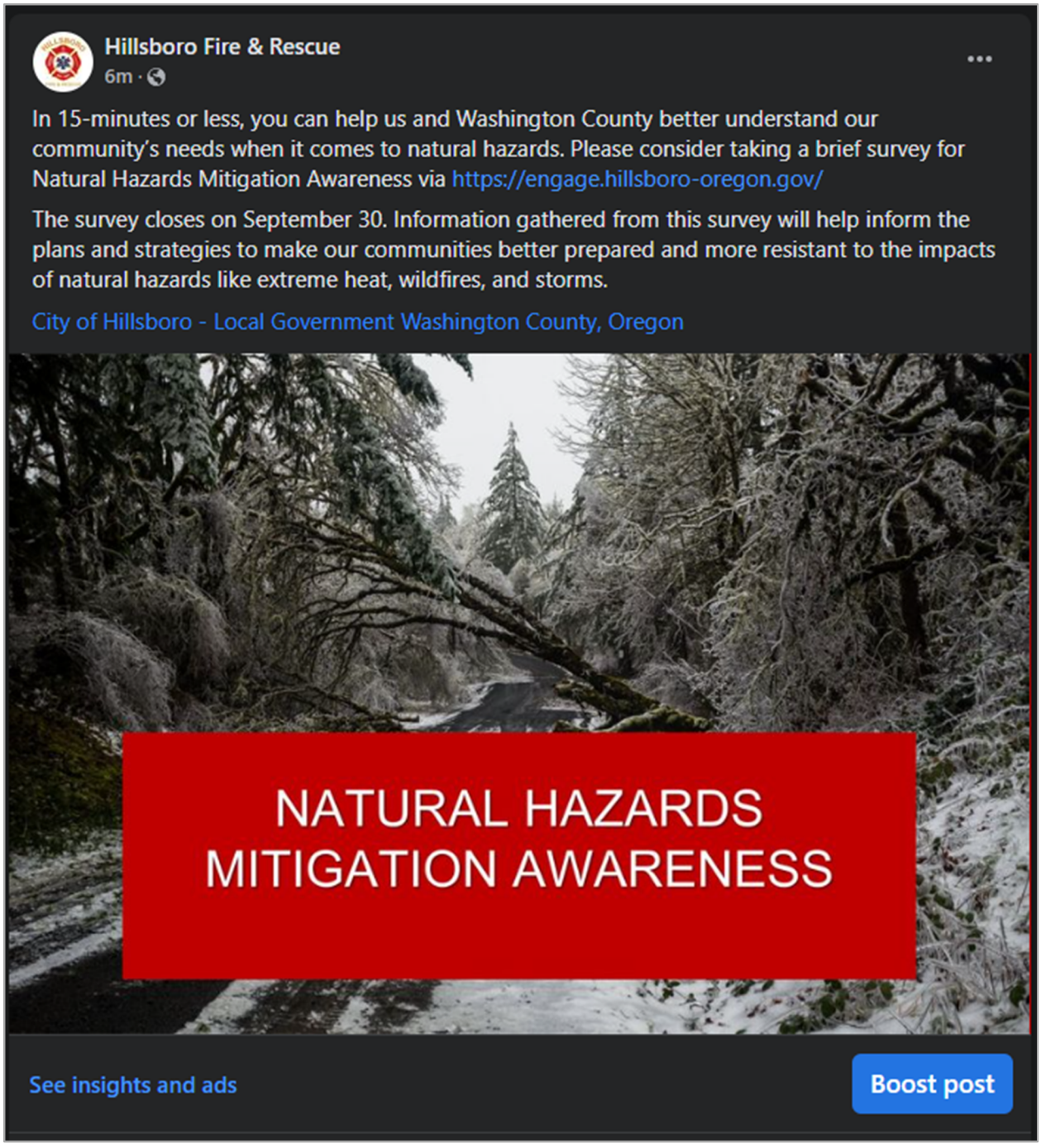


Figure 19: NHMP Public Survey Promotional Post on Hillsboro Fire & Rescue's Facebook Page

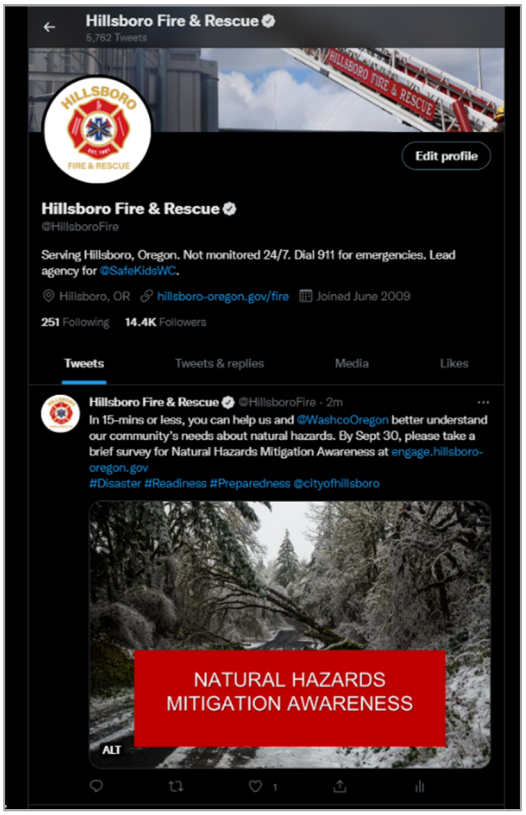


Figure 20: NHMP Public Survey Promotional Post on Hillsboro Fire & Rescue's Twitter Page

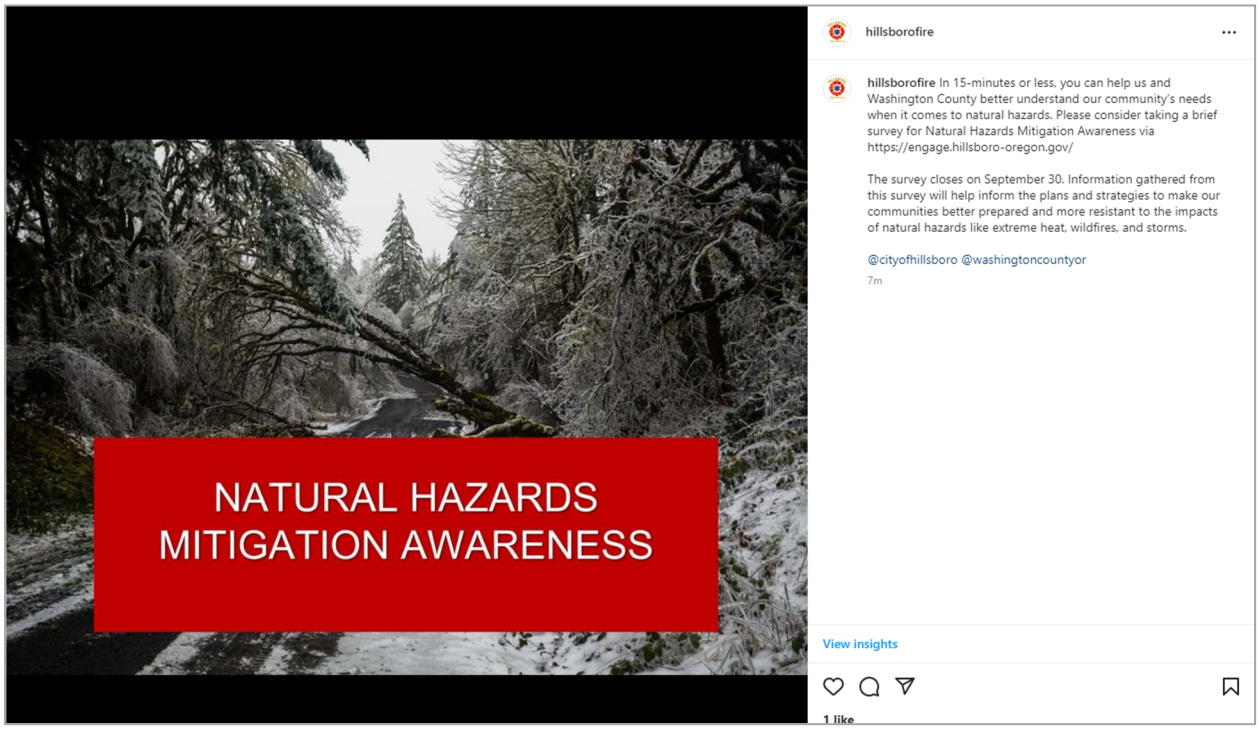


Figure 21: NHMP Public Survey Promotional Post on Hillsboro Fire & Rescue's Instagram Page

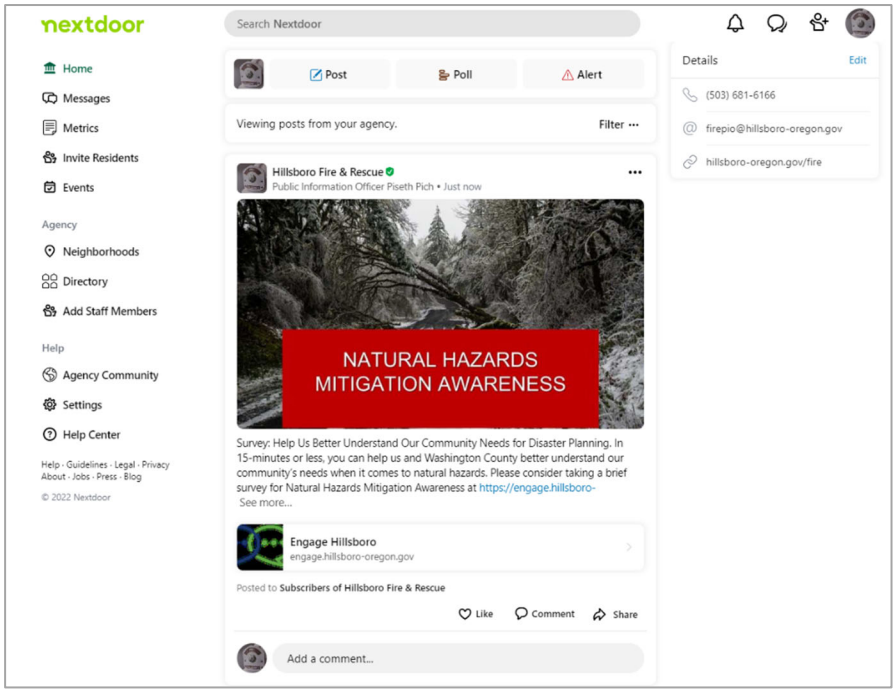


Figure 22: NHMP Public Survey Promotional Post on Hillsboro Fire & Rescue's Nextdoor Page

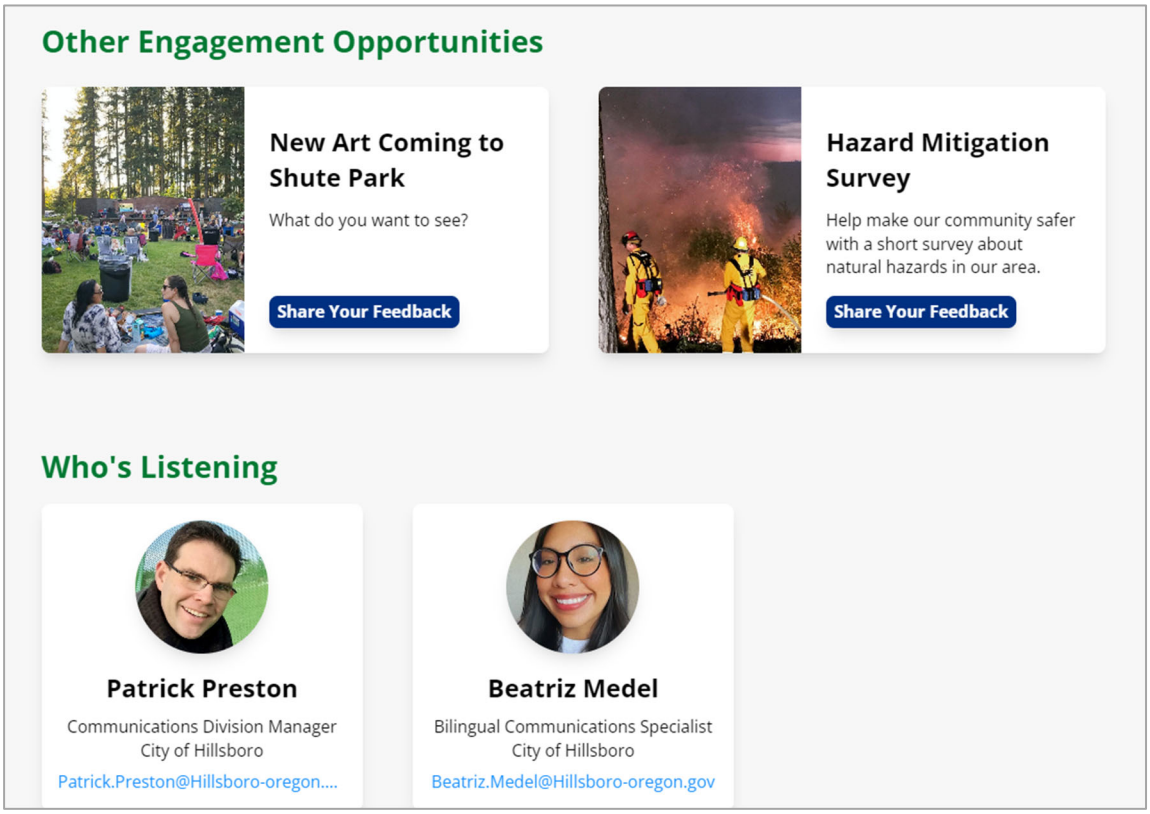


Figure 23: NHMP Public Survey Promotional Post on the Engage Hillsboro Platform



CERT
COMMUNITY EMERGENCY RESPONSE TEAM
HILLSBORO

Hillsboro Emergency Management

Summer 2022

340 E First Avenue
Hillsboro, OR 97123

Phone: 503-681-6166
CERT@hillsboro-oregon.gov

New "988" number for the National Suicide Prevention Lifeline:

In 2020, Congress designated the new 988 dialing code to operate through the existing National Suicide Prevention Lifeline. This new 3-digit code to access crisis support went into effect July 16th, 2022 in order to better serve and aide those experiencing mental health related distress – whether that is thoughts of suicide, mental health or substance use crisis, or any other kind of emotional distress. This is a great step toward providing direct crisis care to those in need. Attached are info sheets in English and Spanish on the new 988 number for the Suicide and Crisis Lifeline.

September 1, 2022 Summer Issue #5

FEEDBACK WANTED

Jurisdictions throughout Washington County have been working to update their Natural Hazard Mitigation Plans and are seeking your feedback. This plan covers disasters like:

Drought
Extreme Heat
Dam Failure
Wildland Fire
Winter Storm
Earthquake
Flood
Volcanic Ash
Landslide
Windstorm

Your response helps to shape the plan and plan for future actions

https://www.surveymonkey.com/r/NaturalHazardMitigationAwarenessSurvey

Figure 24: NHMP Public Survey Promotion in the Hillsboro CERT Newsletter



Figure 25: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on Hillsboro Fire & Rescue's Facebook Page



Figure 26: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on Hillsboro Fire & Rescue's Twitter Page

1.3.1.4. City of North Plains

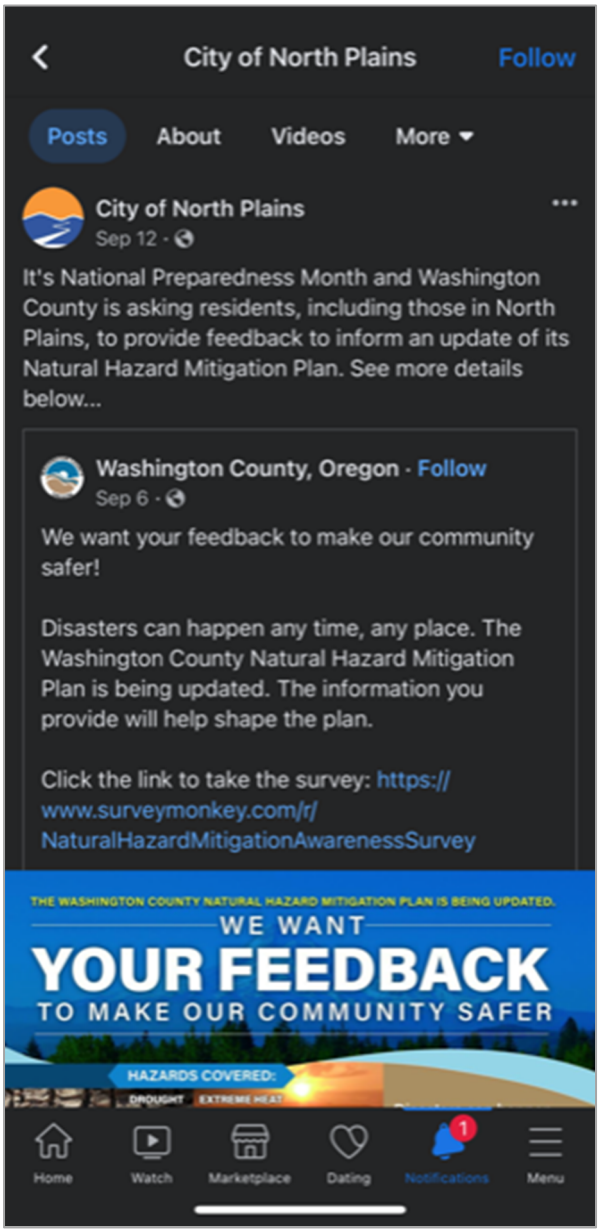


Figure 27: NHMP Public Survey Promotion on the City of North Plains Facebook Page

1.3.1.5. City of Sherwood



Figure 28: NHMP Public Survey Promotion on the City of Sherwood's Facebook Page

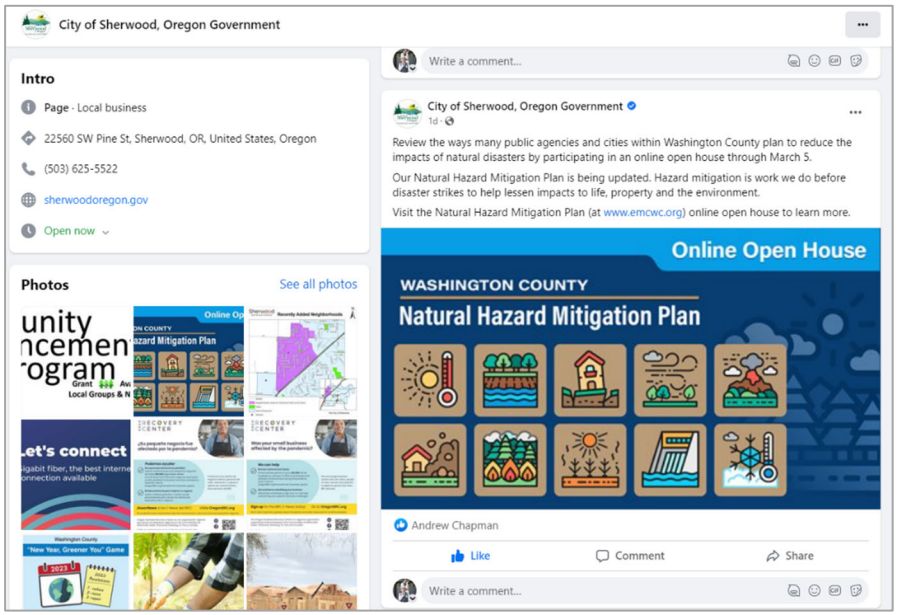


Figure 29: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the City of Sherwood's Facebook Page

1.3.1.6. City of Tigard

The City executed a digital campaign to publicize the NHMP public survey, which included posting it to the City's website and its Facebook, Instagram, Twitter, and LinkedIn pages. The result was a total of 1,838 views and impressions.

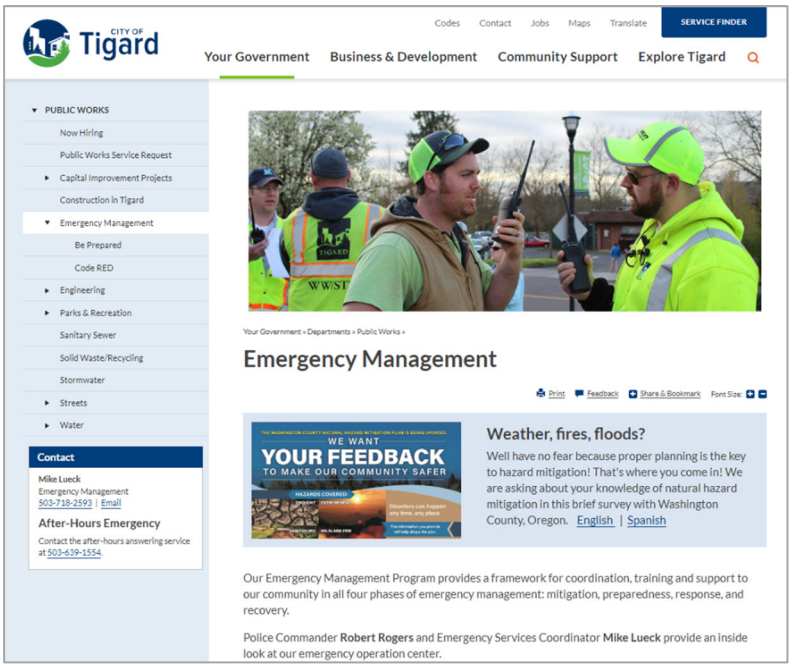


Figure 30: NHMP Public Survey Promotional Post on the City of Tigard Website



Figure 31: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the City of Tigard's Emergency Management Website

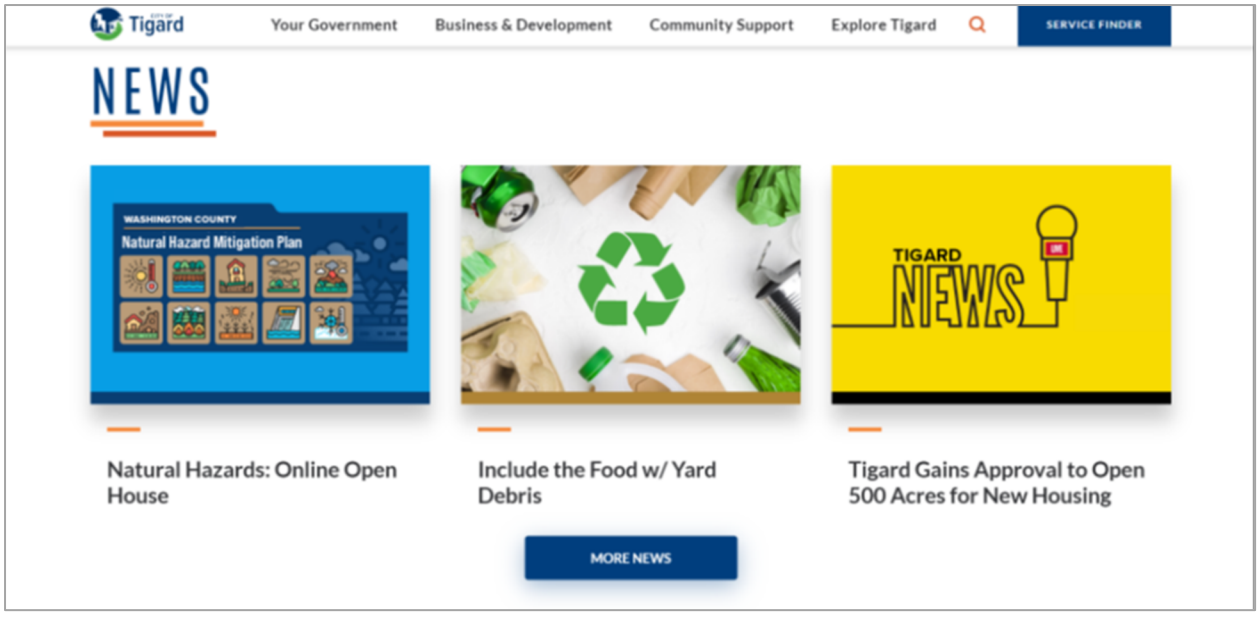


Figure 32: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the City of Tigard's Website Main Page

1.3.1.7. Clean Water Services

Posts on LinkedIn, Twitter, Nextdoor, Instagram, Facebook, Linktree, and in the Clean Water Connection Newsletter were used to reach Clean Water Service's customers and inform them about the public survey and draft plan review opporunity. All NHMP participants are in the CWS service area. Therefore, CWS customers throughout the planning area received information about the NHMP public survey and the draft plan via these outreach channels in addition to the information they received from their local jurisdiction.

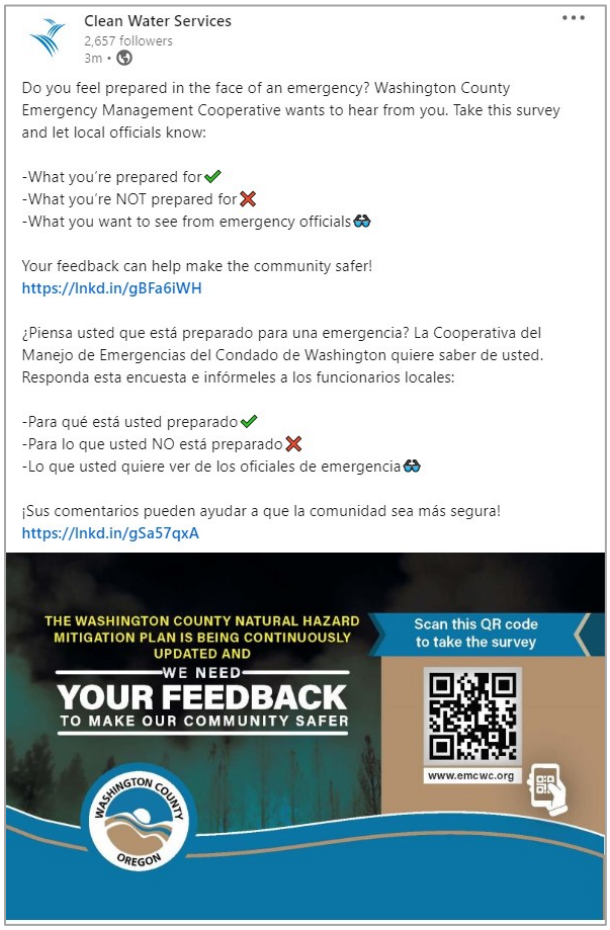


Figure 33: NHMP Public Survey Promotional Post on the Clean Water Services LinkedIn Page



Figure 34: NHMP Public Survey Promotional Post on the Clean Water Services Twitter Page

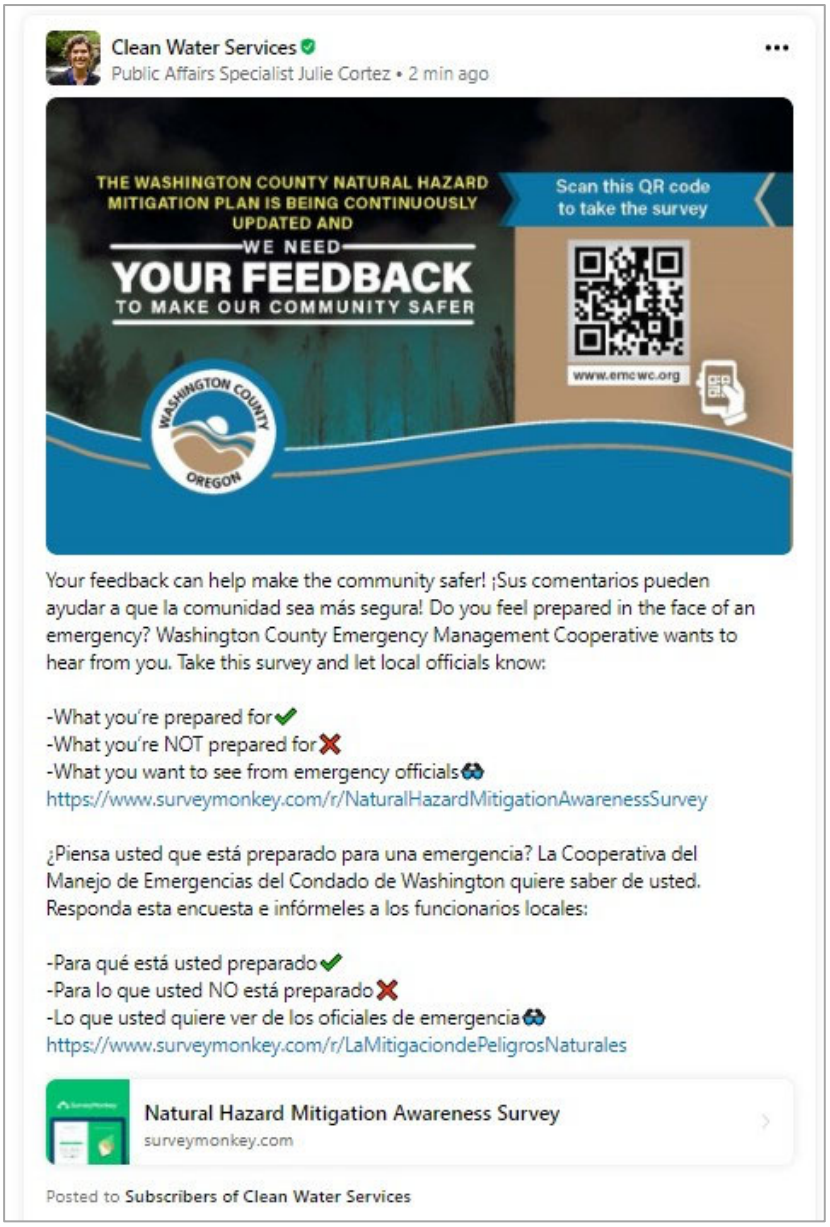


Figure 35: NHMP Public Survey Promotional Post on the Clean Water Services Nextdoor Page



Figure 36: NHMP Public Survey Promotional Post on the Clean Water Services Instagram Page

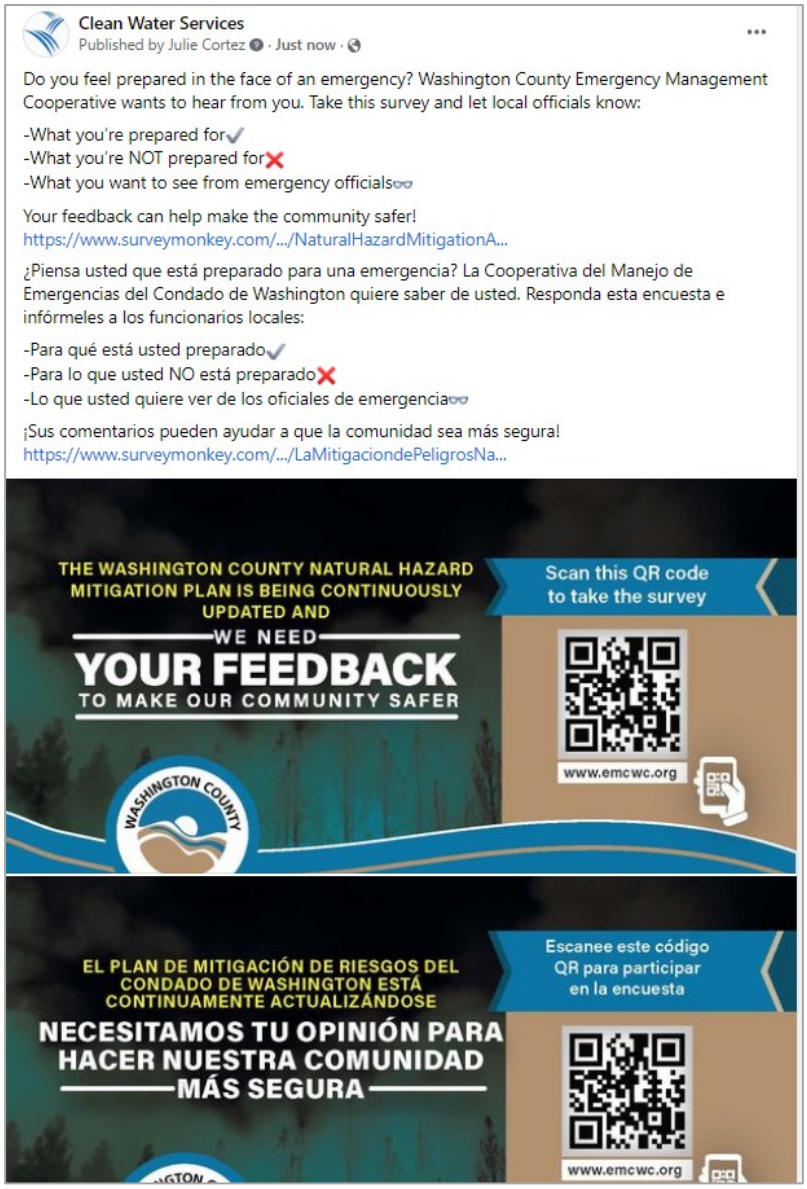


Figure 37: NHMP Public Survey Promotional Post on the Clean Water Services Facebook Page

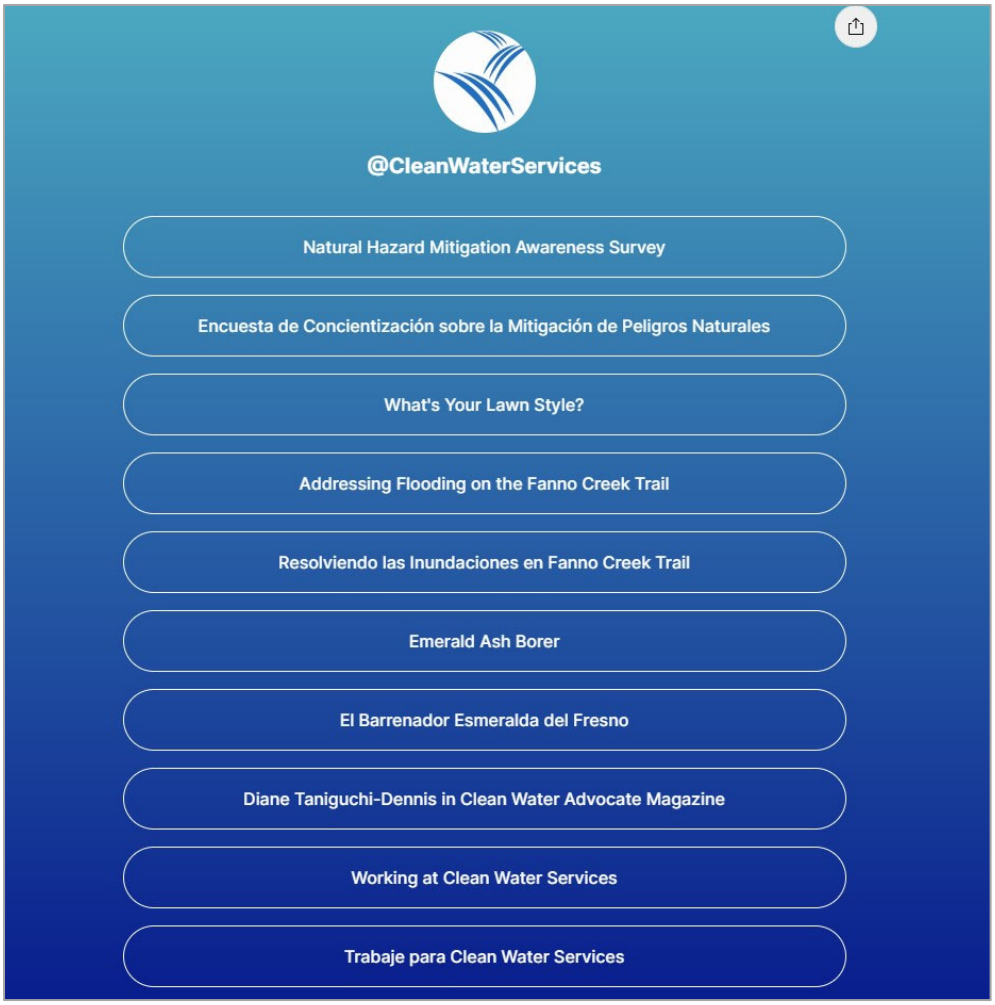


Figure 38: NHMP Public Survey Promotional Post on the Clean Water Services Linktree Page

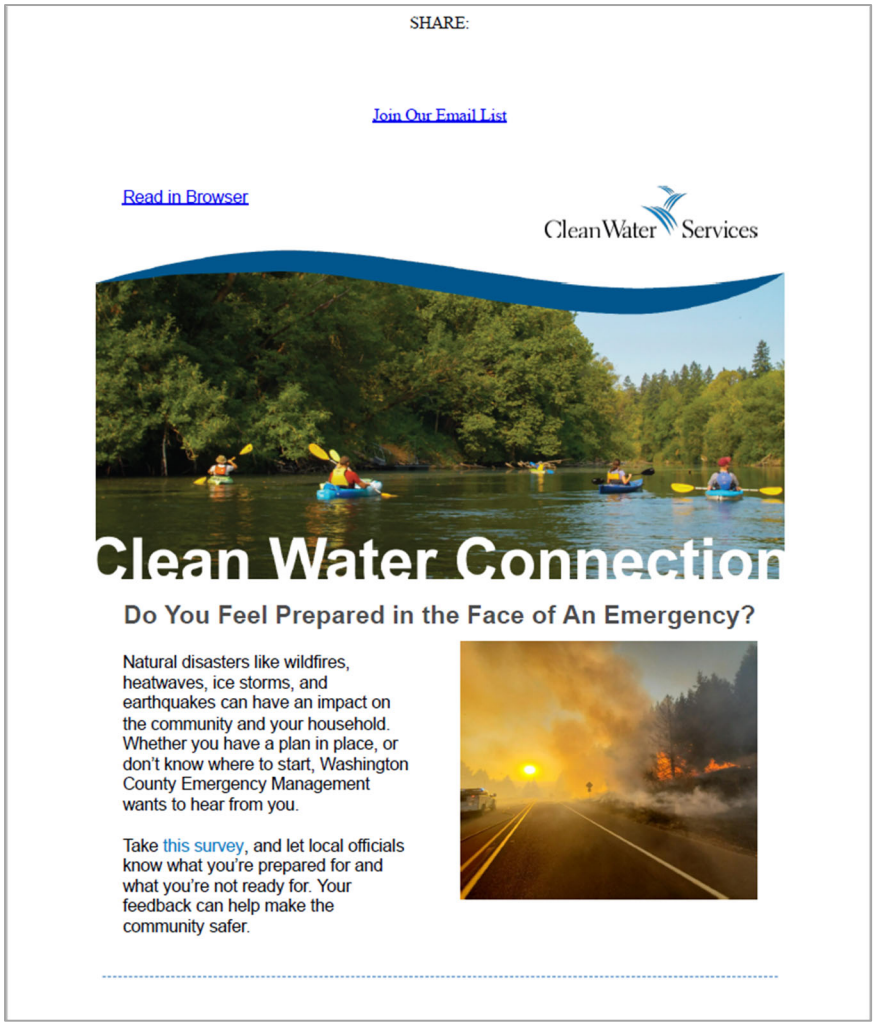


Figure 39: NHMP Public Survey Promotion in the Clean Water Services Clean Water Connection Newsletter



Figure 40: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the Clean Water Services Facebook Page in English and Spanish



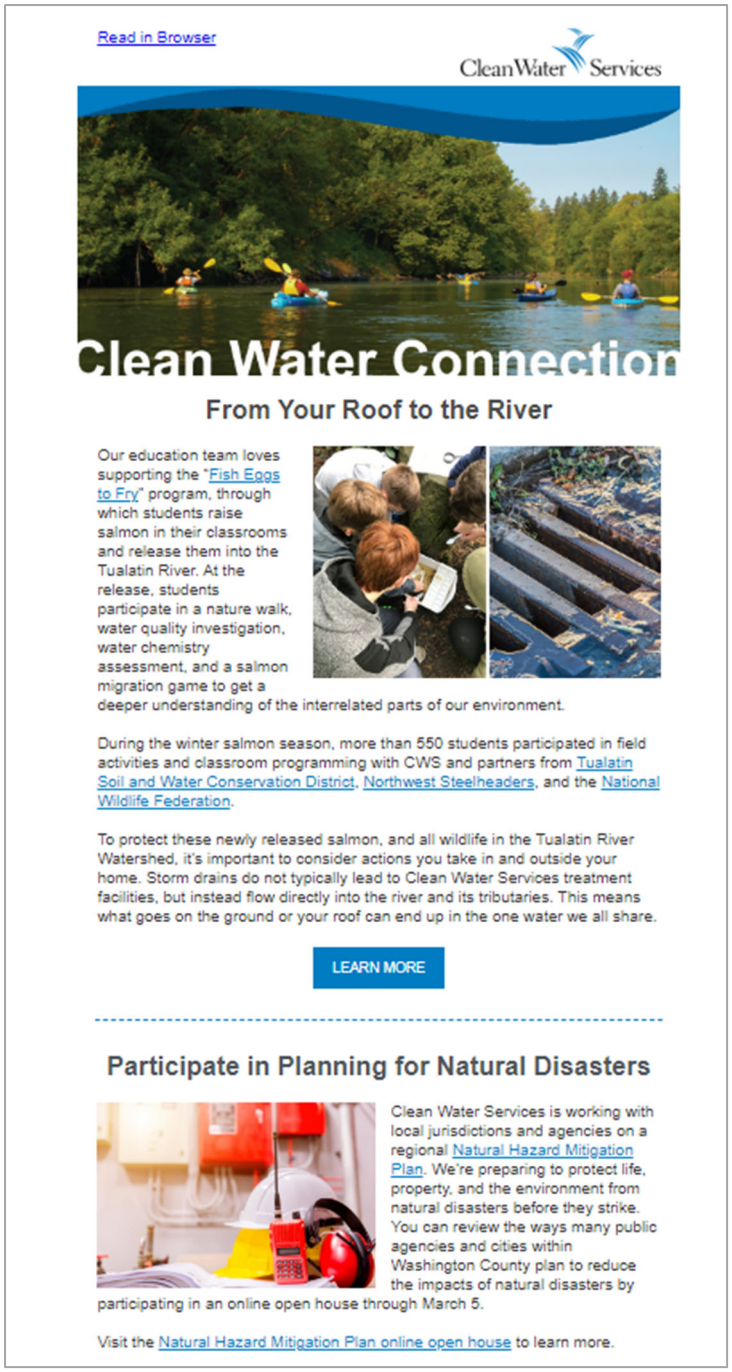
Figure 41: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the Clean Water Services Nextdoor Page in English and Spanish



Figure 42: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the Clean Water Services Twitter Page



Figure 43: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on the Clean Water Services Twitter Page in Spanish



Read in Browser

Clean Water Services

Clean Water Connection

From Your Roof to the River

Our education team loves supporting the "Fish Eggs to Fry" program, through which students raise salmon in their classrooms and release them into the Tualatin River. At the release, students participate in a nature walk, water quality investigation, water chemistry assessment, and a salmon migration game to get a deeper understanding of the interrelated parts of our environment.

During the winter salmon season, more than 550 students participated in field activities and classroom programming with CWS and partners from Tualatin Soil and Water Conservation District, Northwest Steelheaders, and the National Wildlife Federation.

To protect these newly released salmon, and all wildlife in the Tualatin River Watershed, it's important to consider actions you take in and outside your home. Storm drains do not typically lead to Clean Water Services treatment facilities, but instead flow directly into the river and its tributaries. This means what goes on the ground or your roof can end up in the one water we all share.

LEARN MORE

Participate in Planning for Natural Disasters

Clean Water Services is working with local jurisdictions and agencies on a regional Natural Hazard Mitigation Plan. We're preparing to protect life, property, and the environment from natural disasters before they strike. You can review the ways many public agencies and cities within Washington County plan to reduce the impacts of natural disasters by participating in an online open house through March 5.

Visit the Natural Hazard Mitigation Plan online open house to learn more.

Figure 44: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft in the Clean Water Services Clean Water Connection Newsletter

1.3.1.8. Tualatin Hills Park & Recreation District

The Tualatin Hills Park & Recreation District utilized Twitter and Facebook posts, an email blast to 53,000 subscribers, and a post on the organization's website to spread the word about the public survey.



Figure 45: NHMP Public Survey Promotional Post on Tualatin Hills Park & Recreation District's Twitter Page



Figure 46: NHMP Public Survey Promotional Post on Tualatin Hills Park & Recreation District's Facebook Page



Figure 47: NHMP Public Survey Promotional Post in a Tualatin Hills Park & Recreation District Email Blast

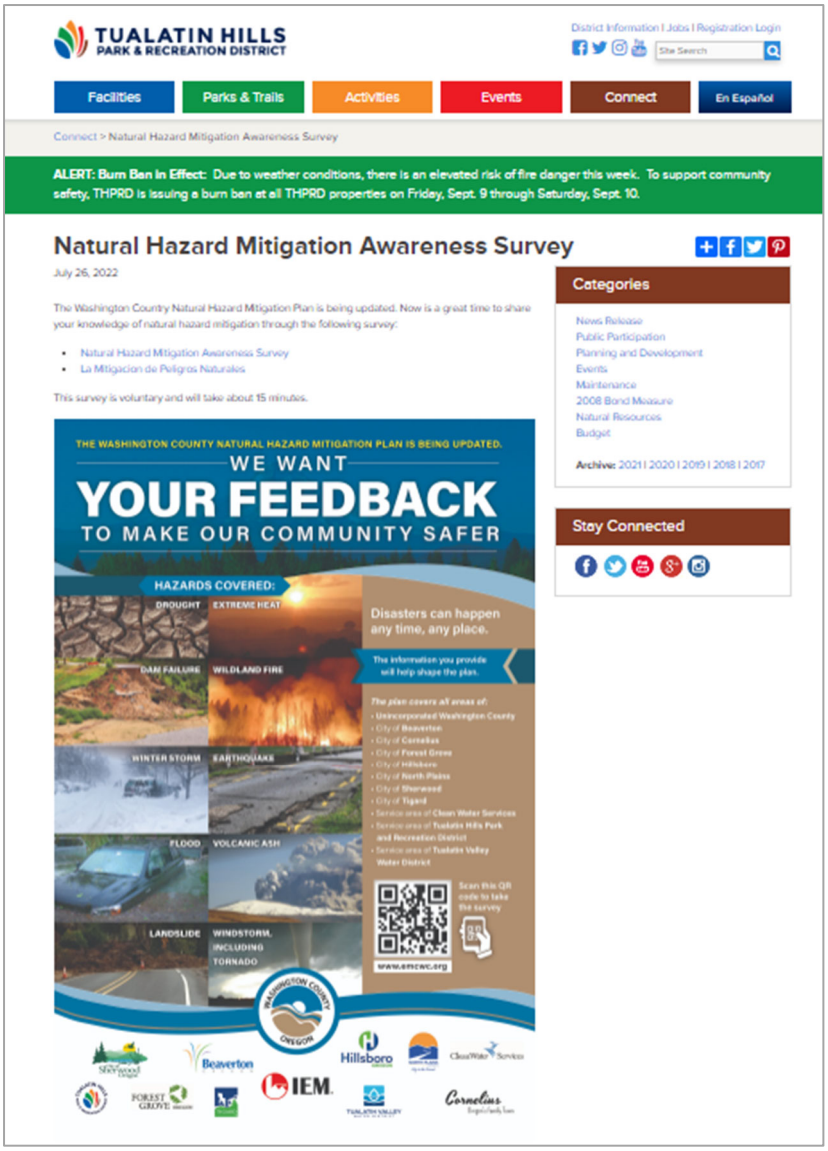
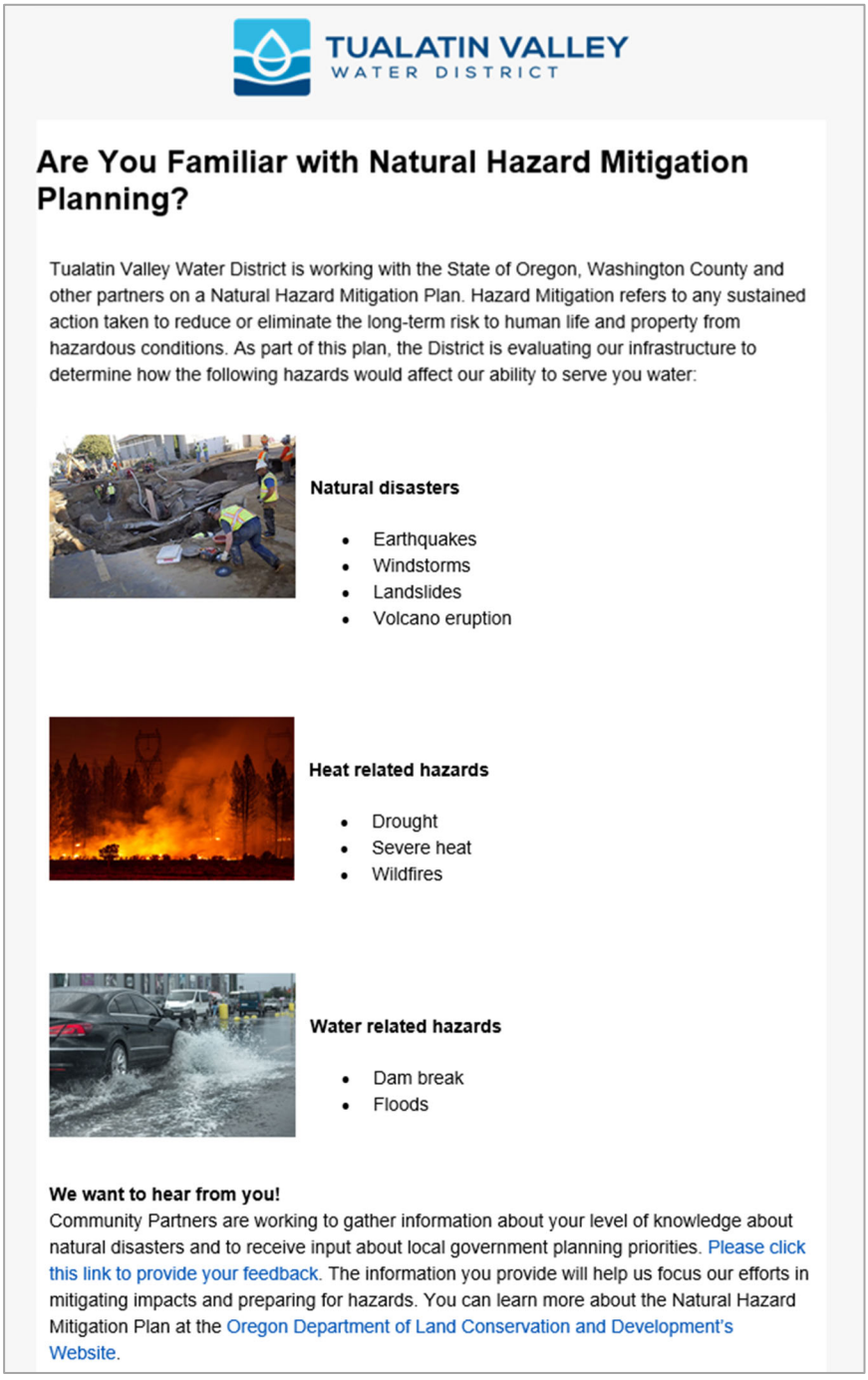


Figure 48: NHMP Public Survey Promotional Post on Tualatin Hills Park & Recreation District's Website

1.3.1.9. Tualatin Valley Water District

Tualatin Valley Water District Communications used an email blast to promote the public survey and the survey was also promoted in TVWD's newsletters and mailers. All NHMP participants are in the Tualatin Valley Water District service area. Therefore, Tualatin Valley Water District customers throughout the planning area received information about the NHMP public survey via this outreach channel in addition to the information they received from their local jurisdiction.



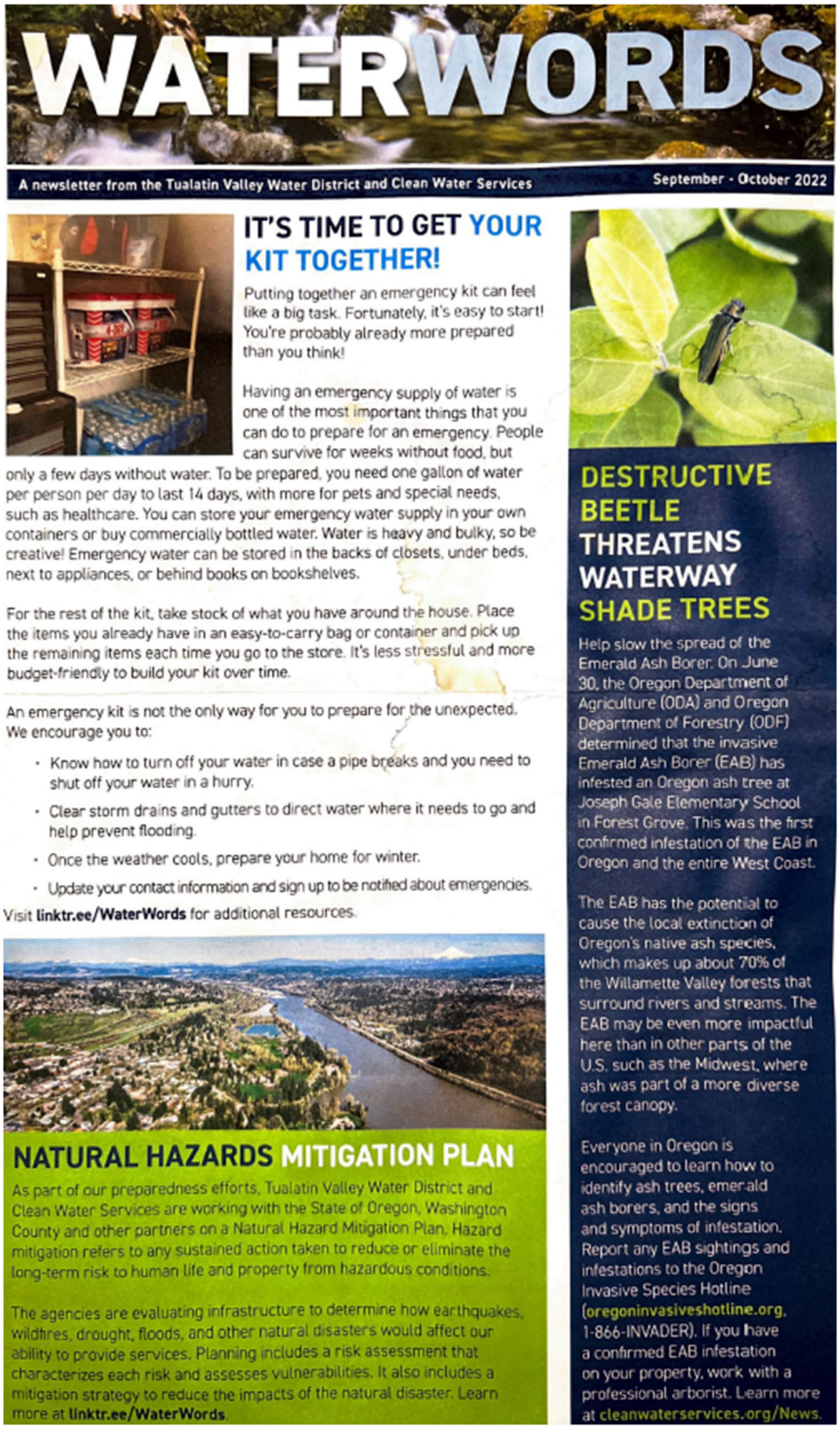
TUALATIN VALLEY
WATER DISTRICT

Are You Familiar with Natural Hazard Mitigation Planning?

Tualatin Valley Water District is working with the State of Oregon, Washington County and other partners on a Natural Hazard Mitigation Plan. Hazard Mitigation refers to any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazardous conditions. As part of this plan, the District is evaluating our infrastructure to determine how the following hazards would affect our ability to serve you water:

We want to hear from you!
Community Partners are working to gather information about your level of knowledge about natural disasters and to receive input about local government planning priorities. Please click this link to provide your feedback. The information you provide will help us focus our efforts in mitigating impacts and preparing for hazards. You can learn more about the Natural Hazard Mitigation Plan at the Oregon Department of Land Conservation and Development's Website.

Figure 49: NHMP Public Survey Promotional Post in a Tualatin Valley Water District Email Blast



WATERWORDS

A newsletter from the Tualatin Valley Water District and Clean Water Services — September - October 2022

IT'S TIME TO GET YOUR KIT TOGETHER!

Putting together an emergency kit can feel like a big task. Fortunately, it's easy to start! You're probably already more prepared than you think!

Having an emergency supply of water is one of the most important things that you can do to prepare for an emergency. People can survive for weeks without food, but only a few days without water. To be prepared, you need one gallon of water per person per day to last 14 days, with more for pets and special needs, such as healthcare. You can store your emergency water supply in your own containers or buy commercially bottled water. Water is heavy and bulky, so be creative! Emergency water can be stored in the backs of closets, under beds, next to appliances, or behind books on bookshelves.

For the rest of the kit, take stock of what you have around the house. Place the items you already have in an easy-to-carry bag or container and pick up the remaining items each time you go to the store. It's less stressful and more budget-friendly to build your kit over time.

An emergency kit is not the only way for you to prepare for the unexpected. We encourage you to:

- Know how to turn off your water in case a pipe breaks and you need to shut off your water in a hurry.
- Clear storm drains and gutters to direct water where it needs to go and help prevent flooding.
- Once the weather cools, prepare your home for winter.
- Update your contact information and sign up to be notified about emergencies.

Visit **linktr.ee/WaterWords** for additional resources.

NATURAL HAZARDS MITIGATION PLAN

As part of our preparedness efforts, Tualatin Valley Water District and Clean Water Services are working with the State of Oregon, Washington County and other partners on a Natural Hazard Mitigation Plan. Hazard mitigation refers to any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazardous conditions.

The agencies are evaluating infrastructure to determine how earthquakes, wildfires, drought, floods, and other natural disasters would affect our ability to provide services. Planning includes a risk assessment that characterizes each risk and assesses vulnerabilities. It also includes a mitigation strategy to reduce the impacts of the natural disaster. Learn more at **linktr.ee/WaterWords**.

DESTRUCTIVE BEETLE THREATENS WATERWAY SHADE TREES

Help slow the spread of the Emerald Ash Borer. On June 30, the Oregon Department of Agriculture (ODA) and Oregon Department of Forestry (ODF) determined that the invasive Emerald Ash Borer (EAB) has infested an Oregon ash tree at Joseph Gale Elementary School in Forest Grove. This was the first confirmed infestation of the EAB in Oregon and the entire West Coast.

The EAB has the potential to cause the local extinction of Oregon's native ash species, which makes up about 70% of the Willamette Valley forests that surround rivers and streams. The EAB may be even more impactful here than in other parts of the U.S. such as the Midwest, where ash was part of a more diverse forest canopy.

Everyone in Oregon is encouraged to learn how to identify ash trees, emerald ash borers, and the signs and symptoms of infestation. Report any EAB sightings and infestations to the Oregon Invasive Species Hotline (**oregoninvasiveshotline.org**, 1-866-INVADER). If you have a confirmed EAB infestation on your property, work with a professional arborist. Learn more at **cleanwaterservices.org/News**.

Figure 50: NHMP Public Survey Promotional Information in Tualatin Valley Water District's WaterWords Print Newsletter Included in Monthly Water Bills

1.3.1.10. Washington County

Washington County emergency management staff attended the Washington County Fair and the Cornelius Farmers Market to do in-person public outreach about the NHMP survey and distribute printed promotional material. Staff were able to talk to approximately 40 people about the survey at the farmers market.

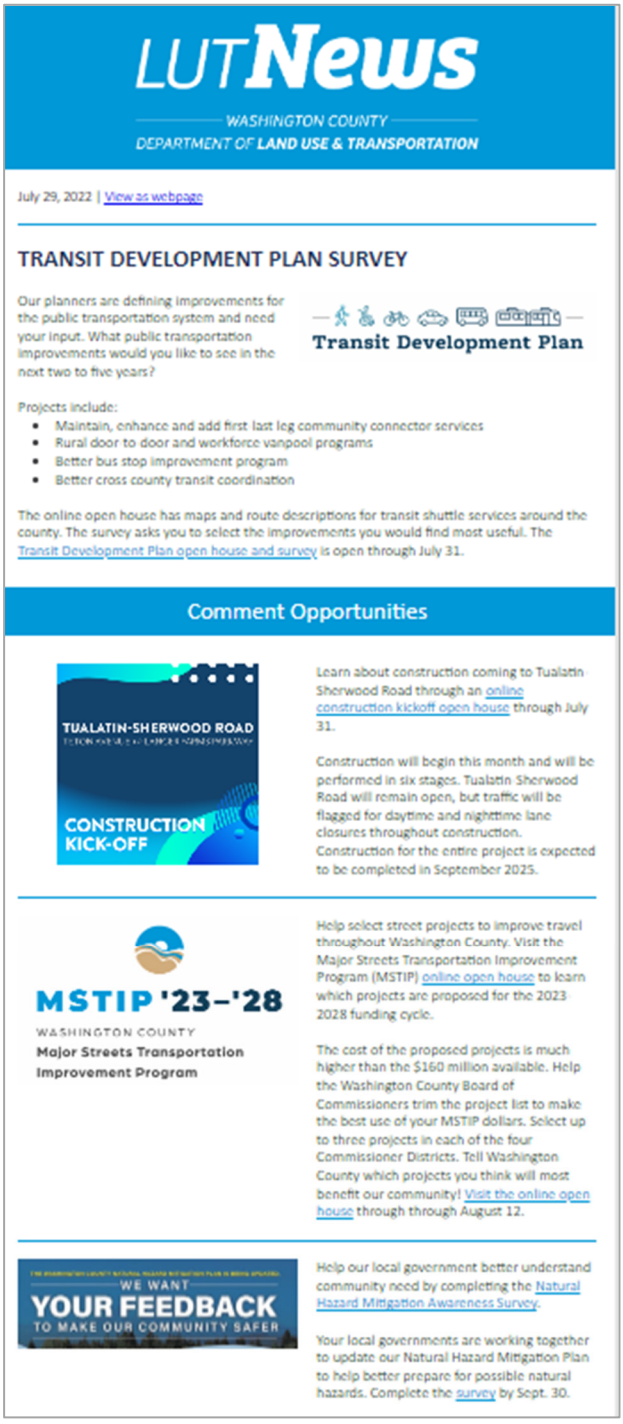


Figure 51: Washington County Emergency Management Table, Including NHMP Public Survey Promotion, at Washington County Fair



Figure 52: Washington County Emergency Management Table, Including NHMP Public Survey Promotion, at Washington County Fair

Digital outreach was performed by including survey information in the County's LUTNews email update twice and Community Engagement Connections weekly e-update two different times. The County also hosted the survey on the Washington County Emergency Management Cooperative website instead of its own sites so each participant could link to it. Social media outreach included 14 posts on the County's Facebook page, seven in English and seven in Spanish, and 14 posts on the County's Twitter page, with seven in English and seven in Spanish.


LUTNews

WASHINGTON COUNTY
DEPARTMENT OF LAND USE & TRANSPORTATION

July 29, 2022 | View as webpage

TRANSIT DEVELOPMENT PLAN SURVEY

Our planners are defining improvements for the public transportation system and need your input. What public transportation improvements would you like to see in the next two to five years?

Transit Development Plan

Projects include:

- Maintain, enhance and add first last leg community connector services
- Rural door to door and workforce vanpool programs
- Better bus stop improvement program
- Better cross county transit coordination

The online open house has maps and route descriptions for transit shuttle services around the county. The survey asks you to select the improvements you would find most useful. The Transit Development Plan open house and survey is open through July 31.

Comment Opportunities

TUALATIN-SHERWOOD ROAD
CONSTRUCTION KICK-OFF

Learn about construction coming to Tualatin Sherwood Road through an online construction kickoff open house through July 31.

Construction will begin this month and will be performed in six stages. Tualatin Sherwood Road will remain open, but traffic will be flagged for daytime and nighttime lane closures throughout construction. Construction for the entire project is expected to be completed in September 2025.

MSTIP '23–'28
WASHINGTON COUNTY
Major Streets Transportation Improvement Program

Help select street projects to improve travel throughout Washington County. Visit the Major Streets Transportation Improvement Program (MSTIP) online open house to learn which projects are proposed for the 2023 2028 funding cycle.

The cost of the proposed projects is much higher than the $160 million available. Help the Washington County Board of Commissioners trim the project list to make the best use of your MSTIP dollars. Select up to three projects in each of the four Commissioner Districts. Tell Washington County which projects you think will most benefit our community! Visit the online open house through through August 12.

WE WANT
YOUR FEEDBACK
TO MAKE OUR COMMUNITY SAFER

Help our local government better understand community need by completing the Natural Hazard Mitigation Awareness Survey.

Your local governments are working together to update our Natural Hazard Mitigation Plan to help better prepare for possible natural hazards. Complete the survey by Sept. 30.

Figure 53: Washington County Public Survey Promotion in LUTNews, July 29, 2022



LUTNews

WASHINGTON COUNTY
DEPARTMENT OF LAND USE & TRANSPORTATION

Sept. 2, 2022 | View as webpage

NOTE: Building Services and Current Planning have
NEW LOBBY/IN-PERSON SERVICE HOURS effective 9/7:
8 a.m.-4 p.m. Monday, Tuesday, Thursday
Closed to in-person services: Wednesday (temporary), Friday
See Media Release

Share the road this back-to-school season

As the school bell rings and class comes back into session, get ready for the return of school busses, young pedestrians and bicyclists.

Remember to allow a larger following distance if you are driving behind a school bus. That will give you enough time to slow down if the bus is making frequent stops. Never pass a bus from either side if it is stopped with its lights flashing and stop sign extended.

Flashing school zone signs are your signal to slow down and look closely for pedestrians. Stop and yield to pedestrians or crossing guards crossing the road. Never block a crosswalk when stopped at an intersection, as it can force pedestrians to go around you and into the path of traffic. Remember that children can make unpredictable choices and take risks when crossing the road.

Students on bikes are also a common sight in school zones. As always, pass bicyclists slowly and leave three feet between your vehicle and the cyclist. Be aware that young bicyclists may turn into your path without signaling or looking. Drivers turning left in front of cyclists is a common cause of crashes.

Parents or guardians can remind their students to walk on sidewalks when possible, look both ways before crossing the street, and avoid playing, pushing, shoving and using phones around traffic. If biking, make sure they have a properly fitted helmet. Remind them to follow traffic signs and signals and use bike lanes where possible.

Comment Opportunities

TRIMET

Take the Public Transportation Plan survey to help TriMet develop a plan for spending about $180 million in statewide transportation improvement funding to improve public transportation. Learn how TriMet is making transit more affordable, accessible, cleaner and safer. Take the survey through Sept. 5.

WE WANT
YOUR FEEDBACK
TO MAKE OUR COMMUNITY SAFER

Help our local government better understand community need by completing the Natural Hazard Mitigation Awareness Survey.

Your local governments are working together to update our Natural Hazard Mitigation Plan to help better prepare for possible natural hazards. Complete the survey by Sept. 30.

Figure 54: Washington County Public Survey Promotion in LUTNews, September 2, 2022

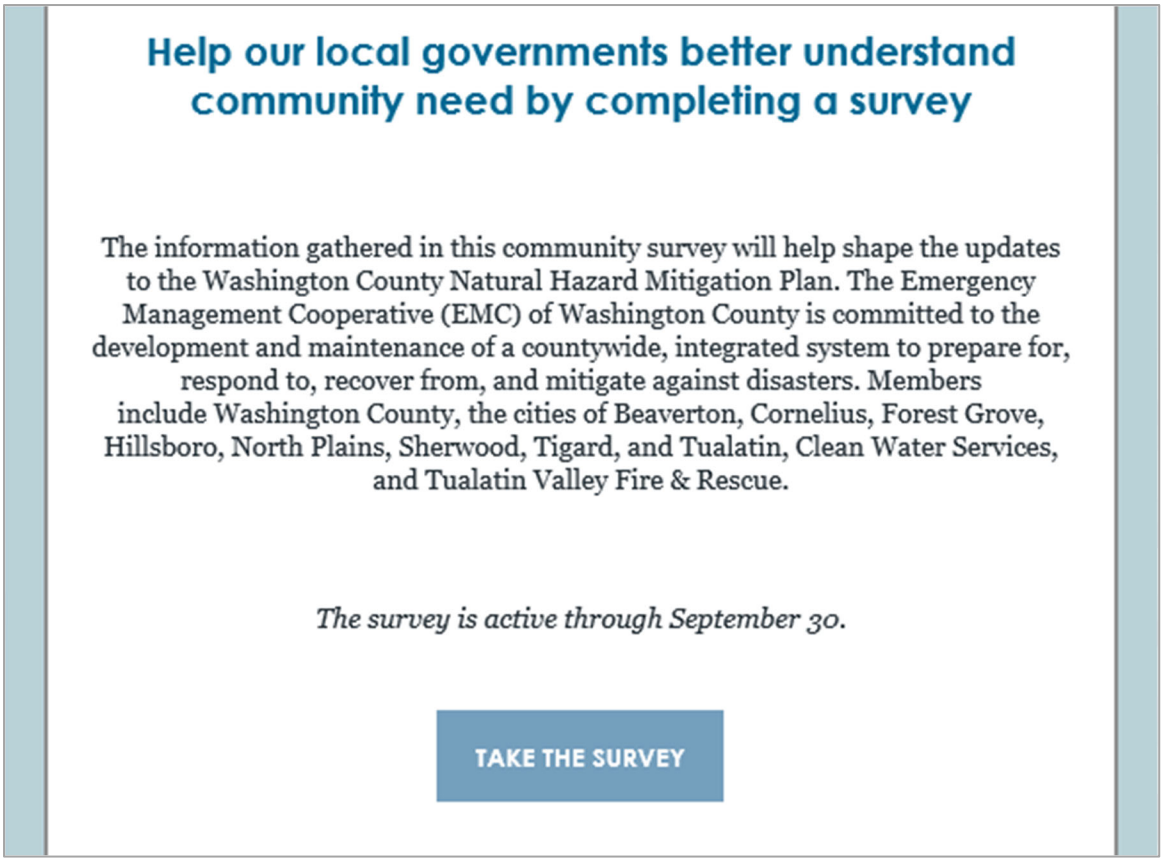


Figure 55: Washington County Public Survey Promotion in Community Engagement Connections Weekly e-Update, September 1, 2022



Figure 56: Washington County Public Survey Promotion in Community Engagement Connections Weekly e-Update, September 29, 2022



Figure 57: NHMP Public Survey Promotional Post on Washington County's Facebook Page in English



Figure 58: NHMP Public Survey Promotional Post on Washington County's Facebook Page in Spanish



Figure 59: NHMP Public Survey Promotional Post on Washington County's Twitter Page in English



Figure 60: NHMP Public Survey Promotional Post on Washington County's Twitter Page in Spanish

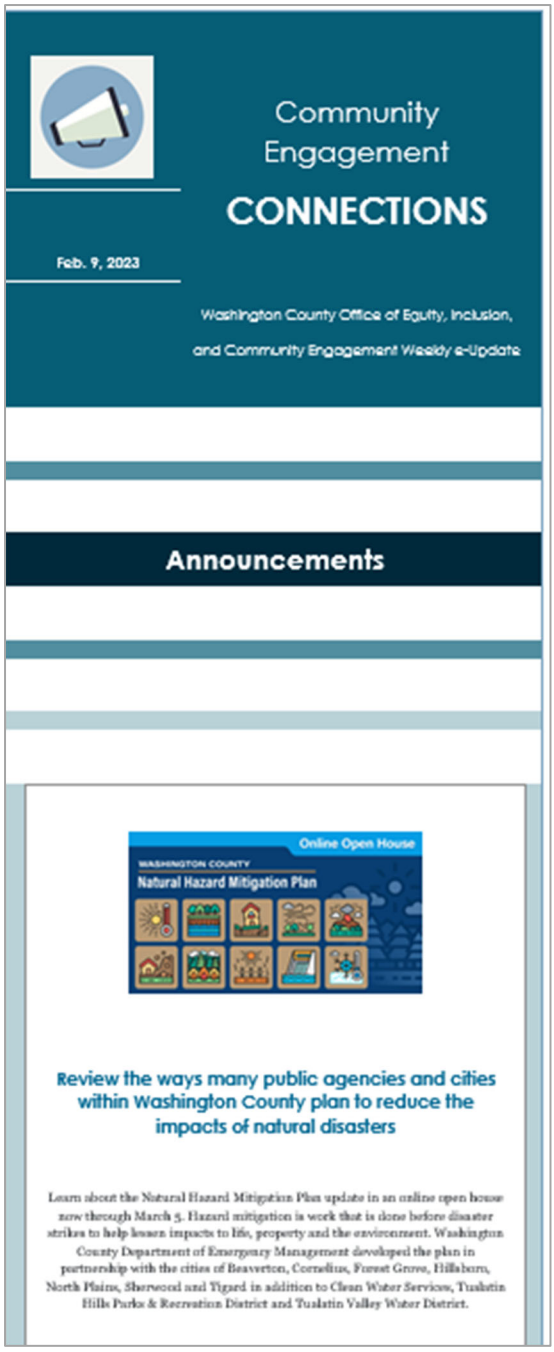


Figure 61: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft in Washington County's Community Engagement Connections Weekly e-Update, February 9, 2023

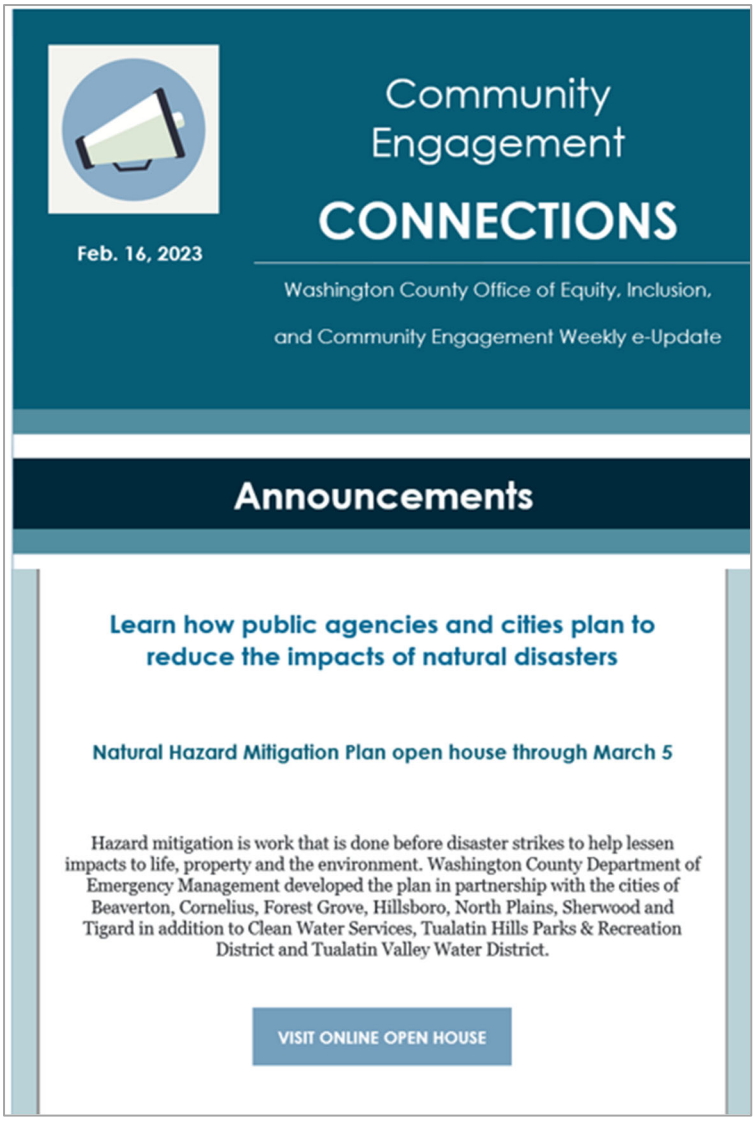


Figure 62: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft in Washington County's Community Engagement Connections Weekly e-Update, February 16, 2023



Figure 63: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on Washington County's Emergency Management Website in English



Figure 64: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on Washington County's Emergency Management Website in Spanish

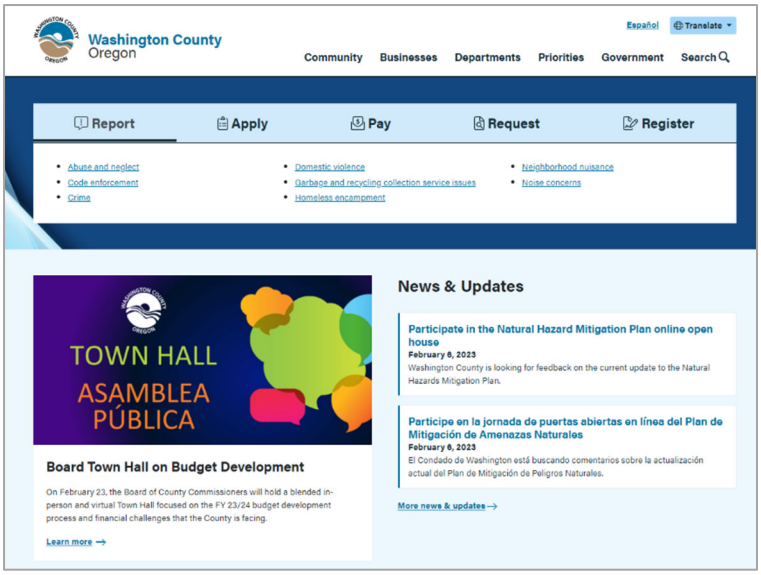
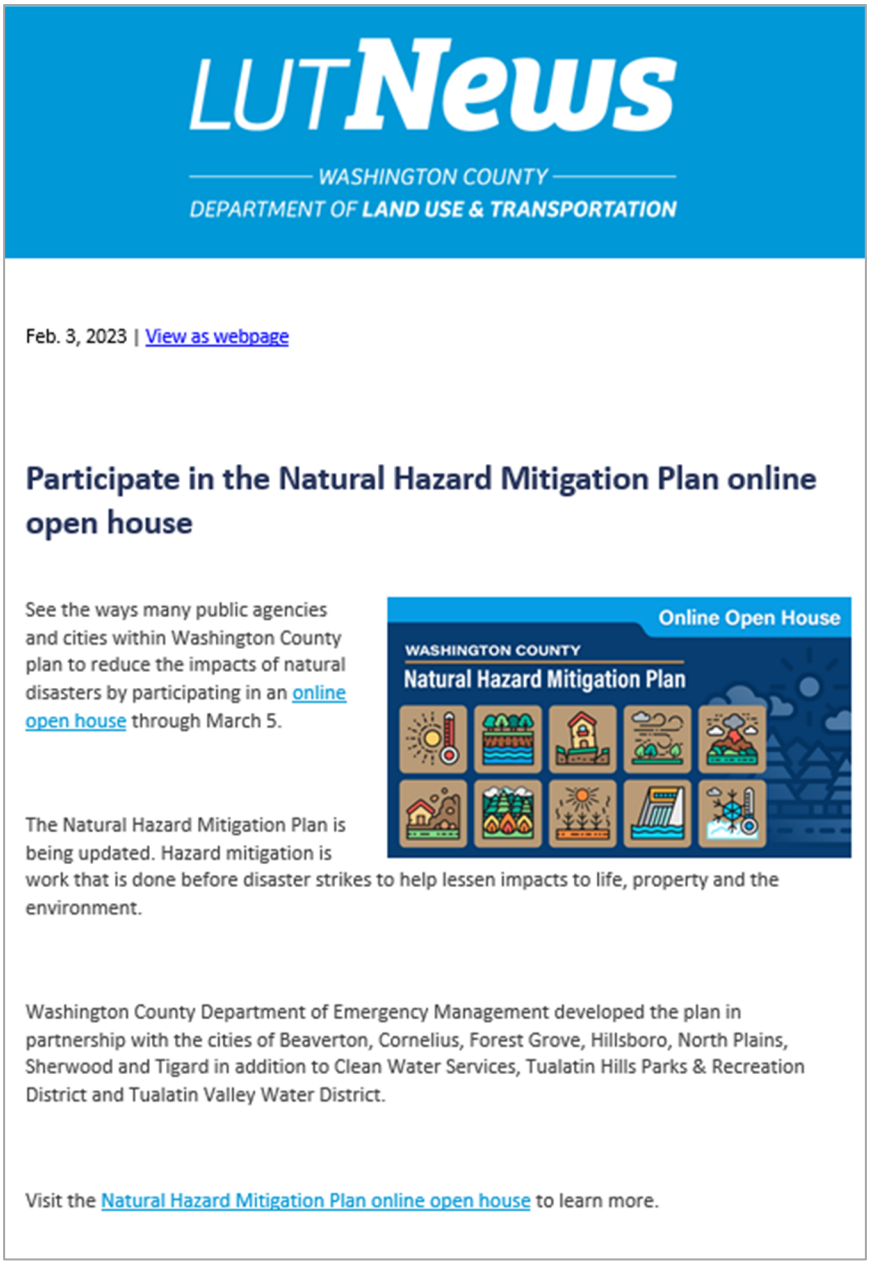


Figure 65: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft on Washington County's Website Main Page in English and Spanish



LUTNews

WASHINGTON COUNTY
DEPARTMENT OF LAND USE & TRANSPORTATION

Feb. 3, 2023 | View as webpage

Participate in the Natural Hazard Mitigation Plan online open house

See the ways many public agencies and cities within Washington County plan to reduce the impacts of natural disasters by participating in an online open house through March 5.

The Natural Hazard Mitigation Plan is being updated. Hazard mitigation is work that is done before disaster strikes to help lessen impacts to life, property and the environment.

Washington County Department of Emergency Management developed the plan in partnership with the cities of Beaverton, Cornelius, Forest Grove, Hillsboro, North Plains, Sherwood and Tigard in addition to Clean Water Services, Tualatin Hills Parks & Recreation District and Tualatin Valley Water District.

Visit the Natural Hazard Mitigation Plan online open house to learn more.

Figure 66: Promotional Post for Online Open House for Public and Stakeholder Review of NHMP Draft in Washington County's LUTNews

1.3.2. Public Survey

A total of 243 responses to the public survey were received from July 25, 2022, to October 6, 2022. The English version of the survey received 240 responses and the Spanish version received three responses. The English version of the survey is below in its complete form with questions and answer choices.[1] The Spanish version of the survey contained the same questions and answer choices.

[1] The survey replicated in this plan includes minor edits to language and format.

Natural Hazard Mitigation Awareness Survey

We are asking about your knowledge of natural hazard mitigation. “Mitigation” is the work done to make something more resistant to damage and to return it to operation faster.

The Washington County Natural Hazard Mitigation Plan is being updated. The information you provide will help shape the plan. The plan covers all areas of:

- Unincorporated Washington County
- City of Beaverton
- City of Cornelius
- City of Forest Grove
- City of Hillsboro
- City of North Plains
- City of Sherwood
- City of Tigard
- Service area of Clean Water Services
- Service area of Tualatin Hills Park and Recreation District
- Service area of Tualatin Valley Water District

Collectively, this group will be referred to as “local government.”

This survey is voluntary and will take about 15 minutes.

* Indicates it is a required question.

*** 1. Which hazards have you experienced in your lifetime, not just in Washington County? (Select all that apply.)**

☐ Dam failure
☐ Drought
☐ Earthquake
☐ Extreme heat
☐ Flood
☐ Landslide
☐ Volcanic ash
☐ Wildland fire
☐ Windstorm, including tornado
☐ Winter storm
☐ Avalanche
☐ Extreme cold event
☐ Hail
☐ Hurricane
☐ Ice storm
☐ Lightning
☐ Tsunami

- None of the above
- Prefer not to answer

2. List any additional natural hazards not listed above that you think could be a threat to your community.

***3. For each hazard below, choose how you think it would affect your home. Next to each hazard, please indicate not likely, somewhat likely, very likely, none of the above, prefer not to answer, or not applicable.**

Dam failure:
Drought:
Earthquake:
Extreme heat:
Flood:
Landslide:
Volcanic ash:
Wildland fire:
Windstorm, including tornado:
Winter storm:

4. For each hazard below, choose how you think it would affect your business. Next to each hazard, please indicate not likely, somewhat likely, very likely, none of the above, prefer not to answer, or not applicable.

Dam failure:
Drought:
Earthquake:
Extreme heat:
Flood:
Landslide:
Volcanic ash:
Wildland fire:
Windstorm, including tornado:
Winter storm:

*** 5. Which of the following are the most important for local government to protect from hazards? (Select up to three.)**

- Communications (cell towers, radio/TV towers, emergency communications systems, etc.)
- First response facilities (fire and police stations, ambulance officers, public works facilities, etc.)
- Parks and sensitive habitats
- Hospitals, urgent care, and critical medical treatment facilities
- Transportation systems (roads and bridges, light rail)
- Utilities providers (electricity, gas, water, sewer)
- Schools
- Businesses (grocery stores, building supply stores, all other private businesses)
- Homes (all residential buildings)
- None of the above
- Prefer not to answer

*** 6. What insurance coverage for natural hazards do you have? This may be found in your home or renter's insurance policy.**

- ☐ Flood insurance (through the National Flood Insurance Program (NFIP))
- ☐ Earthquake insurance
- ☐ Landslide insurance
- ☐ I do not have natural hazard insurance coverage
- ☐ I do not know if I have natural hazard insurance coverage
- ☐ Prefer not to answer

*** 7. What is most important for local government to do to reduce the impacts of hazards? (Select up to three.)**

- ☐ Identify sources for low-income loans or other financial options to allow people to conduct natural hazard impact reduction activities on their property
- ☐ Provide public education no natural hazard risks and mitigation strategies
- ☐ Implement earthquake structural retrofit projects for critical public facilities
- ☐ Develop and adopt hazard-specific ordinances to address future development in hazard areas
- ☐ Enhance the function of natural features (e.g., erosion prevention in stream channels)
- ☐ Protect historical resources
- ☐ Reduce damages to utilities
- ☐ Relocate homes out of the floodplain, including raising them above the floodplain
- ☐ None of the above
- ☐ Prefer not to answer

*** 8. Read the statements below and use one of the following bulleted choices to indicate whether you or someone in your household has done this, or if you do not feel this activity is necessary:**

- **I/we have done this.**
- **I/we plan to do this in the future.**
- **I/we have not done this.**
- **I am/we are unable to do this.**
- **I/we do not feel it necessary to do this.**
- **None of the above.**
- **Prefer not to answer.**

Attended meetings or received written information on natural disasters or emergency preparedness

Talked with members in your household about what to do in a case of a natural disaster or emergency

Developed a household/family emergency plan in order to decide what everyone would do in the event of a disaster

Prepared a disaster supply kit (stored extra food, water, batteries, or other emergency supplies)

In the last year, has anyone in your household been trained in first aid or cardiopulmonary resuscitation (CPR)?

*** 9. Ideally, how much time would you spend preparing yourself and/or your household for a natural disaster or emergency event? (Select only one.)**

- 0–1 hour/month
- 2–3 hours/month
- 1–2 hours/week (equates to 52–104 hours a year)
- 3–4 hours/week (equates to 156–208 hours a year)
- None of the above

*** 10. What steps have you taken to prepare for a natural disaster? (Select all that apply.)**

- Developed a reconnection plan: where to go and who to call
- Learned how to shut off utilities to your home
- Installed a smoke detector on each level of the home
- Stored a battery-powered radio
- Stored a fire extinguisher
- Stored batteries
- Stored flashlight(s)
- Stored food, enough for at least 3 days
- Stored medical supplies (first aid kit)
- Stored water, enough for at least 3 days
- Made a fire escape plan
- Prepared a disaster supply kit
- Received first aid/CPR training
- None of the above
- Prefer not to answer
- Other (please specify)

*** 11. What nonstructural modifications for earthquakes have you made to your home? (Select all that apply.)**

- Anchored bookcases or cabinets to walls
- Secured water heater to wall
- Installed latches on drawers or cabinets
- Fitted gas appliances with flexible connections
- None of the above
- Prefer not to answer
- Does not apply
- Other (please specify)

*** 12. What structural modifications for earthquakes have you made to your home? (Select all that apply.)**

- ☐ Secured home to foundation
- ☐ Braced inside of cripple wall with sheathing
- ☐ Braced unreinforced chimney
- ☐ Braced unreinforced masonry and concrete walls and foundations
- ☐ None of the above
- ☐ Prefer not to answer
- ☐ Does not apply
- ☐ Other (please specify)

*** 13. Did the possible occurrence of natural hazards affect your decision on where you currently live?**

- ☐ Yes
- ☐ No
- ☐ None of the above
- ☐ Prefer not to answer

*** 14. If you could, would you be willing to spend more money on a home (including rental housing) that had features that made it more disaster resistant?**

- ☐ Yes
- ☐ No
- ☐ I do not know
- ☐ None of the above
- ☐ Prefer not to answer

*** 15. If you own property, which of the following incentives, if any, would motivate you to take additional steps to better protect the property from a natural disaster?**

- ☐ Insurance discount
- ☐ Low interest rate loan
- ☐ Lower new home construction costs
- ☐ Mortgage discount
- ☐ Tax break or incentive
- ☐ Does not apply
- ☐ None of the above
- ☐ Prefer not to answer
- ☐ Other (please specify)

*** 16. Please tell us how much you trust each source to provide you with information about how to make your household and home safer from natural disasters. (Next to each source, place an "X" in the applicable box.)**

	Not at All	Somewhat	Neutral	Mostly	Very Much
News Media					
Government agency					
Insurance agent or company					
Utility company					
University or research institution					
American Red Cross					
Other non-profit organization					
Commercial resource (building supply store, builders/contractors, private resource)					
Trusted community member (friend/family, community group, religious leader)					
Social media influencer					
Other (please specify)					

17. What is the most effective way for you to receive information about how to make your household and home safer from natural disasters? Choose up to five answers.

- ☐ Newspaper stories or advertisements (print, e-paper)
- ☐ Television (news, advertisements)
- ☐ Radio (news, advertisements)
- ☐ Schools (information sent home with children)
- ☐ Outdoor advertisements (billboards, etc.)
- ☐ Community group, community member, or word of mouth
- ☐ Books
- ☐ Direct mail
- ☐ Local government
- ☐ Internet
- ☐ Factsheet or brochure
- ☐ Public workshops/meetings
- ☐ Magazines
- ☐ University or research institution
- ☐ Social media (news, advertising, etc.)
- ☐ Digital advertising (pop-up ads)
- ☐ None of the above
- ☐ Prefer not to answer
- ☐ Other (please specify)

*** 18. The following statements will help determine community priorities for planning for natural hazards. Please tell us how important each one is to you. (Next to each statement, place an "X" in the applicable box.)**

	Very Important	Somewhat Important	Neutral	Low Importance	Not Important
Protecting private property					
Protecting critical facilities (e.g., transportation networks, hospitals, fire stations)					
Preventing development in hazard areas (e.g., not allowing construction in a floodplain)					
Enhancing the function of natural features (e.g., streams, wetlands)					
Protecting historical and cultural landmarks					
Promoting cooperation among public agencies, citizens, nonprofit organizations, and businesses					
Protecting and reducing damage to utilities					
Strengthening emergency services (e.g., police, fire, ambulance)					
Other (please specify)					

*** 19. The following statements strive to understand your thoughts regarding the ability of the public to participate in this process. Please tell us if you agree with each statement. (Next to each statement, place an "X" in the applicable box.)**

	Agree	No Opinion	Disagree	Prefer Not to Answer
I have ample opportunity to provide input to the natural hazard mitigation planning process about my concerns about natural hazards in a language I can comfortably communicate in.				
My input, suggestions, and concerns are heard and understood by my local government officials.				
I receive timely and useful responses from my input, suggestions, and concerns regarding natural hazard mitigation planning.				

	Agree	No Opinion	Disagree	Prefer Not to Answer
The needs and concerns of my local community (cultural group, neighborhood, etc.) are adequately addressed in the natural hazard mitigation planning process.				

20. That concludes the questions on natural hazards. The next few questions ask about different types of people in the community. We want to know if different groups in our community are being heard. We encourage you to answer these questions, but if you prefer not to, please select "prefer not to answer."

*** 21. Where do you live?**

- ☐ Unincorporated Washington County (such as areas like Cherry Grove, Garden Home, Bethany, Durham, etc., and rural areas)
- ☐ City of Beaverton
- ☐ City of Cornelius
- ☐ City of Forest Grove
- ☐ City of Hillsboro
- ☐ City of North Plains
- ☐ City of Sherwood
- ☐ City of Tigard
- ☐ Prefer not to answer
- ☐ Other (please specify)

*** 22. What zip code do you live in? If you prefer not to answer, please type N/A.**

*** 23. Which of the following includes your age?**

- ☐ Under 18
- ☐ 18–24
- ☐ 25–34
- ☐ 35–44
- ☐ 45–54
- ☐ 55–64
- ☐ 65–74
- ☐ 75 or older
- ☐ Prefer not to answer

*** 24. Within these categories, where do you place your racial or ethnic identity? (Select all that apply.)**

- ☐ Native American, American Indian, or Alaska Native
- ☐ Asian or Asian American
- ☐ Black or African American

- ☐ Hispanic or Latino/a/x
- ☐ Native Hawaiian or other Pacific Islander
- ☐ White
- ☐ Prefer not to answer
- ☐ Other (please specify)

*** 25. How do you identify your gender? (Select all that apply.)**

- ☐ Man
- ☐ Woman
- ☐ Transgender
- ☐ Non-binary, genderqueer, or third gender
- ☐ Prefer not to answer
- ☐ A gender not listed above (please describe)

*** 26. If you live within Washington County, what is your housing status?**

- ☐ Own
- ☐ Rent
- ☐ Currently houseless
- ☐ Prefer not to answer
- ☐ Other (please specify)

*** 27. Do you or someone living in the household have one or more of the following disabilities that should be considered in mitigation planning projects, such as for mobility access or evacuation alerts? (Select all that apply.)**

- ☐ Hearing difficulty (deaf or having serious difficulty hearing).
- ☐ Vision difficulty (blind or having serious difficulty seeing, even when wearing glasses).
- ☐ Cognitive difficulty (due to a physical, mental, or emotional problem; having difficulty remembering, concentrating, or making decisions).
- ☐ Ambulatory difficulty (unable to walk or having serious difficulty walking or climbing stairs).
- ☐ Self-care difficulty (unable to bathe or dress or having difficulty bathing or dressing).
- ☐ Independent living difficulty (because of a physical, mental, or emotional problem; unable to do errands alone or having difficulty doing errands alone).
- ☐ No disability.
- ☐ Prefer not to answer.
- ☐ A disability not listed above (please describe)

*** 28. What language or dialect is used most in your home?**

- ☐ American Sign Language
- ☐ Arabic
- ☐ Cantonese
- ☐ Chuukese

- English
- Japanese
- Karen
- Korean
- Mandarin
- Mon-Khmer
- Nepali
- Persian
- Romanian
- Russian
- Somali
- Spanish
- Tagalog
- Ukrainian
- Vietnamese
- Prefer not to answer
- A language or dialect not listed above (please describe)

*** 29. What is your education experience?**

- Less than high school
- Some high school
- High school diploma
- Some college or an associate's or two-year technical degree
- Bachelor's
- Post-graduate
- Prefer not to answer
- Other (please describe)

*** 30. Which of the following best describes your current employment status?**

- Employed full-time
- Employed part-time
- Work from home (part-time or full-time)
- Homemaker
- Student and not employed
- Student and employed
- Retired
- Not employed, not actively looking to work
- Not employed, actively looking for work
- Disabled and unable to work
- Prefer not to answer
- Other (please describe)

*** 31. To which zip code do you travel to for school? If this is not applicable, please type N/A.**

*** 32. To which zip code do you travel to for work? If this is not applicable, please type N/A.**

*** 33. Including yourself, how many people live in your household?**

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8 or more
- ☐ Prefer not to answer

*** 34. How many children under the age of 18 live in your household?**

- ☐ No children
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6 or more
- ☐ Prefer not to answer

35. Would you like to receive updates on mitigation projects and information? If so, please provide your email address.

End of Survey

1.3.3. Summary of Public Comments

1.3.3.1. Summary of Public Survey Responses

A total of 243 responses to the public survey were received from July 25, 2022, to October 6, 2022. The English version of the survey received 240 responses and the Spanish version received three responses. The natural hazard experienced most by survey respondents was extreme heat, followed by winter storm, ice storm, lightning, and earthquake. Respondents believe their homes are very likely to be affected by earthquake, extreme heat, winter storm, drought, and wildland fire, in that order. Business owners believe their businesses would be very likely to be affected by earthquake, winter storm, extreme heat, windstorm, including tornado, and wildland fire, in that order.

Medical facilities, communications infrastructure, first responder facilities, utilities providers, and transportation systems are the top five most important facilities and/or systems for local governments to protect from natural hazards. Respondents believe the most important actions local governments should take to reduce the impacts of hazards include implementing earthquake structural retrofit projects for critical public facilities; providing public education on natural hazard risks and mitigation strategies; reducing damages to utilities; developing and adopting hazard-specific ordinances to address future development in hazard areas; and enhancing the function of natural features (e.g., erosion prevention in stream channels).

Almost 41% of those who replied to the survey reported they have earthquake insurance for their homes; approximately 11% reported they have flood insurance through the National Flood Insurance Program; and a little over 2% reported they have landslide insurance. Almost 30% reported they did not know if they have natural hazard insurance coverage, and 24% reported they do not have natural hazard insurance coverage.

The preparedness activity completed by the majority of respondents or someone in their household is attending meetings or receiving written information on natural disasters or emergency preparedness, followed by talking with members in their household about what to do in case of a natural disaster or emergency, and preparing a disaster supply kit (stored extra food, water, batteries, or other emergency supplies). Respondents reported ideally they would spend up to one hour a month preparing for a natural disaster or emergency event. Most survey takers reported they have installed a smoke detector on each level of their home; stored flashlight(s), batteries, medical supplies, and enough food and water for at least three days; and have a fire extinguisher.

Popular nonstructural modifications for earthquakes reportedly completed by respondents were securing water heaters to the wall and anchoring bookcases or cabinets to the walls. Almost 66% of people surveyed reported they have not made any structural modifications for earthquakes to their homes. The majority of survey respondents indicated the possible occurrence of natural hazards did not affect where they chose to live; however, almost 66% of respondents reported they would be willing to spend more money purchasing or renting a home with features that made it more disaster resistant. Of those respondents who reported they own property, financial incentives, including tax breaks or incentives and insurance discounts, would motivate them to take additional steps to better protect their property from a natural disaster.

The most trusted source for survey respondents to get information about how to make their household and home safer from natural disasters was universities or research institutions, and the least trusted source was social media influencers. The top five effective ways for respondents to receive information about how to make their household and home safer from natural disasters include local governments, factsheets or brochures, the Internet, public workshops or meetings, and direct mail.

Protecting critical facilities, protecting and reducing damage to utilities, strengthening emergency services, and preventing development in hazard areas are very important priorities for respondents when they think about planning for natural hazards. Close to 37% of survey takers believe they have had ample opportunity to provide input during the natural hazard mitigation planning process about their natural hazard-related concerns in a language they could comfortably communicate in; however, the majority of respondents did not have an opinion about this question.

All survey responses were reviewed by the NHMP Steering Committee. Responses not applicable to natural hazards, mitigation, or the planning process are not published in this report, but are available for review by contacting Washington County Emergency Management.

1.3.3.2. Summary of Public Comments About Draft NHMP

A total of 16 responses to the comment form posted with the draft NHMP were received from February 3, 2023, to March 5, 2023. All comments were reviewed by the NHMP Steering Committee. Responses not

applicable to natural hazards, mitigation, or the planning process are not published in this report, but are available for review by contacting Washington County Emergency Management.

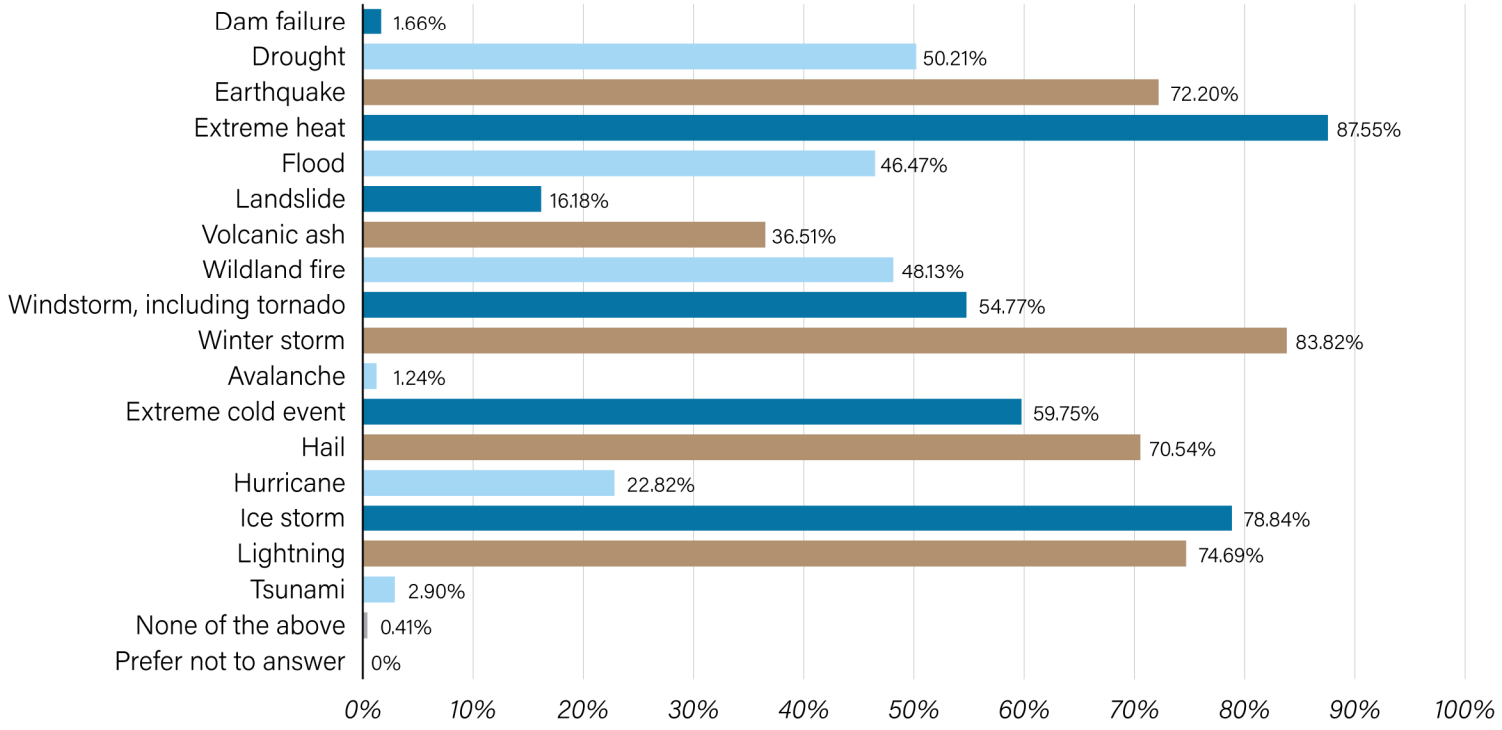
Approximately 82% of those who left comments did not participate in the natural hazard mitigation awareness survey that was posted from July 25, 2022, to October 6, 2022. This indicates this public outreach opportunity reached a different audience than the survey did, widening the reach of engagement with Washington County residents. Respondents indicated they may use the information in the NHMP in their daily lives to become better prepared, including increasing their awareness of high hazard areas and taking steps to be sufficient for two weeks in case of an event. Those who left comments also mentioned keeping the NHMP as a resource and sharing it with family and friends.

1.3.4. Public Survey Results

Answered | **240**
Skipped | **0**

Which hazards have you experienced in your lifetime, not just in Washington County? (Select all that apply.)

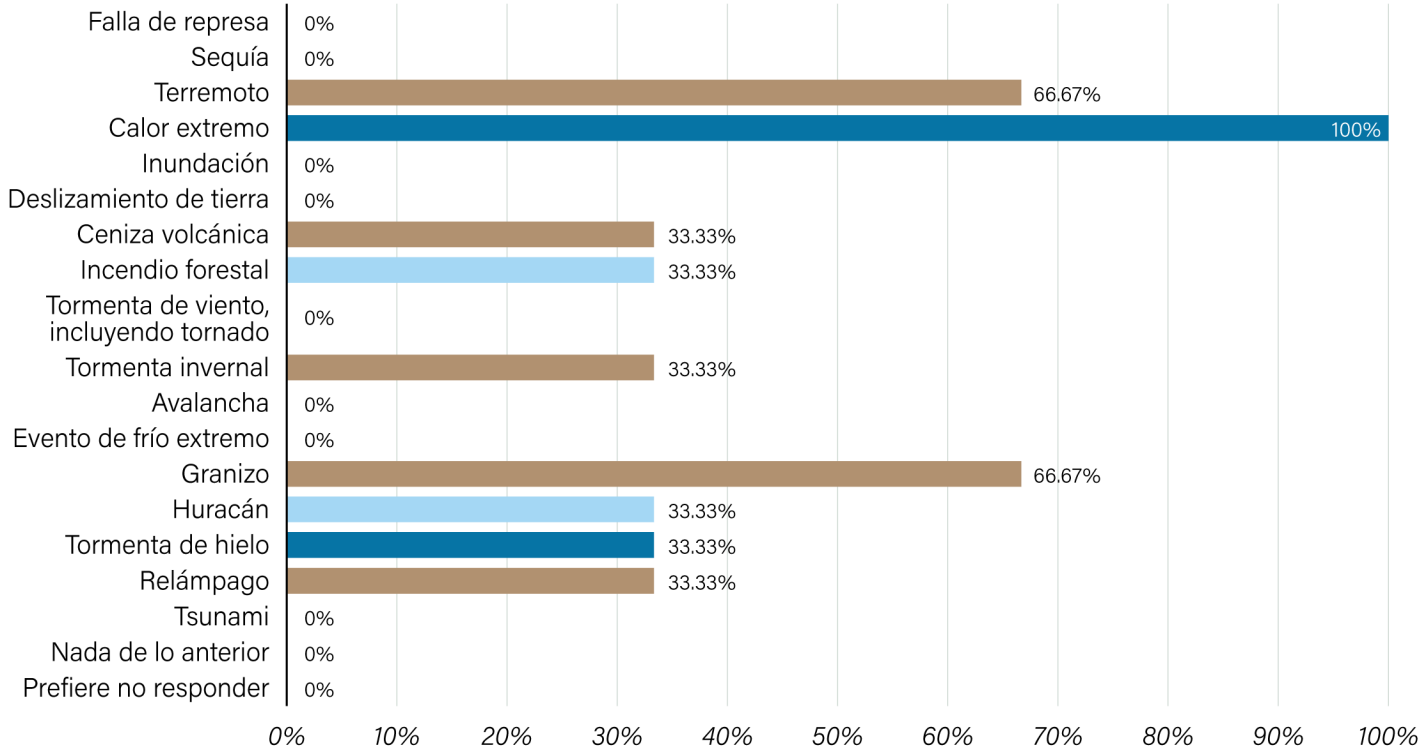
Q1



Answered | 3
Skipped | 0

¿Qué peligros ha experimentado en su vida, no solo en el condado de Washington? (Seleccione todo lo que corresponda.)

Q1



Q2. List any additional natural hazards not listed above that you think could be a threat to your community.

Answered: 55 Skipped: 185

#	RESPONSES
1	Smoke
2	Snowstorms
3	Wildfires in the Wildland Urban Interface (WUI)
4	Bird flu
5	Climate dome and uncertain other extreme heat/drought conditions we have not experienced before
6	Poor air quality, soil erosion, and other effects related to climate change
7	Drought, extreme heat, earthquake, and wildfire
8	Global warming
9	Torrential rains, wildfire smoke, solar storms, which affect electronics, ashfall from fires, black ice
10	Smoke from wildfires
11	Smoke from forest fires. I'm not in a place that is likely to burn, but living with weeks of smoke is not healthy for anyone, especially the elderly, sick, infants, etc.
12	I wonder if wildland fire includes fires that start in towns (i.e., I experienced the Almeda fire in Southern Oregon)
13	Storm water hazards from Bull Mountain runoff
14	Water pollution, natural pollutants or man-made
15	Sinkhole
16	Sinkhole
17	Tornados
18	Solar electromagnetic pulse (EMP), pandemic
19	Record rainfall in short order, as occurred in Centralia/ Chehalis, WA last year, is much more likely with climate change
20	Tree falling on houses
21	Sequela of winter storms: power outages, loss of home heating ability, etc.; solar flare. Should we not also list non-natural hazards such as terrorist takedown of power systems?

#	RESPONSES
22	Smoke
23	Pests and invasive species
24	Invasive species (particularly disease-bearing insects)
25	Poor air quality, potentially due to wildfire
26	Air pollution is horrible. My health. 17th and 18th of August avoiding the outdoors
27	Natural food chain collapse
28	Plague, food scarcity, water scarcity
29	Dead tree and unmoved weeds in neighborhoods
30	Putting a Chevron Station in/near a floodplain, wildlife area, poses a HUGE potential disaster to everyone in the surrounding neighborhood. Any of the above natural disasters will affect this and our precious water. What the heck is WACO thinking in approving this!! IF you really care? I foresee a civil lawsuit in the future—totally avoidable
31	Rats, pandemic
32	Sinkholes
33	Smoke from wildfires
34	Radon exposure
35	Air quality, widespread disease
36	Water contamination/pollution, zoonotic disease, invasive species

Q2. Enumere cualquier peligro natural adicional no mencionado anteriormente que crea que podría ser una amenaza para su comunidad.

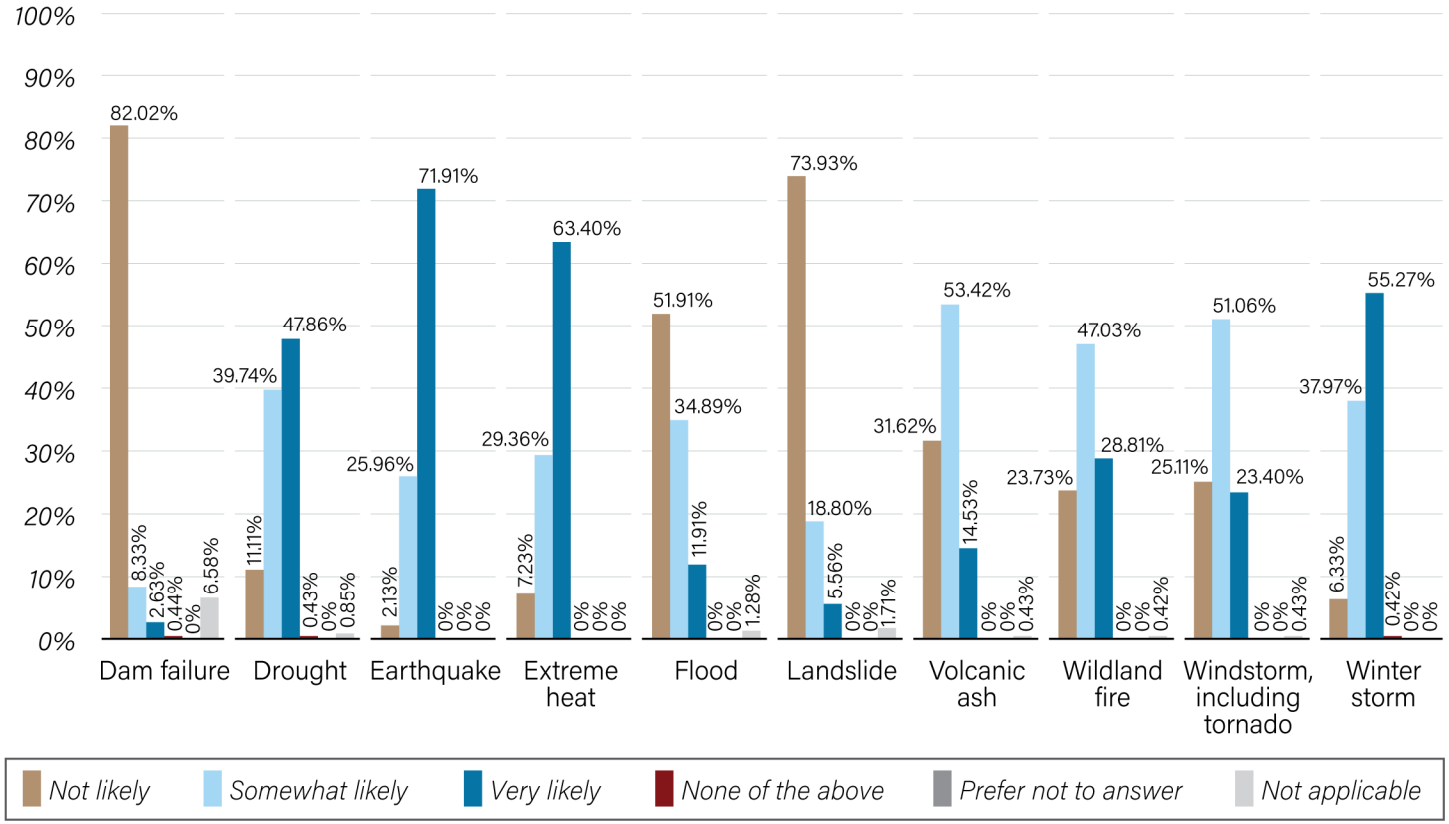
Answered: 3 Skipped: 0

#	RESPUESTAS
1	Pandemias (Pandemics)
2	No hay otro (No others)

Answered | **240**
Skipped | **0**

For each hazard below, choose how you think it would affect your home.

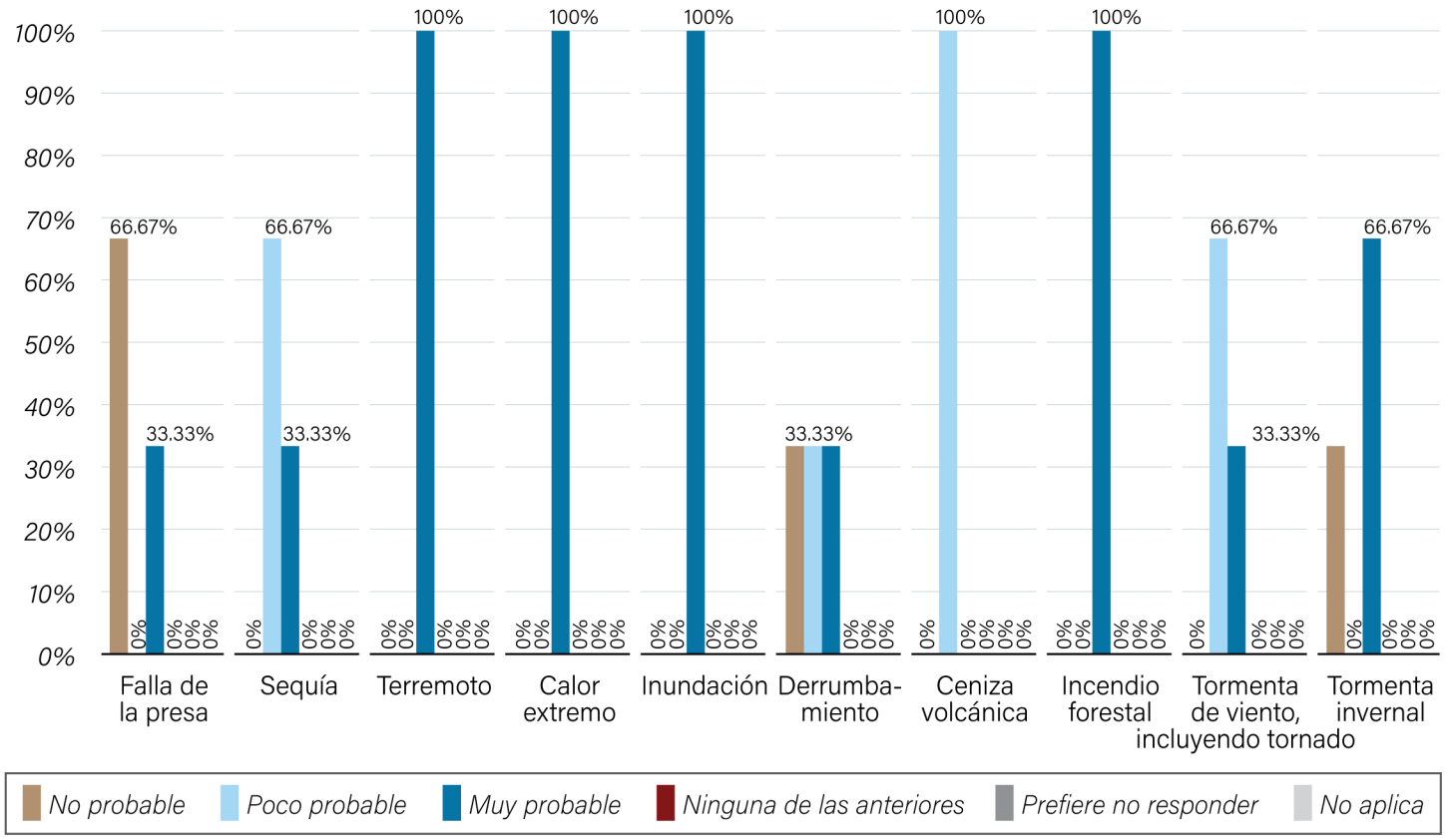
Q3



Answered | 3
Skipped | 0

Para cada peligro a continuación, elija cómo cree que afectaría a su hogar.

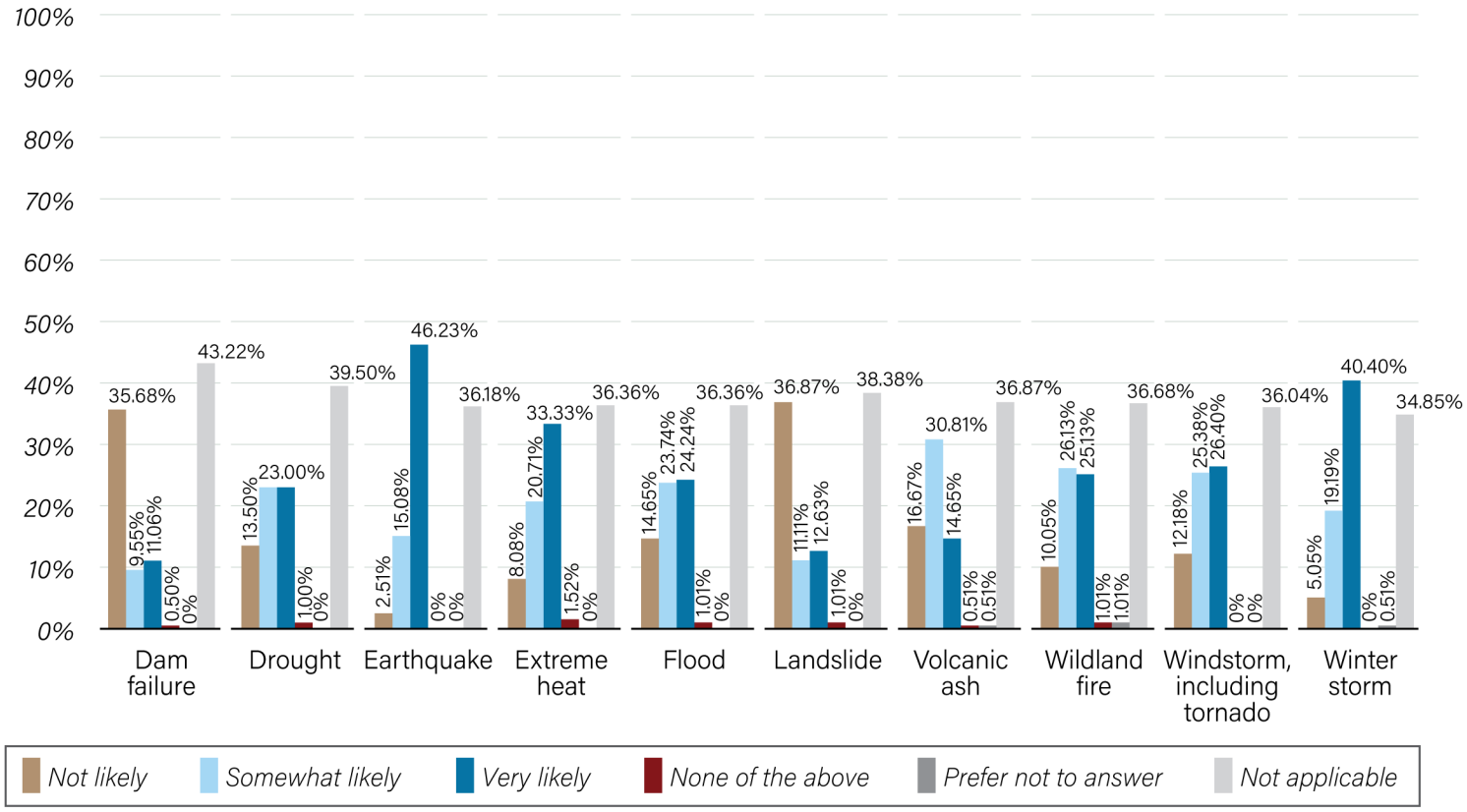
Q3



Answered | **203**
Skipped | **37**

For each hazard below, choose how you think it would affect your business.

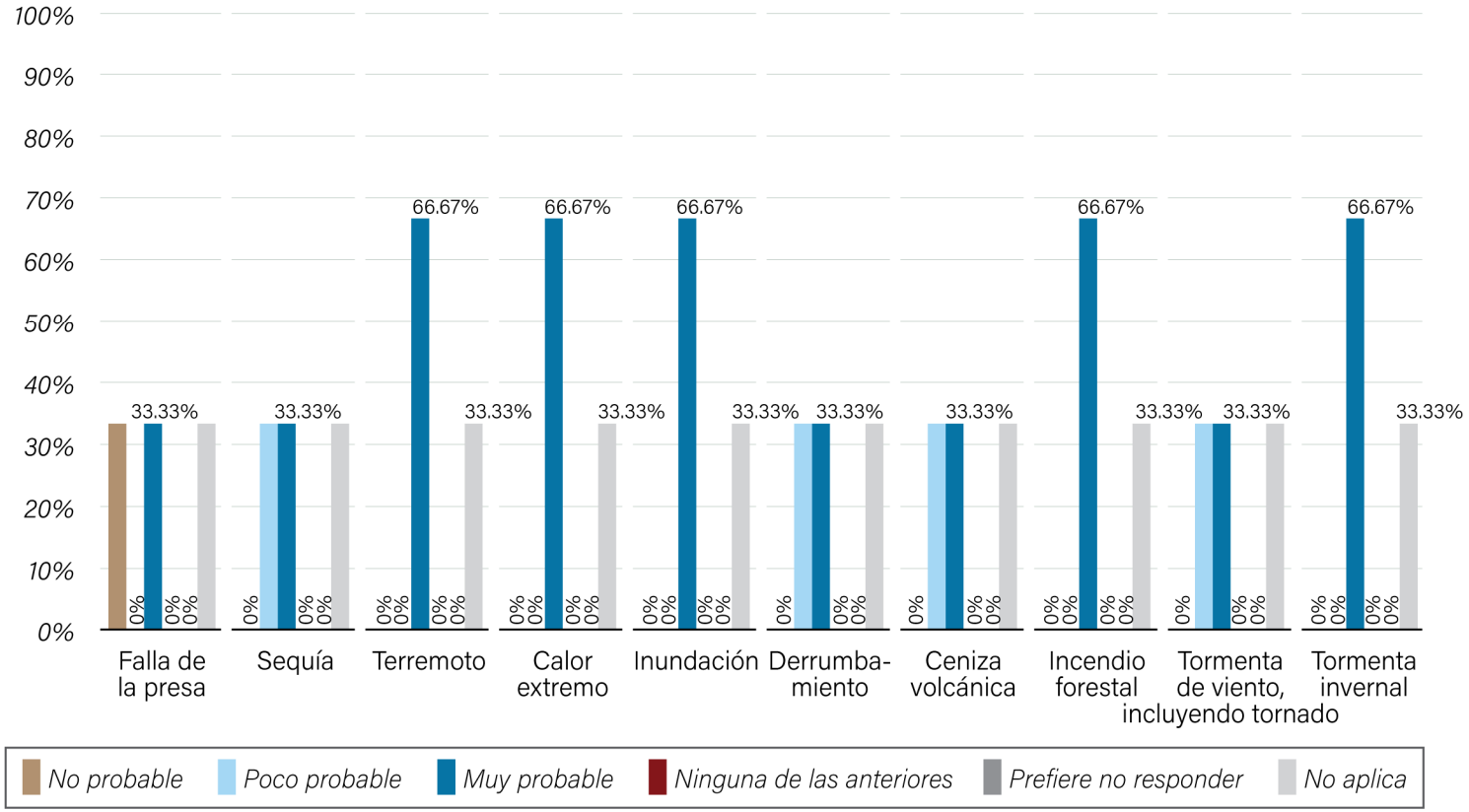
Q4



Answered | 3
Skipped | 0

Para cada peligro a continuación, elija cómo cree que afectaría a su negocio.

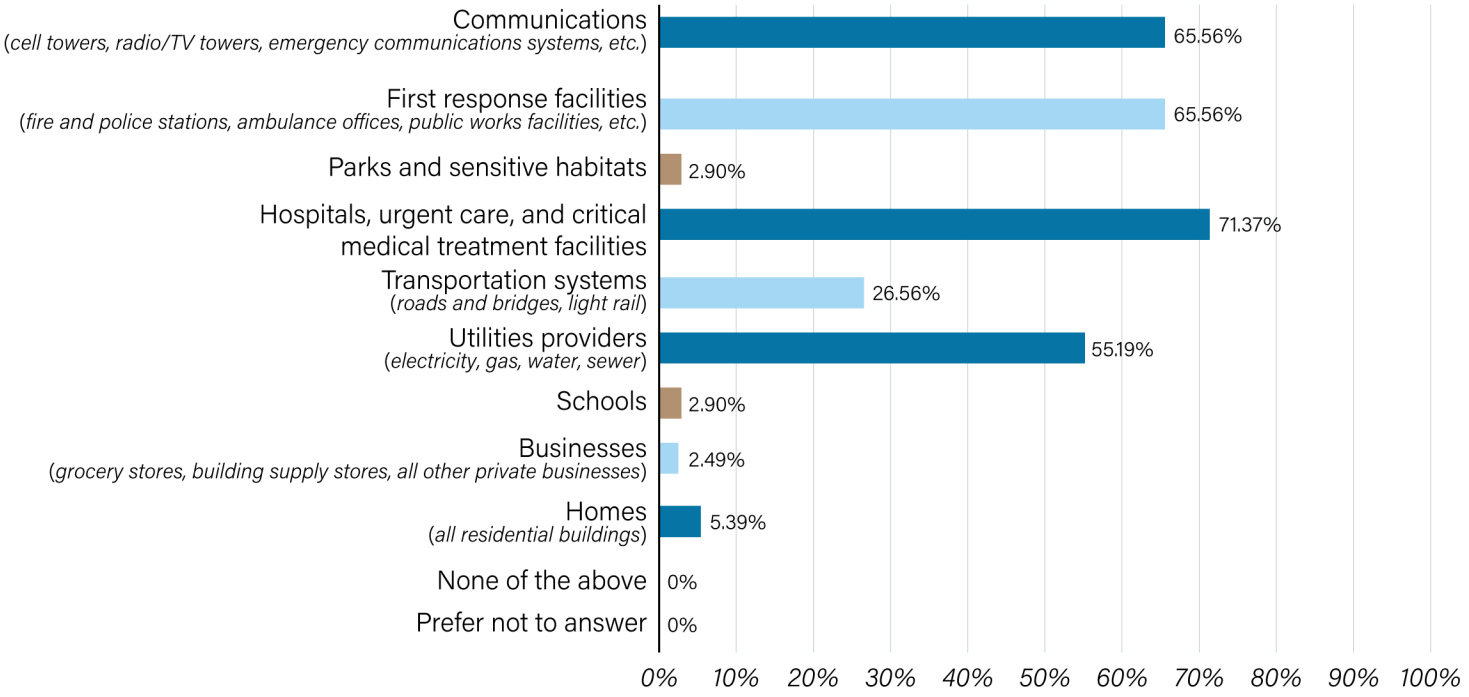
Q4



Answered | 240
Skipped | 0

Which of the following are the most important for local government to protect from hazards? (Select up to three.)

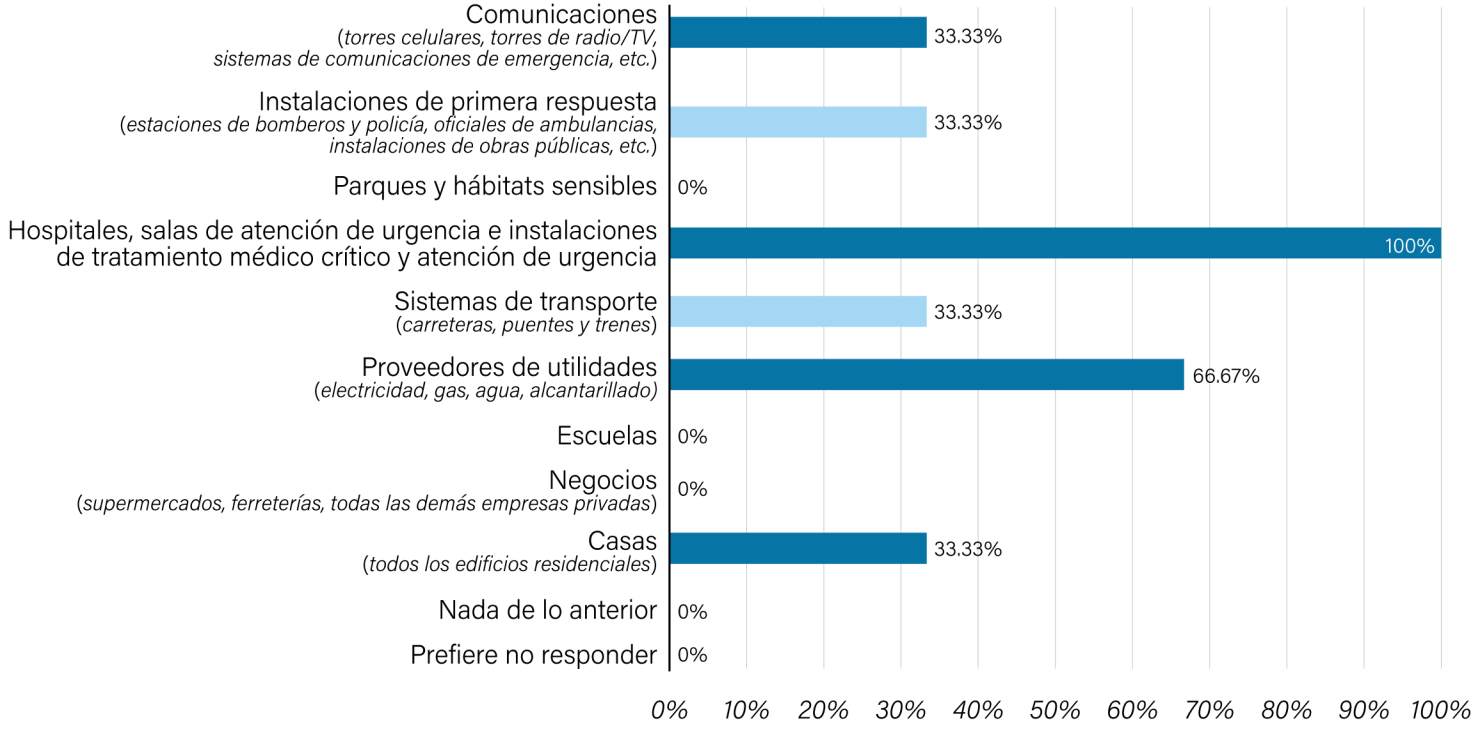
Q5



Answered | 3
Skipped | 0

¿Cuáles de los siguientes son los más importantes para que el gobierno local los proteja de los peligros? (Seleccione hasta tres.)

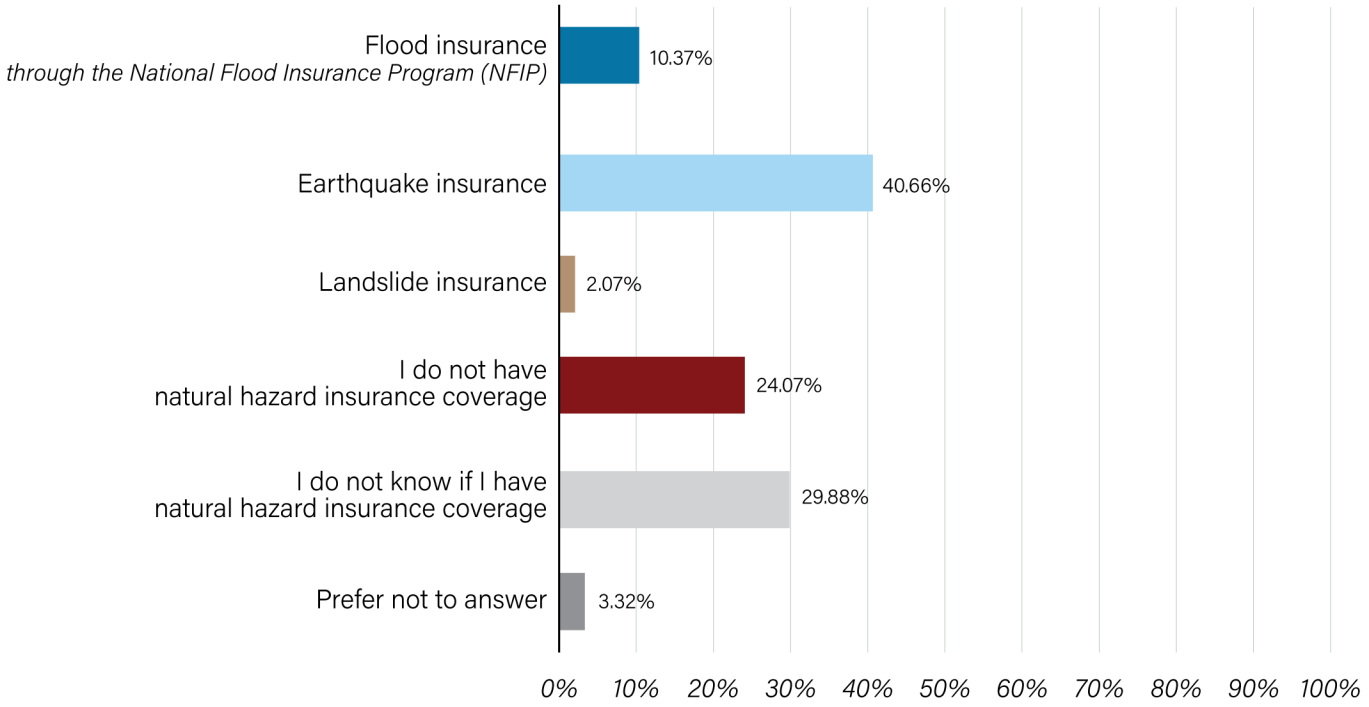
Q5



Answered | 240
Skipped | 0

What insurance coverage for natural hazards do you have? This may be found in your home or renter's insurance policy.

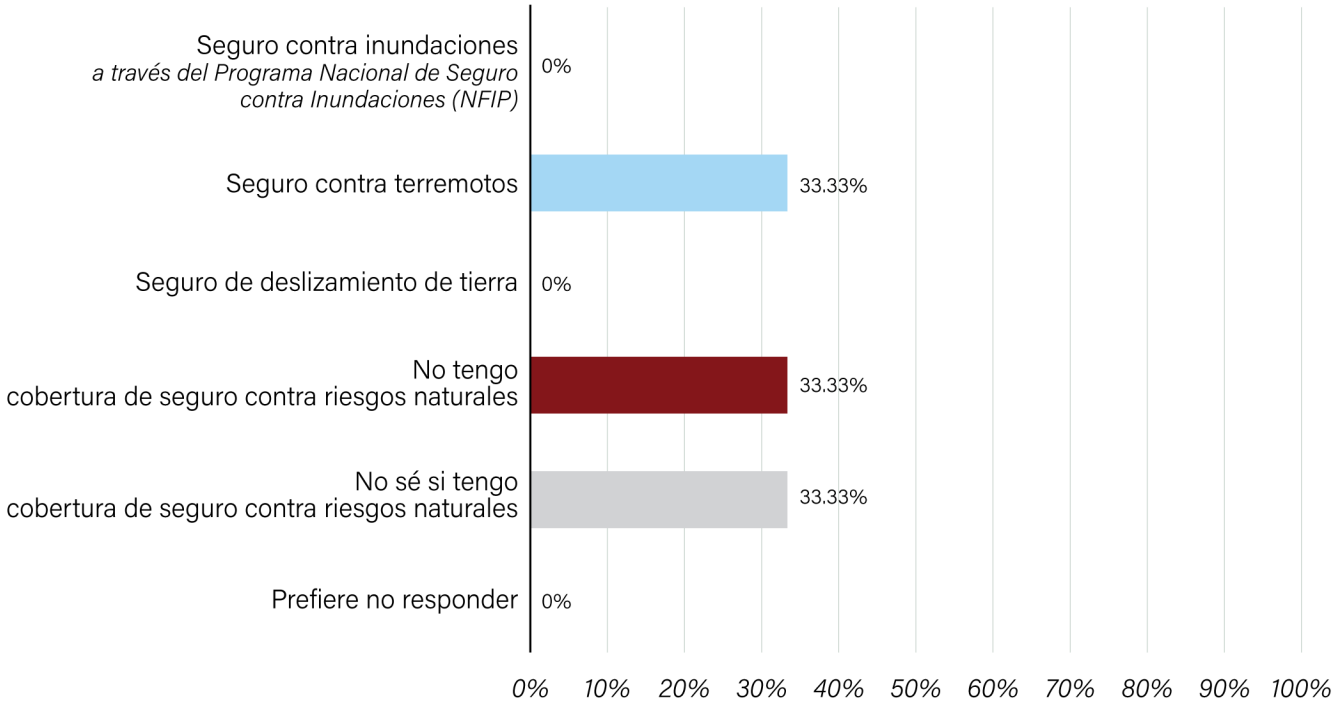
Q6



Answered | 3
Skipped | 0

¿Qué cobertura de seguro para riesgos naturales tiene? Esto se puede encontrar en la póliza de seguro de su casa o inquilino.

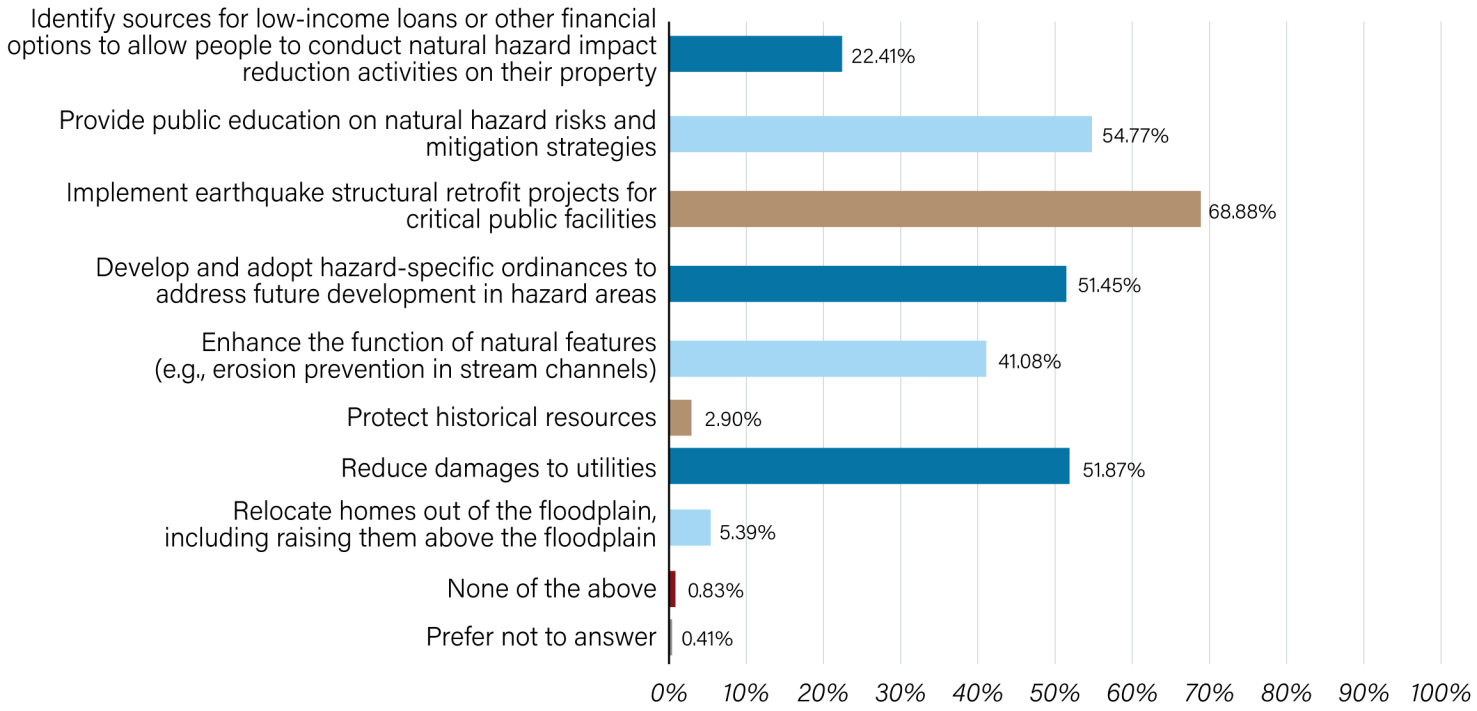
Q6



Answered | 240
Skipped | 0

What is most important for local government to do to reduce the impacts of hazards? (Select up to three.)

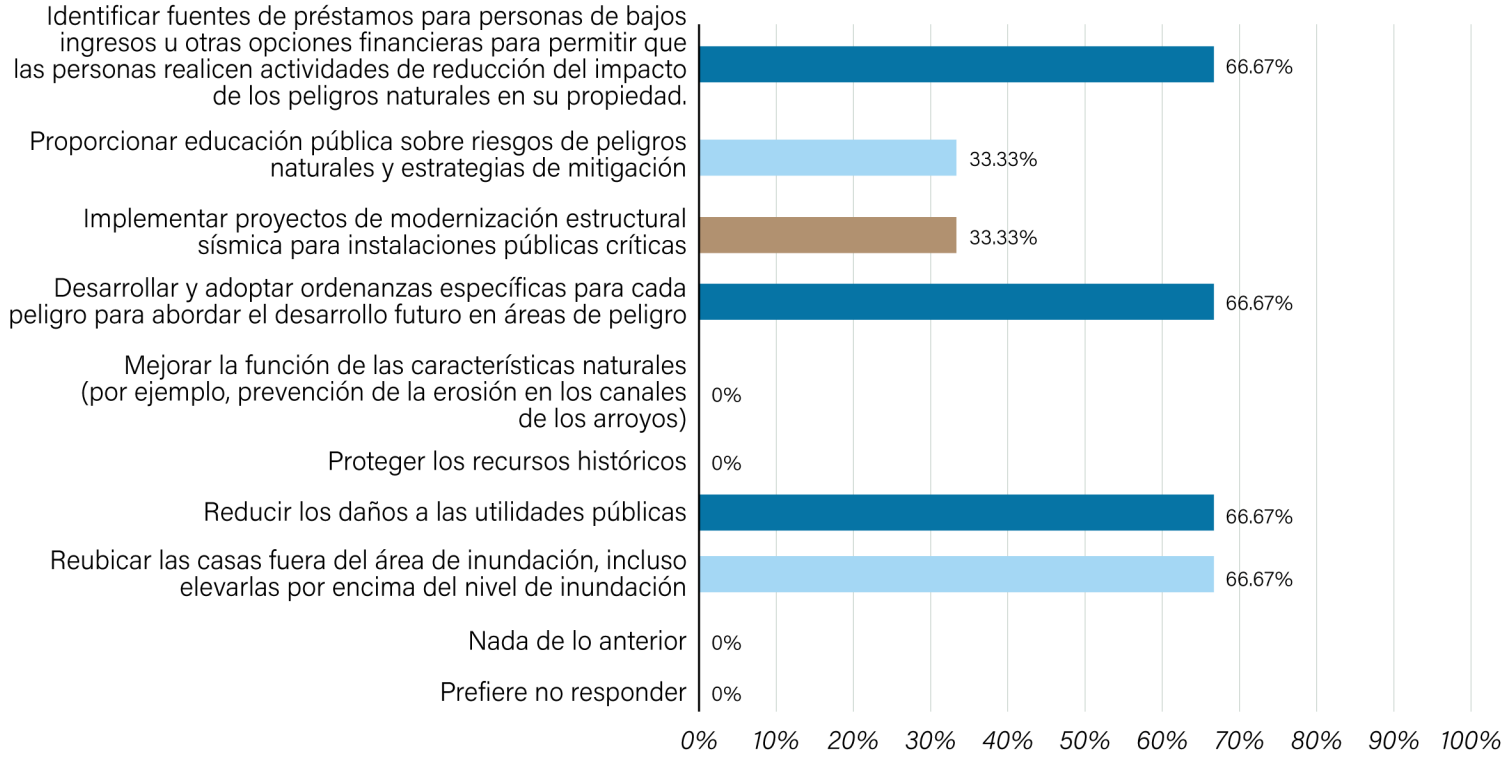
Q7



Answered | 3
Skipped | 0

¿Qué es lo más importante que debe hacer el gobierno local para reducir los impactos de los peligros? (Seleccione hasta tres.)

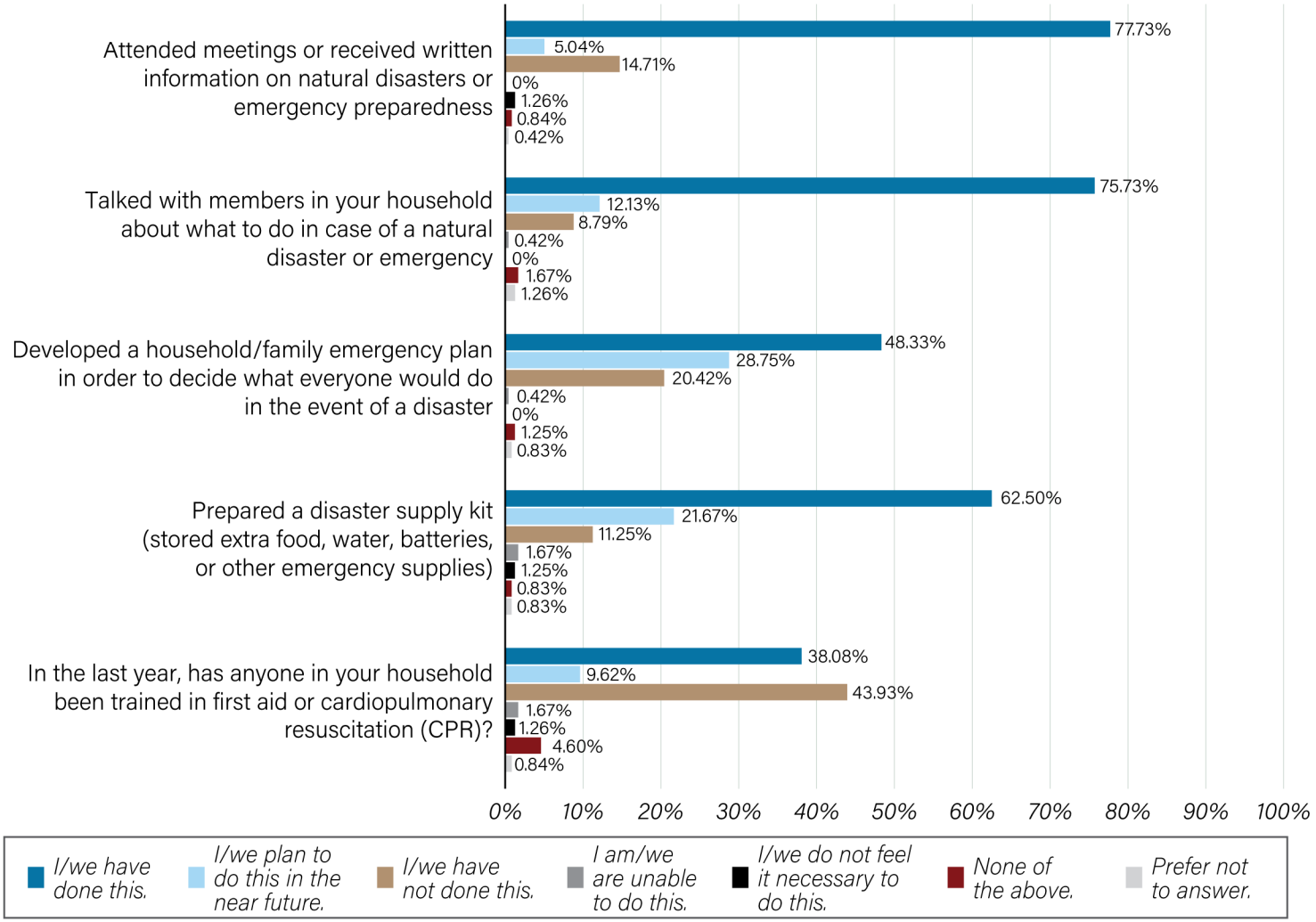
Q7



Answered | **240**
Skipped | **0**

Read the statements below. For each activity, select whether you or someone in your household has done this, or if you do not feel this activity is necessary.

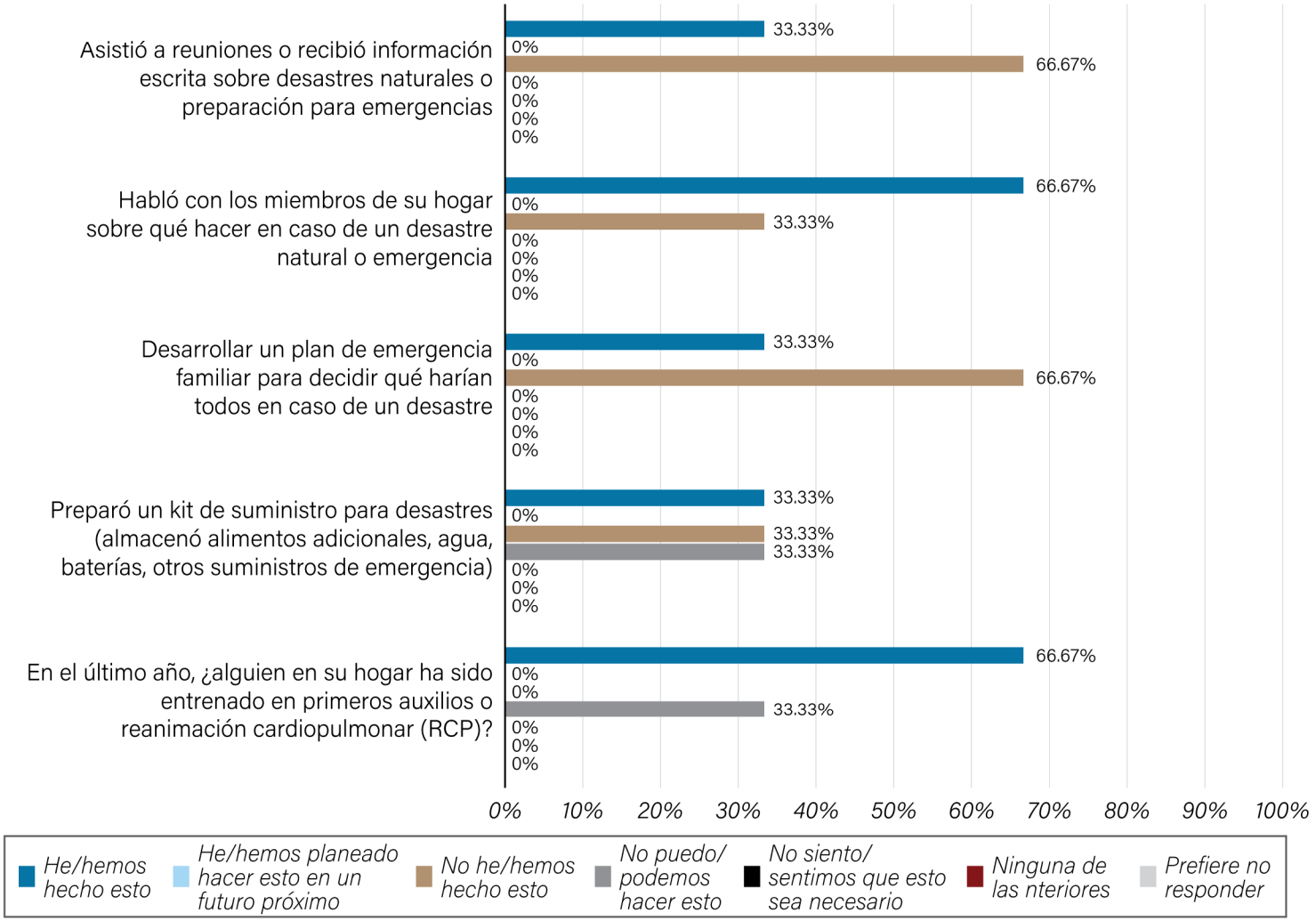
Q8



Answered | 3
Skipped | 0

Lea las declaraciones a continuación. Para cada actividad, seleccione si usted o alguien en su hogar ha hecho esto, o si no cree que esta actividad sea necesaria.

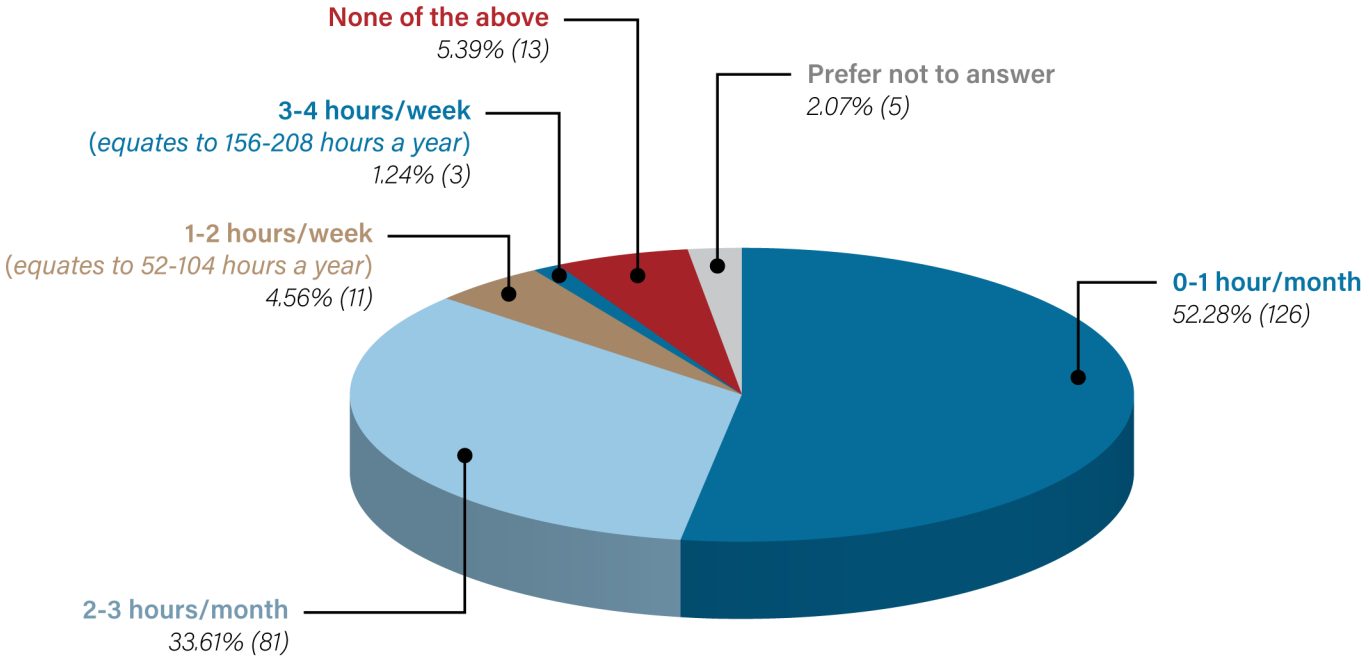
Q8



Answered | **240**
Skipped | **0**

Ideally, how much time would you spend preparing yourself and/or your household for a natural disaster or emergency event?

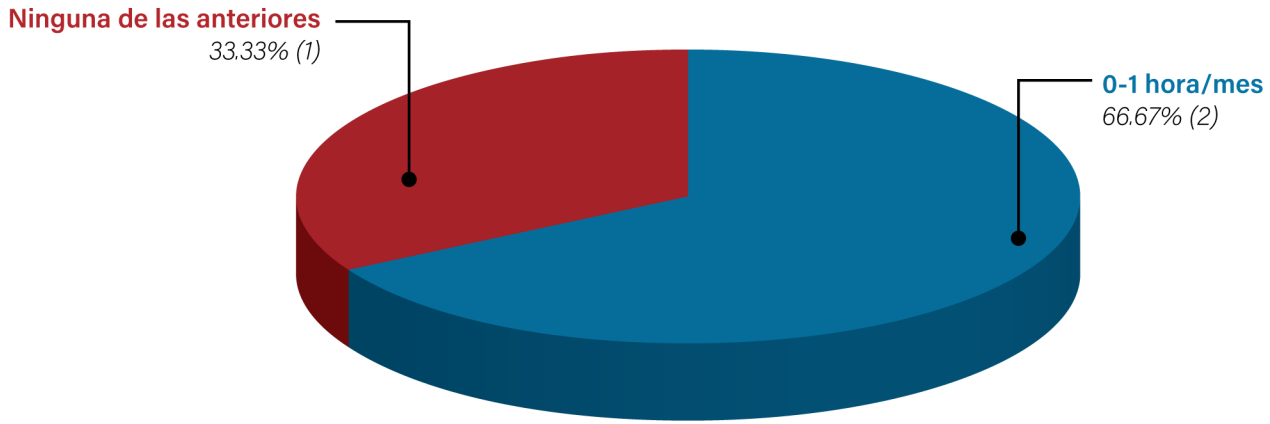
Q9



Answered | 3
Skipped | 0

Idealmente, ¿cuánto tiempo pasa preparándose a sí mismo y/o a su hogar para un evento de desastre natural o emergencia?

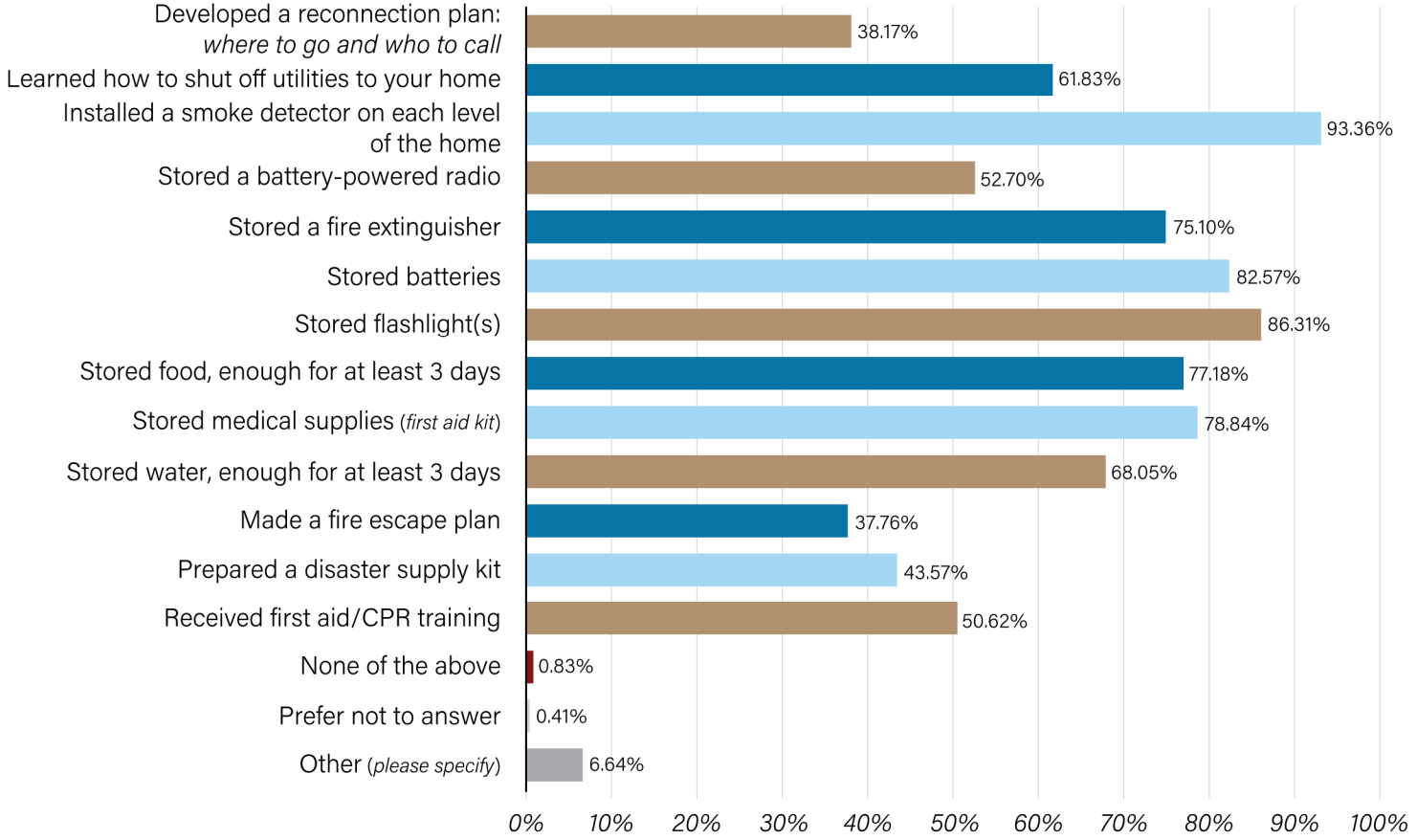
Q9



Answered | **240**
Skipped | **0**

What steps have you taken to prepare for a natural disaster? (Select all that apply.)

Q10

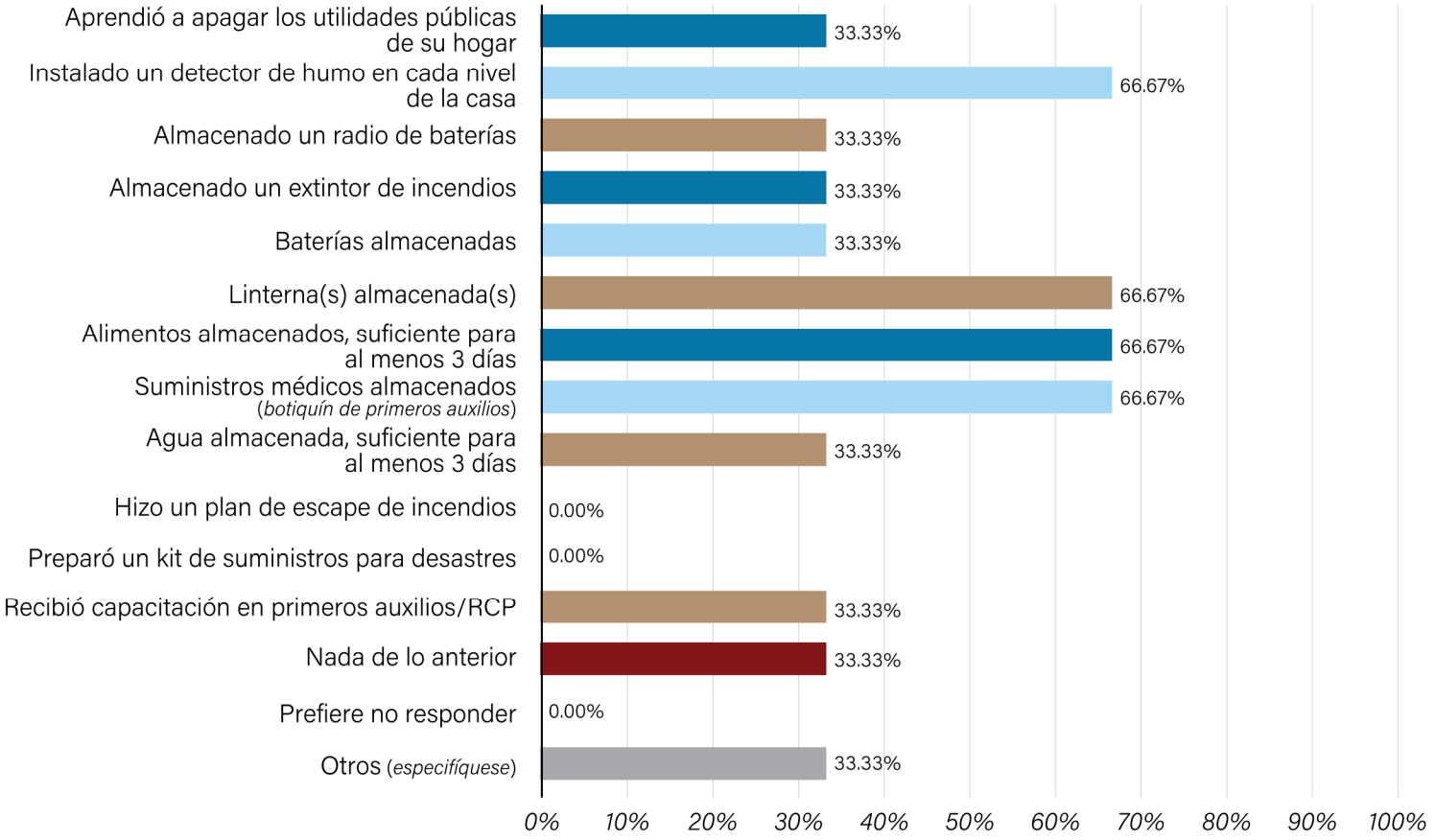


#	OTHER (PLEASE SPECIFY)
1	FEMA Emergency Response training.
2	Bought solar lights we can string, bought extra small propane tanks for the BBS, bought cases of water and rice, extra bags of dog food, keep our gas vehicle tanks full if they get below 3/4 tank. Bought nuke pills just in case.
3	We have taken CPR courses, just out of date by a year or two.
4	Taught Map Your Neighborhood to many local folks.
5	My disaster kit hasn't been updated in years. Don't know what's in it.
6	Ample basic survival training.
7	Have water purification chemicals and equipment.
8	Posted current list of medical prescriptions for first responders.
9	Participated in community awareness program.
10	Need constant readiness classes, want to keep on top of this and practice, practice, practice.
11	Talk to my neighbors about getting prepared for an earthquake.
12	Include pets in our plan, keep copies of important documents and phone numbers.
13	Battery powered radio we do not have.
14	Prioritized evacuation list.
15	Rather than store water, we have a filtration system and access to a creek.
16	We did more of these things before the pandemic (have not done CPR training since). I became unemployed and had immediate needs not being met. Emergency planning and access to materials needs to be free for all. Businesses should pay more in taxes for preparedness and development should be banned in sensitive areas. Much more can be accomplished through regulation than education for households. Not everyone can afford the things on this list!

Answered | 3
Skipped | 0

¿Qué pasos ha tomado para prepararse para un desastre natural? (Seleccione todo lo que aplique.)

Q10

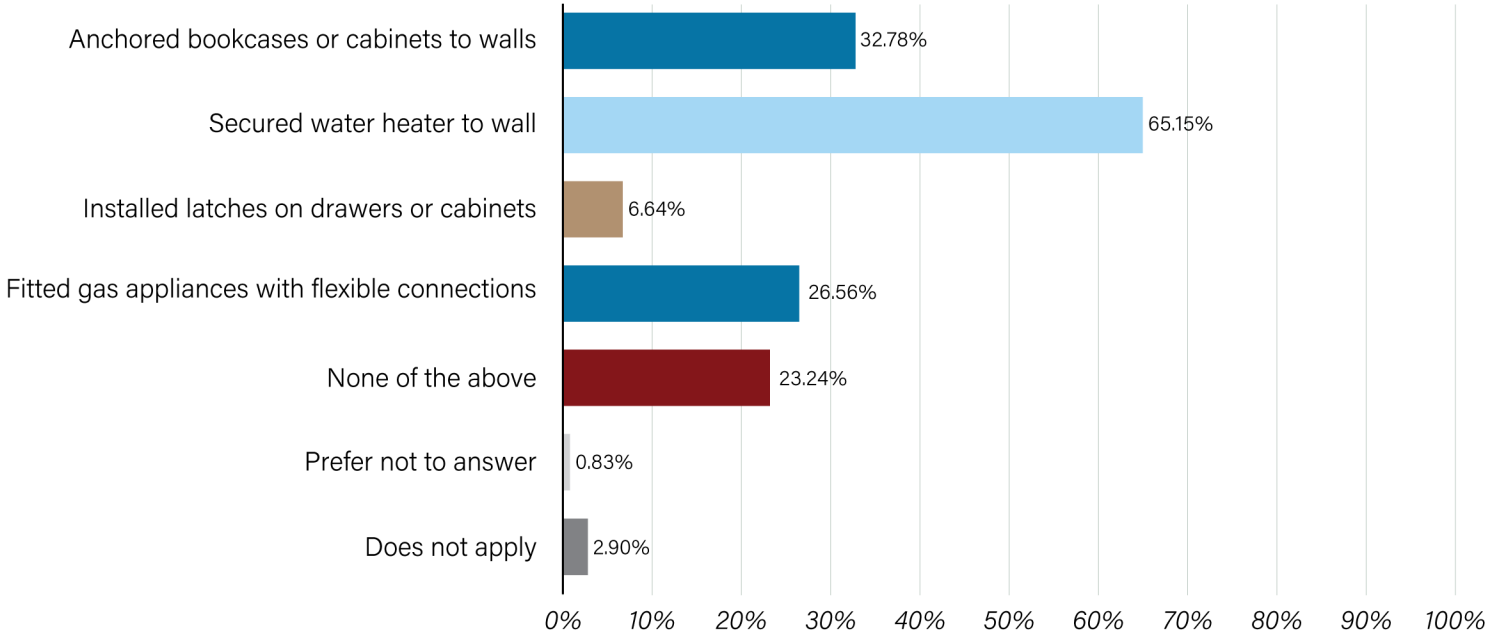


#	OTROS (ESPECIFIQUE)
1	No tengo dinero para esto. (I do not have money for this.)

Answered | **240**
Skipped | **0**

What nonstructural modifications for earthquakes have you made to your home? (Select all that apply.)

Q11

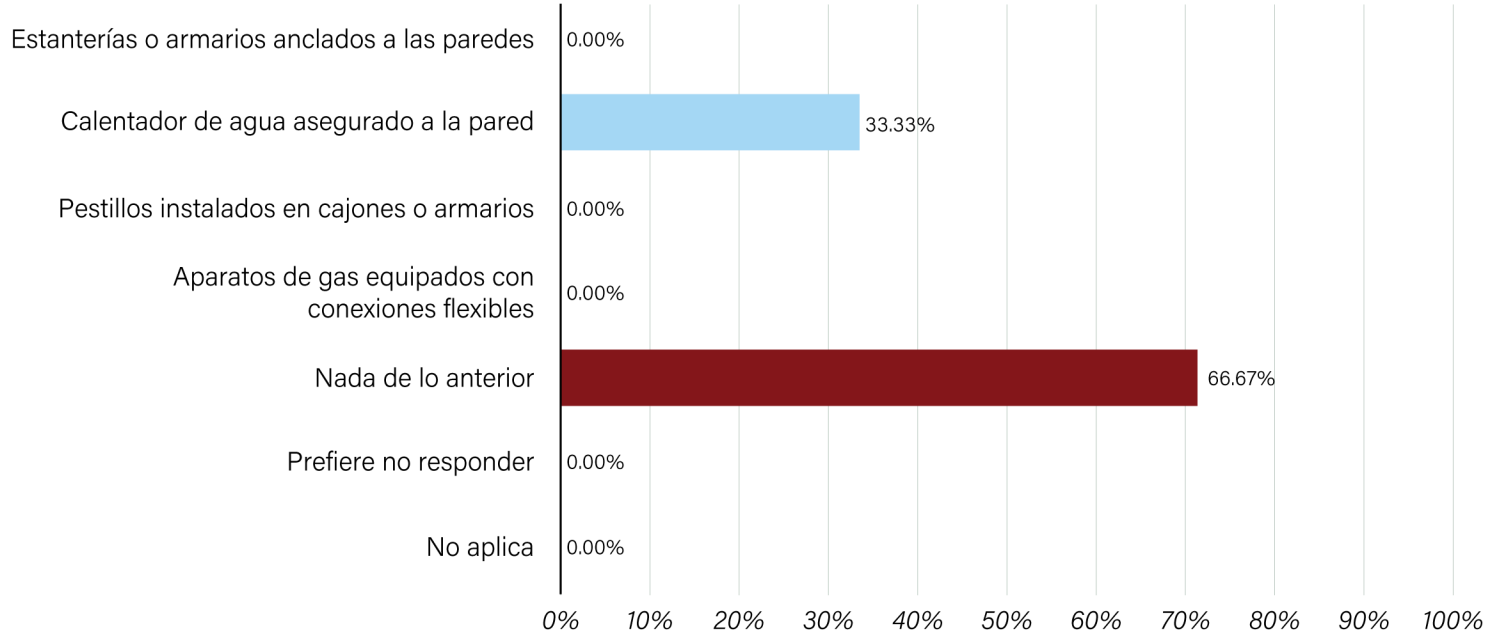


#	OTHER (PLEASE SPECIFY)
1	Used museum putty to secure items on shelves.
2	Planning to install kitchen latches! Just need to find best for us.
3	I keep a space under my bed specifically for earthquake protection. I also have all of my possessions hooked or otherwise secured to walls.
4	We are working on getting rid of all gas appliances.
5	Working on this.
6	Anchored shelves in garage to studs.
7	No gas appliances by choice.
8	The water heater was already secured.
9	I have looked at state maps to see how at risk my house is.
10	I feel that the gas company should come check what houses need to change the fittings (as they did installation in the first place and are the only qualified ones to help?).
11	We don't have gas appliances.

Answered | 3
Skipped | 0

¿Qué modificaciones no estructurales para terremotos ha hecho en su hogar? (Seleccione todo lo que corresponda.)

Q11

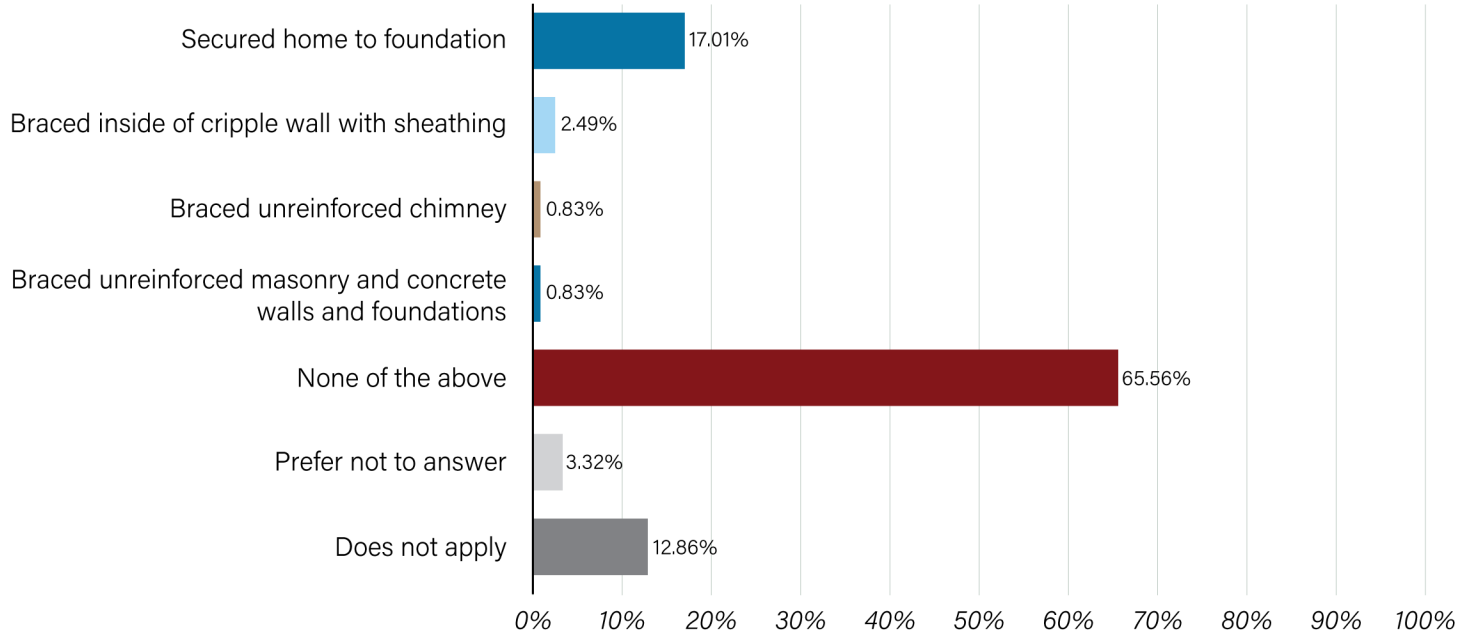


#	OTROS (ESPECIFIQUE)
1	Rento y no tengo dinero. (I rent and I do not have money.)

Answered | **240**
Skipped | **0**

What structural modifications for earthquakes have you made to your home? (Select all that apply.)

Q12

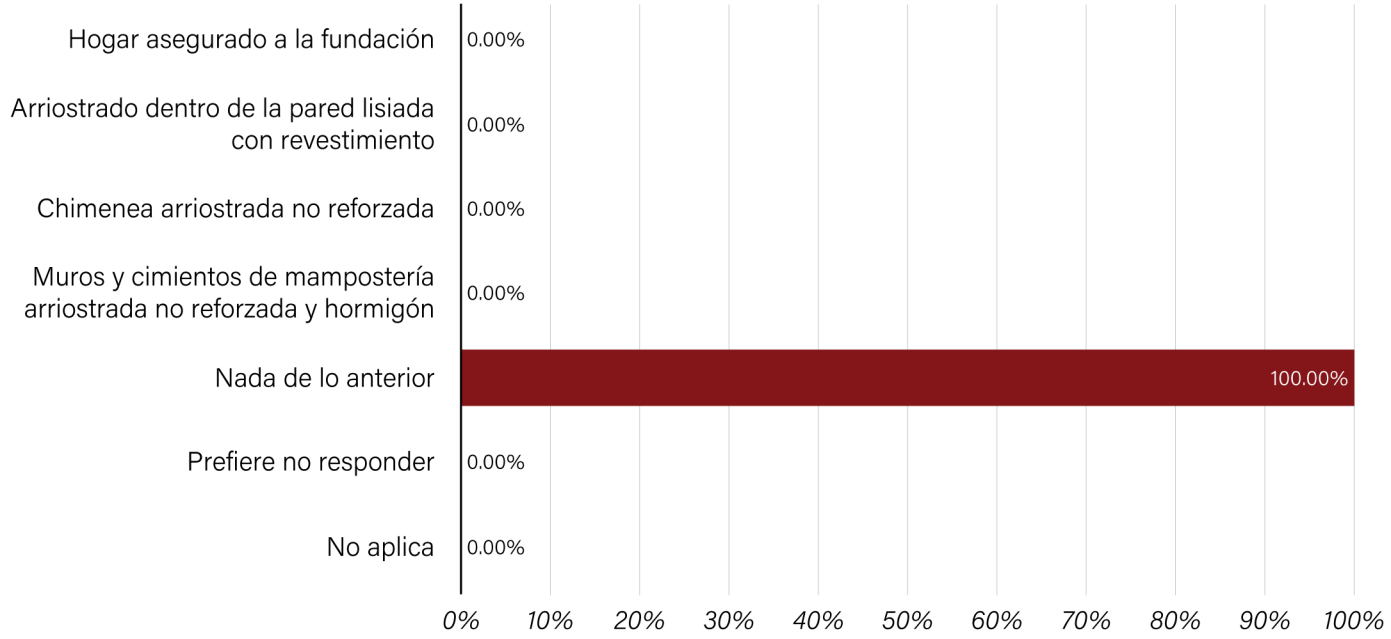


#	OTHER (PLEASE SPECIFY)
1	We have an ICF home - concrete and rebar.
2	Had seismic engineer determine no retrofit needed.
3	Not sure. :(
4	Not sure if my masonry chimney is reinforced or not, house built in 1992.
5	The home doesn't belong to me.
6	Not sure, house was built in 2000.
7	Working on this.
8	We were told that our foundation is secured, but I don’t know if I believe it.
9	Made our support beams up to earthquake code (built in 2000 and was not built to code).
10	We rent.
11	New construction.
12	We are unable to do anything structural to this home as we do not own it but rent it. It is up to housing but they have not done anything like this.
13	Live in a condo; do not know which of these have been done.
14	Apartment renter; not allowed to.
15	Removed unreinforced chimney.
16	I live in an exceptionally old home that already had a secured foundation.
17	Not sure.
18	Cleared overgrown brush from lot and we get our trees pruned every 2 to 3 years to maintain their health and prevent damage from falling branches.
19	Like many, I rent.
20	Stop your government overreach. Stop raising taxes for nonsense. Believe people can take responsibility. Leave them alone.

Answered | 3
Skipped | 0

¿Qué modificaciones estructurales para terremotos has hecho en tu casa? (Seleccione todo lo que corresponda.)

Q12

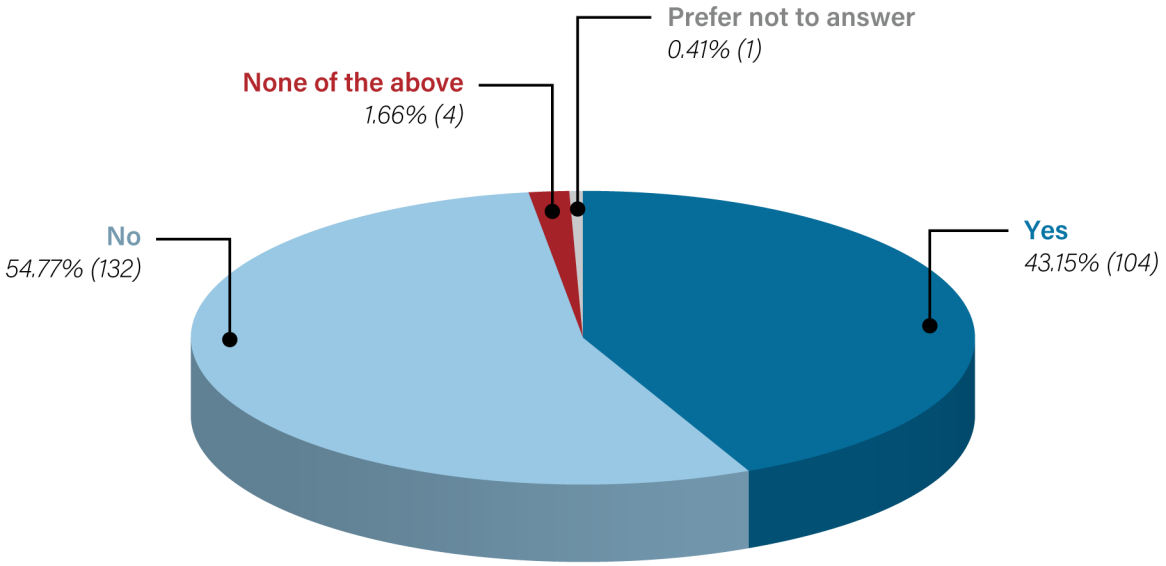


#	RESPUESTAS
1	Rento y no tengo dinero. (I rent and I do not have money.)

Answered | **240**
Skipped | **0**

Did the possible occurrence of natural hazards affect your decision on where you currently live?

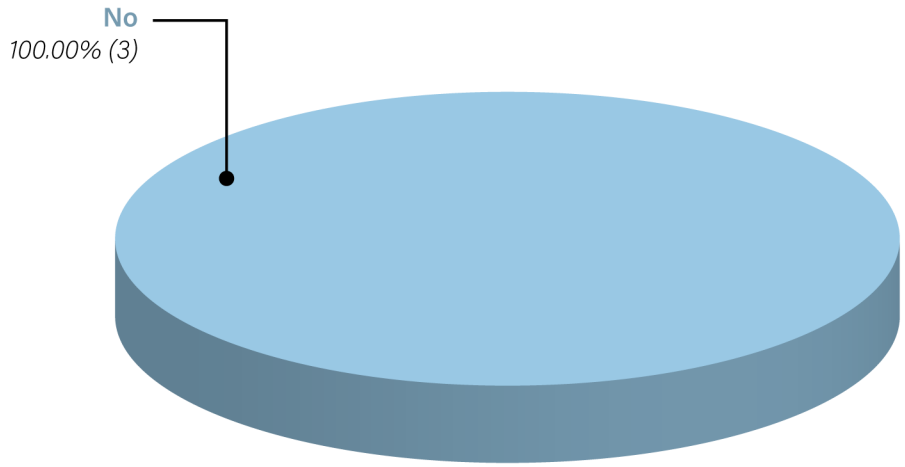
Q13



Answered | 3
Skipped | 0

¿La posible ocurrencia de peligros naturales ha afectado su decisión sobre dónde vive actualmente?

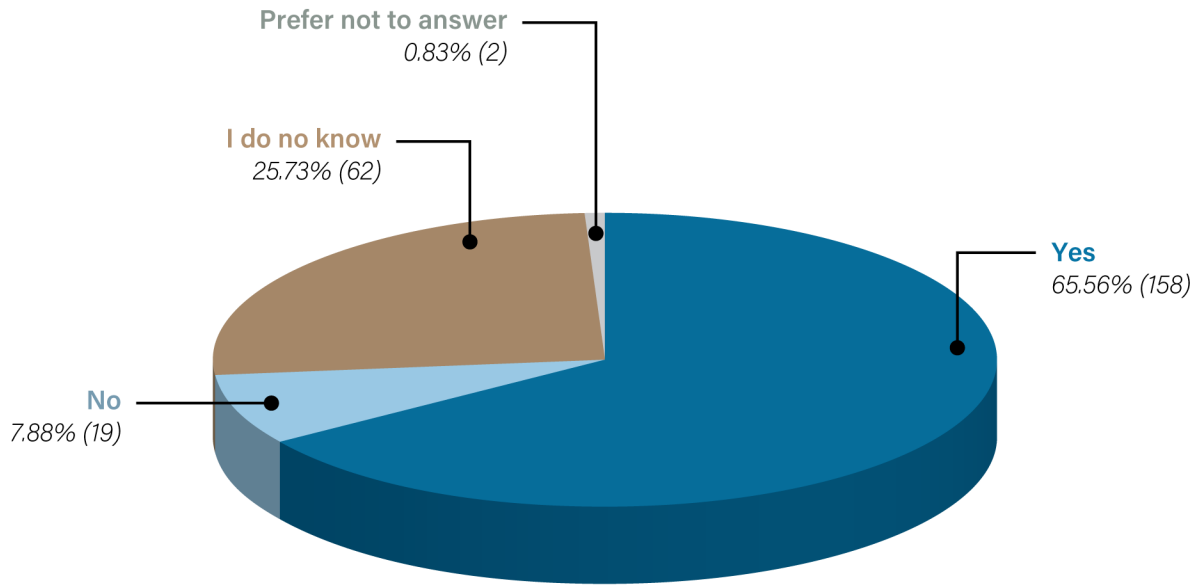
Q13



Answered | 240
Skipped | 0

If you could, would you be willing to spend more money on a home (including rental housing) that had features that made it more disaster resistant?

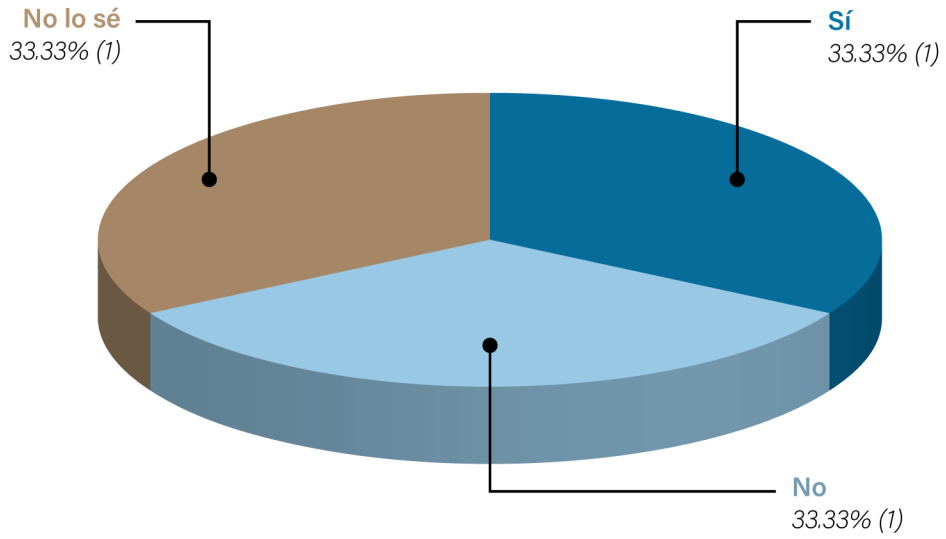
Q14



Answered | 3
Skipped | 0

Si pudiera, ¿estaría dispuesto a gastar más dinero en una casa (incluida la vivienda de alquiler) que tuviera características que la hicieran más resistente a los desastres?

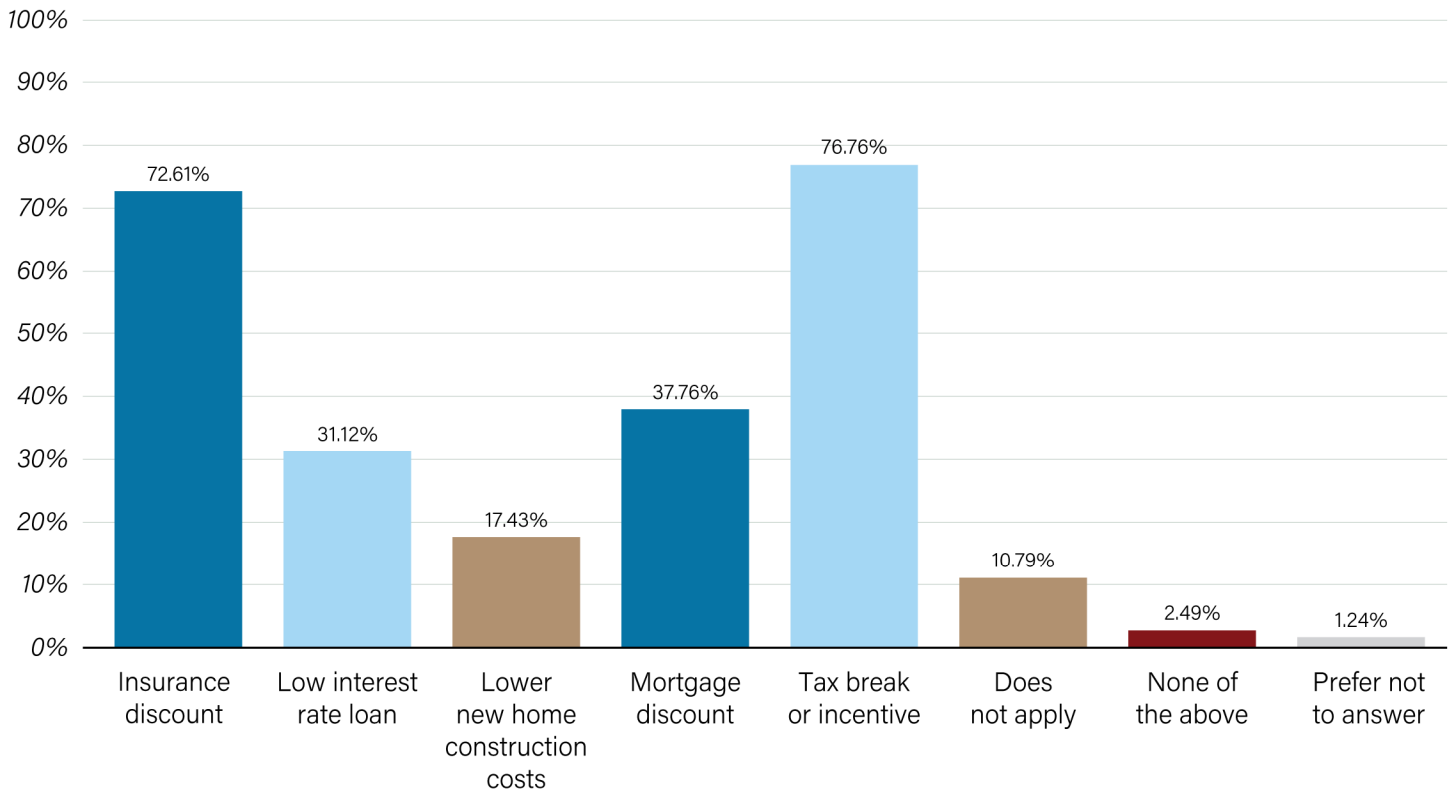
Q14



Answered | **240**
Skipped | **0**

If you own property, which of the following incentives, if any, would motivate you to take additional steps to better protect the property from a natural disaster?

Q15

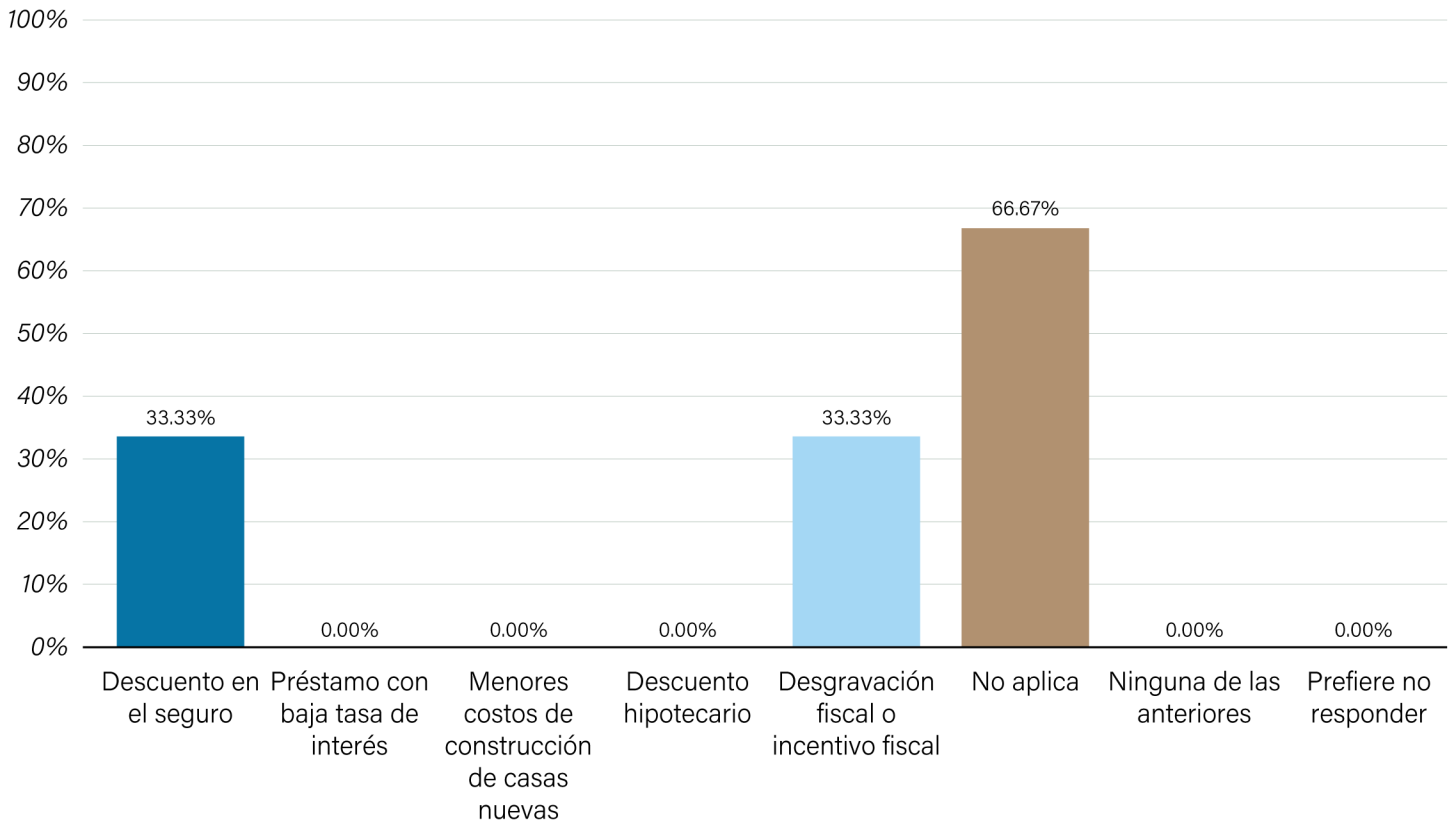


#	OTHER (PLEASE SPECIFY)
1	Government-operated program that connects homeowners with qualified contractors to do inspections, make recommendations, and do this work.
2	Condo.
3	Please improve building codes and inspections so that contractors are more liable for doing the right thing that actually benefit and protect homes.
4	Help doing the upgrades.
5	I chose insurance discount and tax break, but that usually ends up in the seller's pocket, not the homeowner’s. How to avoid that?
6	People CANNOT afford to pay more rent or more for their mortgage. It is disrespectful to think renters could or would pay more. LANDLORDS and rental agencies should be better regulated. Having renters pay is an absurd idea.
7	The biggest key would be being assured that the people performing the work were qualified and not taking advantage of homeowners.

Answered | 3
Skipped | 0

Si usted es dueño de una propiedad, ¿cuál de los siguientes incentivos, si los hay, le motivaría a tomar medidas adicionales para proteger mejor la propiedad de un desastre natural?

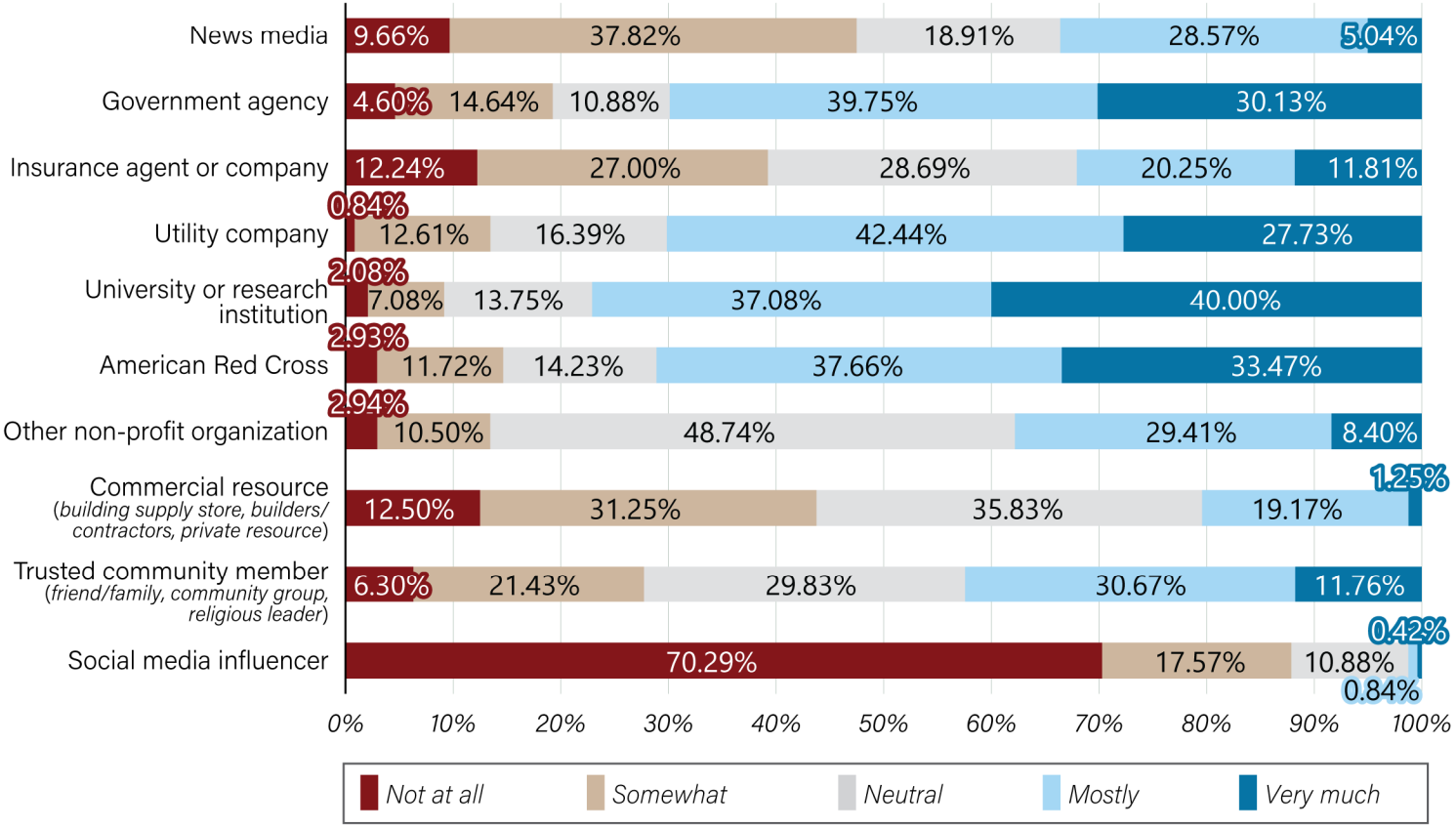
Q15



Answered | 240
Skipped | 0

Please tell us how much you trust each source to provide you with information about how to make your household and home safer from natural disasters.

Q16

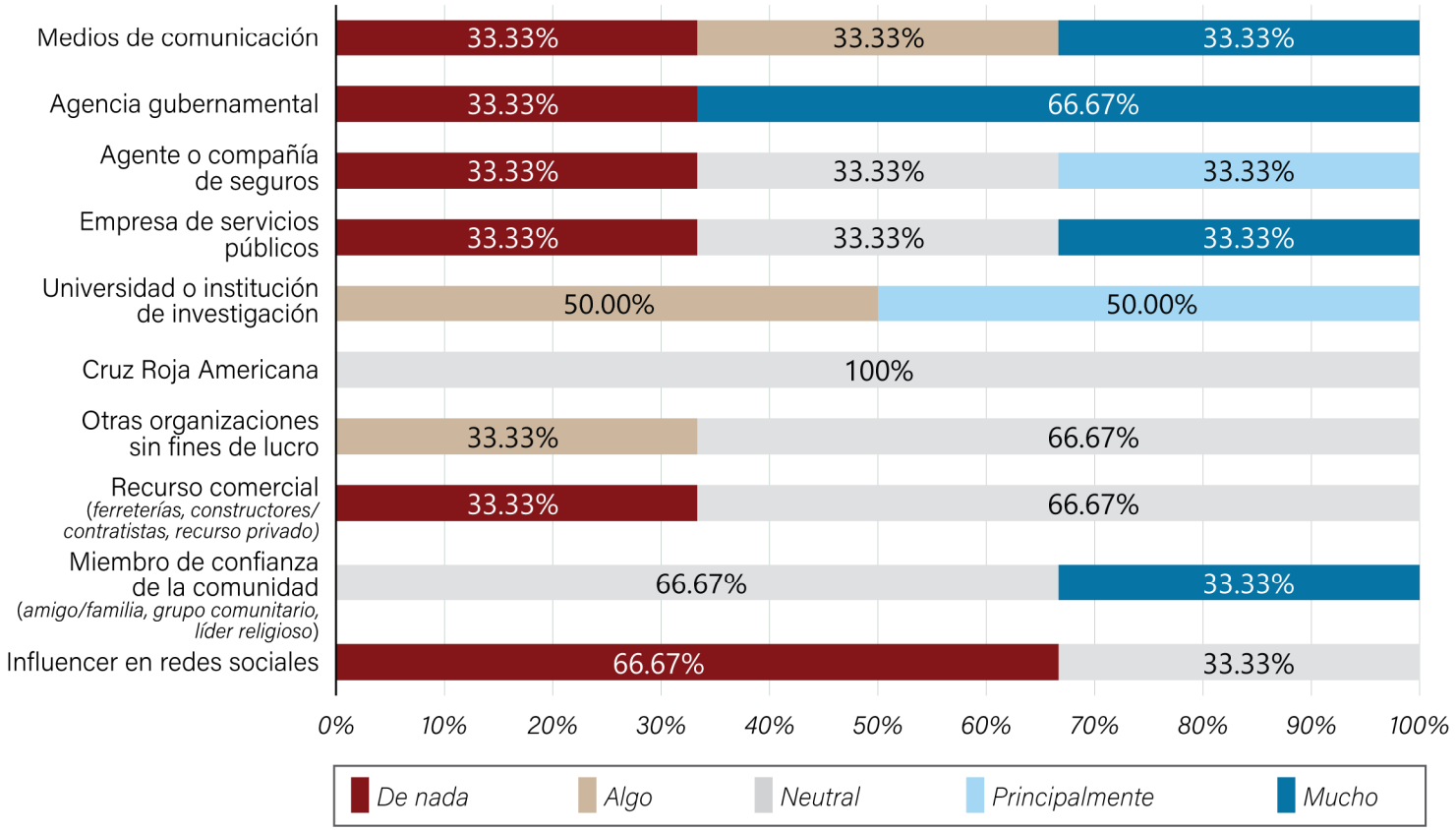


#	OTHER (PLEASE SPECIFY)
1	Subject matter experts
2	Fire department
3	The library: get educated
4	We do our own research
5	Experts in their field
6	Various emergency management instructors Very Much
7	Fire Department
8	News media, to me means or public broadcasting
9	CERT, Tualatin Valley Fire and Rescue, Oregon Office of Emergency Management
10	Mutual Aid groups
11	Depends on the news media (are we talking PBS or Fox talk shows?). And depends on the government agency (are we talking an environmental agency or the police?)
12	It would be key to have contractors vetted with no financial ties

Answered | 3
Skipped | 0

Por favor, díganos cuánto confía en cada fuente para proporcionarle información sobre cómo hacer que su hogar y su familia estén más seguros de los desastres naturales.

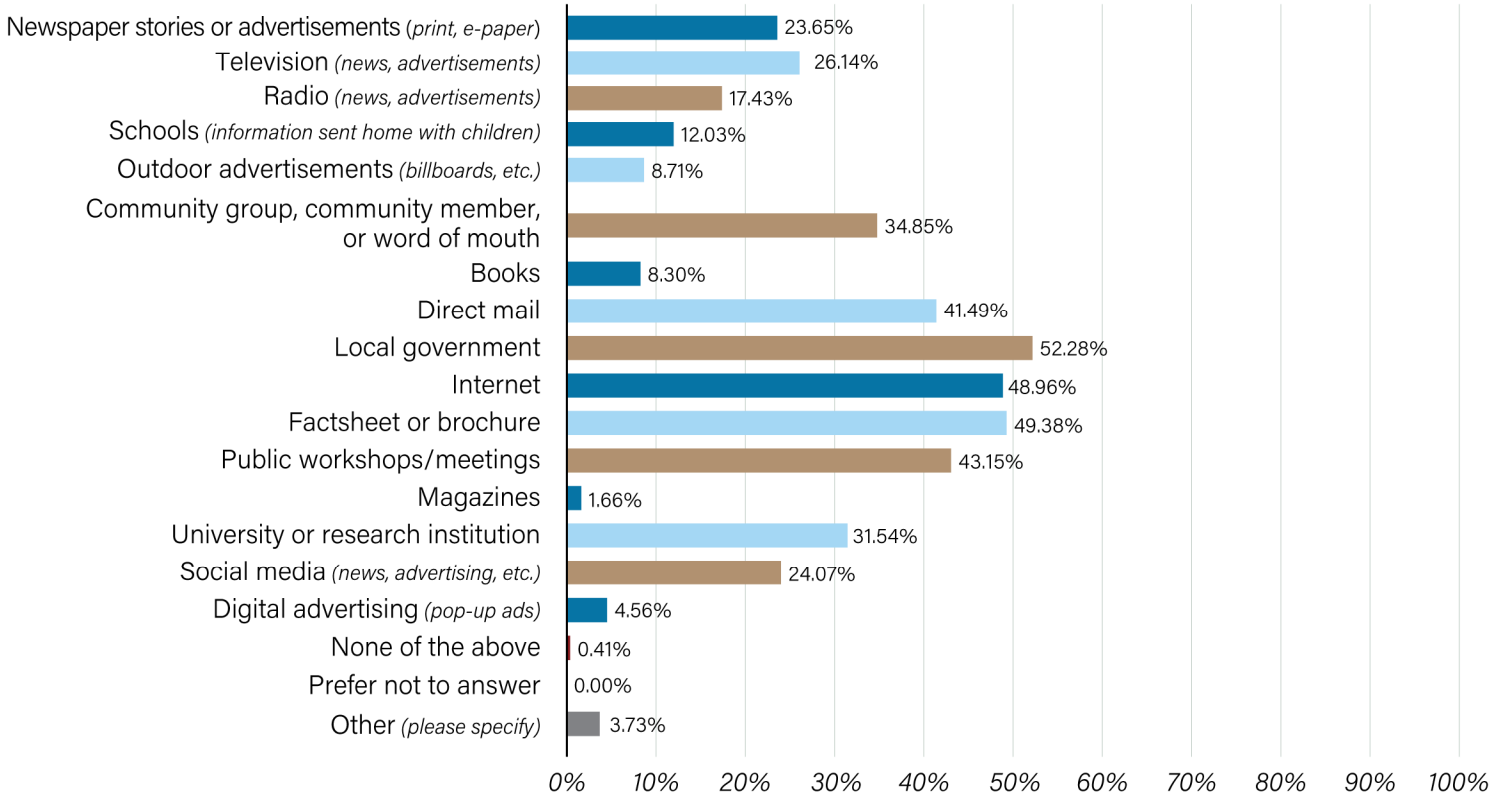
Q16



Answered | **240**
Skipped | **0**

What is the most effective way for you to receive information about how to make your household and home safer from natural disasters? Choose up to five answers.

Q17

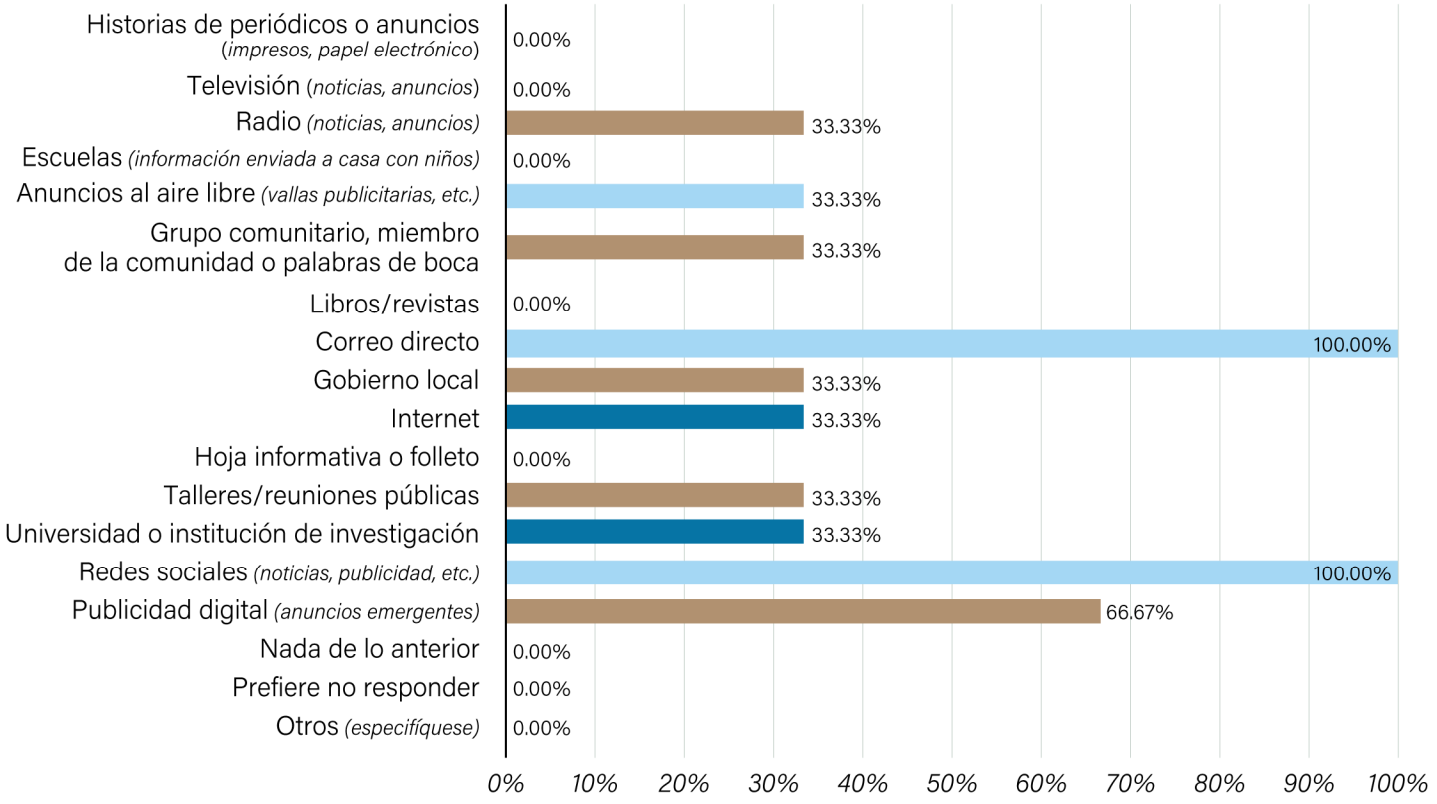


#	OTHER (PLEASE SPECIFY)
1	Text messages
2	Library signage and direct mail
3	Cedar Hills Ready has a host of expert info that I follow
4	Emails and mailings from the Beaverton CERT program
5	Local library
6	I am a middle-aged person with elders to care for living in a senior 55+ community. We need more community outreach at our location.
7	MA 'zines
8	My dad was the head building code inspector for the state of Oregon; I learned a lot from his daily rants.
9	Utilities and county people should come around to neighborhoods and address houses and their differing situations according to the years their houses were built/quality etc.

Answered | 3
Skipped | 0

¿Cuál es la forma más efectiva de recibir información sobre cómo hacer que su hogar y su familia estén más seguros frente a los desastres naturales? Elige hasta cinco respuestas.

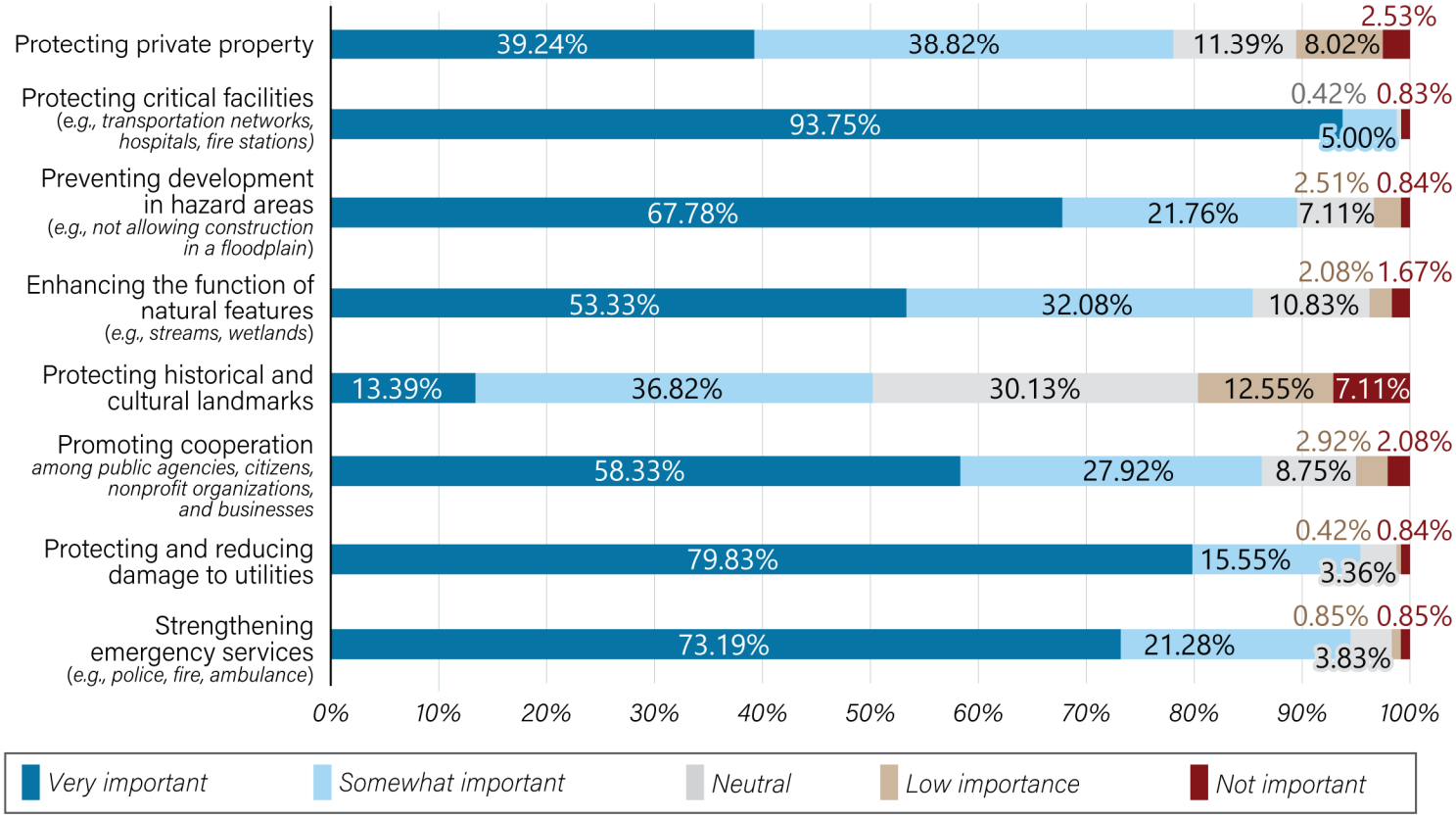
Q17



Answered | **240**
Skipped | **0**

The following statements will help determine community priorities for planning for natural hazards. Please tell us how important each one is to you.

Q18

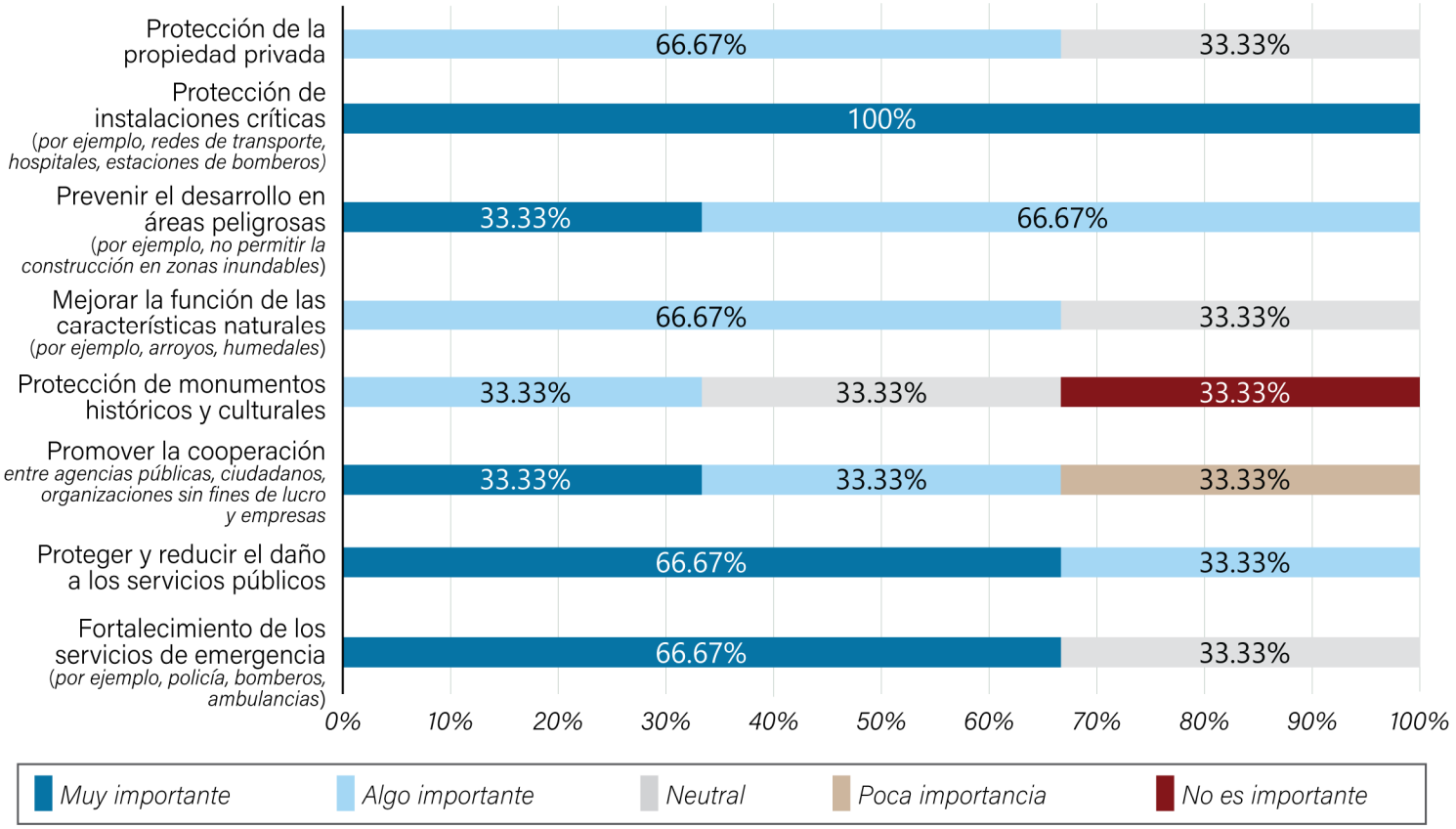


#	OTHER (PLEASE SPECIFY)
1	We need more police officers. Lots more. They cannot handle current emergencies as it is.
2	Police are not important. Helping neighbors plan together for emergency preparedness.
3	Yes. All of them!
4	Important to reach non-English speaking and low-income communities.
5	Implement better standard requirements for rentable housing in terms of preventative measures and safety features. Maybe require ALL buildings to have suggested evacuation plans in plain view (including apartments) so that anyone in a new space can escape quickly if need be. Also make quick escape routes possible for people with disabilities a requirement for all new buildings.
6	More National Guard emergency training and funding.
7	Fire and ambulance, but with police—it depends on what strengthening means. The first two will be the most important.
8	Rebuilding or relocating after a disaster to prevent the facility from being damaged in any future disaster.
9	Money to do this. Maybe local government can make sure they are keeping lines in good shape.
10	Public outreach to train citizens to get organized in their households and work with the neighbors on their streets or in their community homes to develop an emergency communication plan and coordinated disaster response plan.
11	Develop a plan to assist elderly and handicapped people.
12	Protecting schools—making them earthquake safe.
13	Police and ambulance services are not the same and should not be lumped. Medical services are very important. Paramilitary forces are not.
14	Educate community in preparation and recovery; make training available to more people at a lower cost.

Answered | 3
Skipped | 0

Las siguientes declaraciones ayudarán a determinar las prioridades de la comunidad para la planificación de los peligros naturales. Por favor, díganos lo importante que es cada uno para usted.

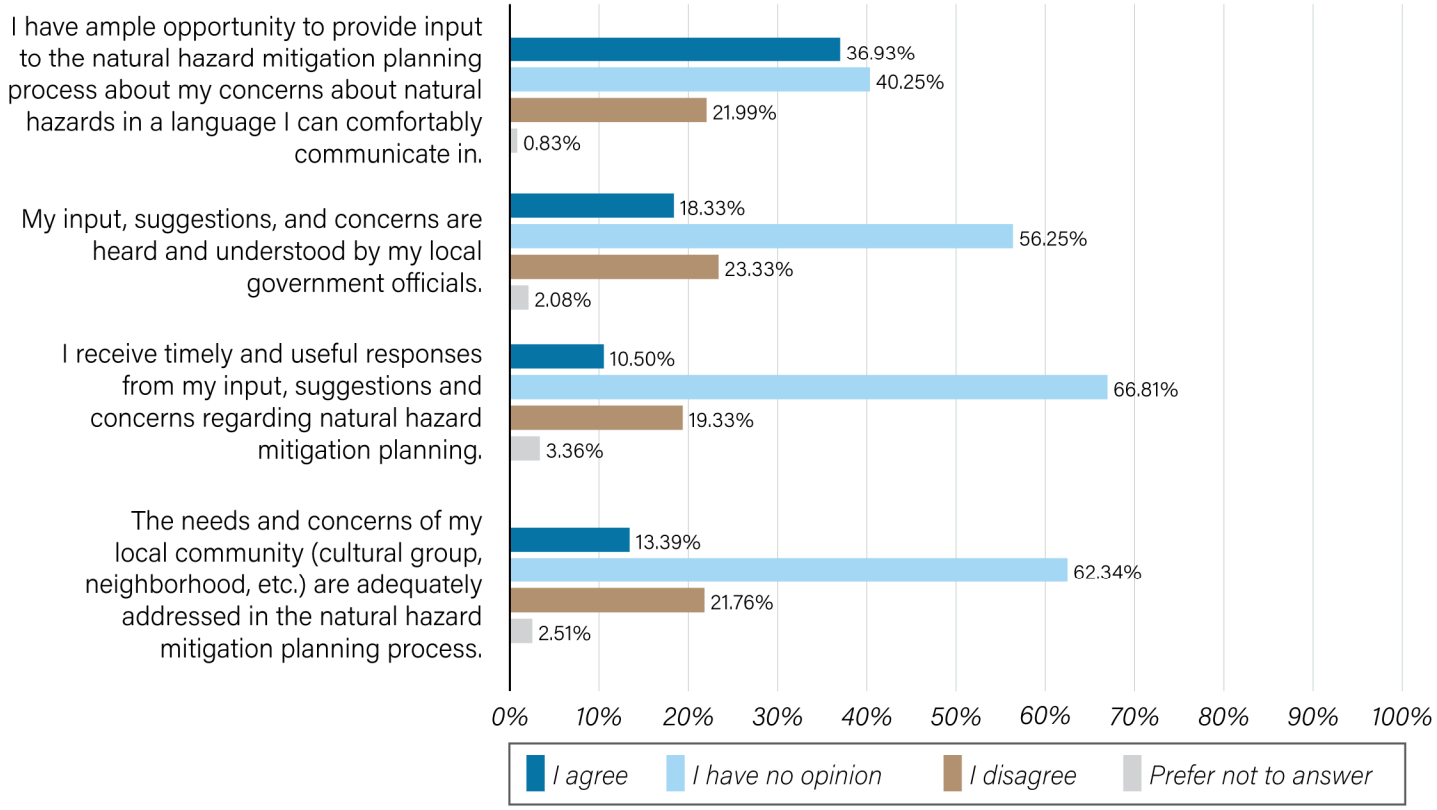
Q18



Answered | **240**
Skipped | **0**

The following statements strive to understand your thoughts regarding the ability of the public to participate in this process.
Please tell us if you agree with each statement.

Q19

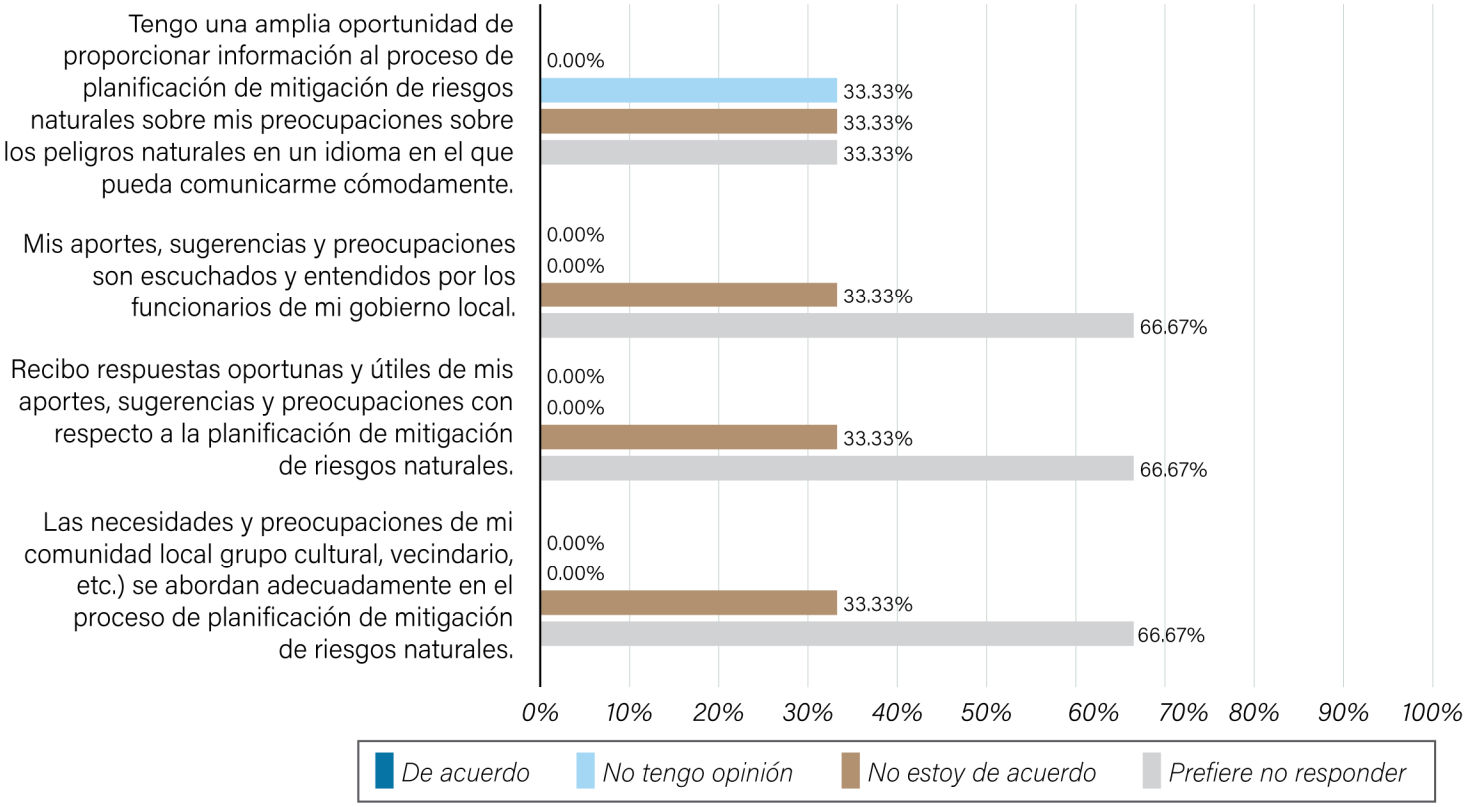


Answered | 3
Skipped | 0

Las siguientes declaraciones se esfuerzan por comprender sus pensamientos con respecto a la capacidad del público para participar en este proceso.

Por favor, díganos si está de acuerdo con cada declaración.

Q19



Q20. That concludes the questions on natural hazards. The next few questions ask about different types of people in the community. We want to know if different groups in our community are being heard. We encourage you to answer these questions, but if you prefer not to, please select “prefer not to answer."

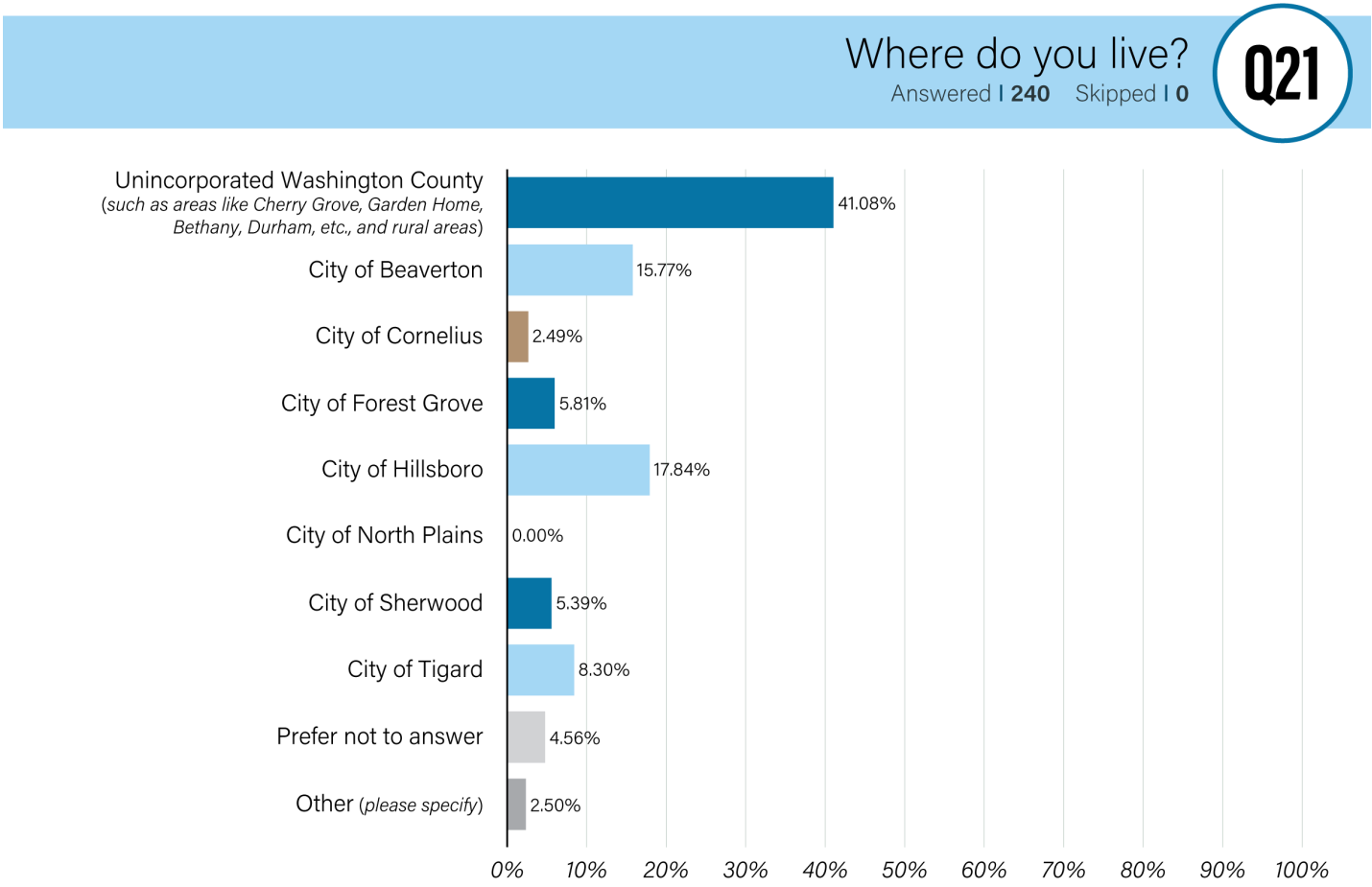
Answered: 10 Skipped: 230

#	RESPONSES
1	Community groups are trying to get Washington County to pursue a Climate Action Plan, to add climate disaster to the EMS program. We need greater support to make this happen.
2	Question #19 makes no sense because this is the first time I’ve ever been reached out to for input on this type of plan and I’ve lived in Beaverton for over 40 years! Also need a comment/question section in your survey. Plus, why ask the same questions over, just rewording; seems trying to guide an outcome.
3	Okay.
4	I don't know if community understands or knows about emergency preparedness.
5	FYI, disasters are not "natural" in that it is human poor planning that makes it a disaster.
6	Are these plans being made accessible? For those who are low income, have a disability or health condition, speak a different language, unable to drive, etc. and may be impacted more during a natural disaster?
7	Okay.
8	General citizen, BIPOC, faith base, volunteer groups, elderly communities, disabilities access and/or functional needs population, and houseless.
9	I live in the Summerfield 55+ civic association. They have no plans in place for an emergency management plan for seniors living here.
10	So “where do you place your racial or ethnic identity” "requires an answer" even though I responded by filling in the "other" box.

Q20. Con esto concluyen las preguntas relacionadas a los peligros naturales. Las siguientes preguntas tratan sobre los diferentes tipos de personas en la comunidad. Queremos saber si los diferentes grupos de nuestra comunidad están siendo escuchados. Le recomendamos que responda a estas preguntas, pero si prefiere no hacerlo, por favor "seleccione preferir no responder".

Answered: 1 Skipped: 2

#	RESPUESTAS
1	OK

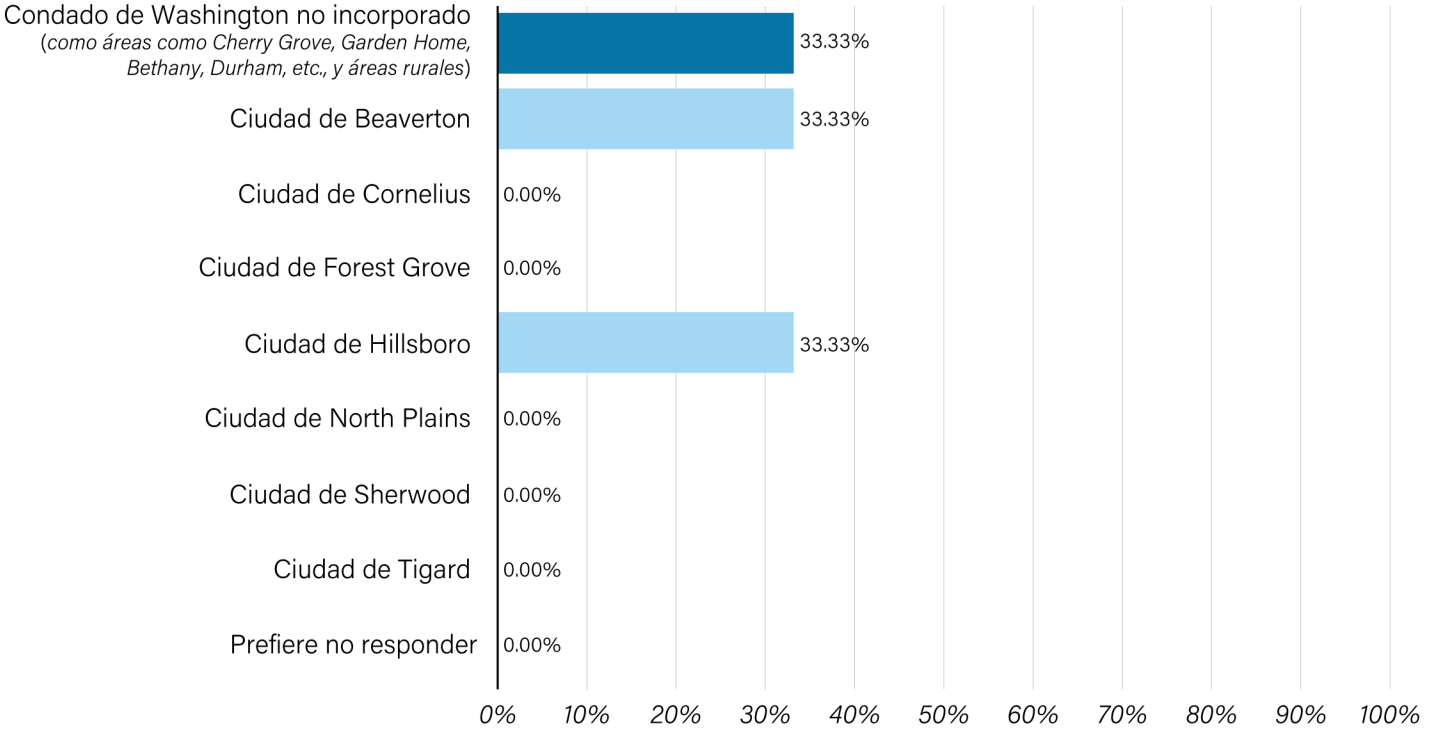

Where do you live?
Answered | 240 Skipped | 0
Q21
Unincorporated Washington County (such as areas like Cherry Grove, Garden Home, Bethany, Durham, etc., and rural areas)
41.08%
City of Beaverton
15.77%
City of Cornelius
2.49%
City of Forest Grove
5.81%
City of Hillsboro
17.84%
City of North Plains
0.00%
City of Sherwood
5.39%
City of Tigard
8.30%
Prefer not to answer
4.56%
Other (please specify)
2.50%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

#	OTHER (PLEASE SPECIFY)
1	Near Gales Creek, Oregon
2	City of Portland
3	Portland
4	Tualatin
5	I have a Portland address in Washington County.
6	Tualatin. Why isn't Tualatin listed? Tualatin's logo appears at the bottom of the page I clicked for the survey.

¿En dónde vives?

Q21

Answered | 3 Skipped | 0



Q22. What zip code do you live in? If you prefer not to answer, please type N/A.

Answered: 240 Skipped: 0

ZIP CODE	NUMBER OF RESPONSES
97003	7
97005	7
97006	12
97007	11
97008	14
97062	2
97078	5
97106	3
97113	6
97116	18
97117	3
97123	24
97124	22
97133	2
97140	13
97217	1
97223	13
97224	12
97225	7
97229	32
97266	1
97299	1
97006	1

ZIP CODE	NUMBER OF RESPONSES
97124, 97003	1
N/A	22

Q22 ¿En qué código postal vives? Si prefiere no responder, escriba N/A.

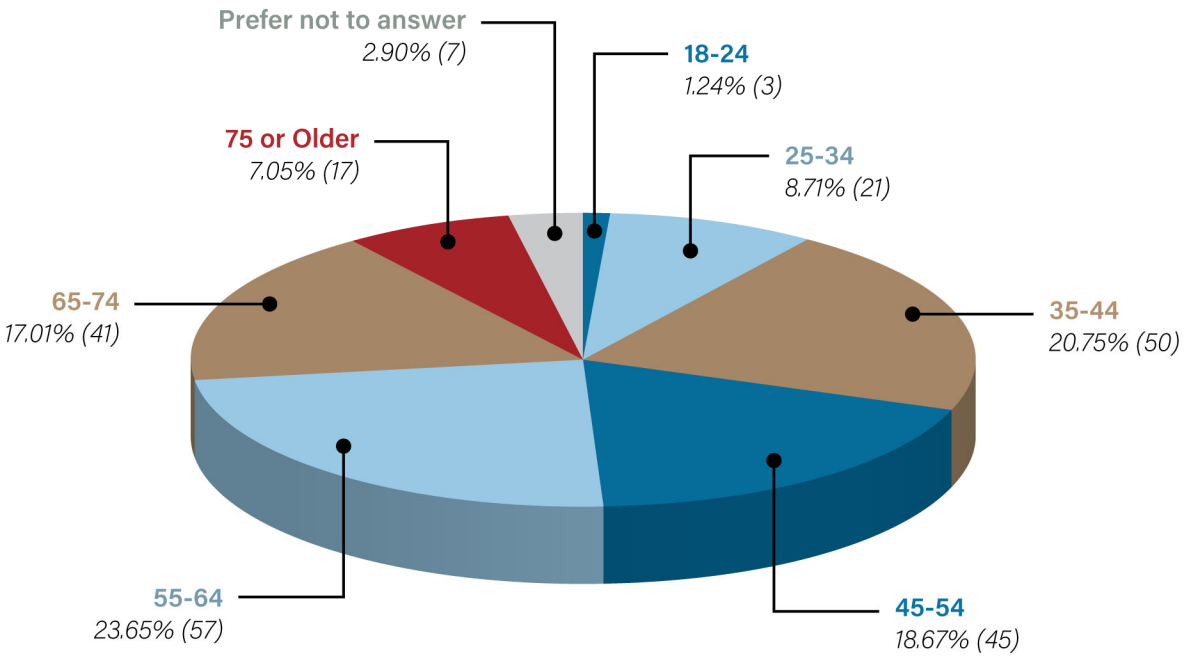
Answered: 3 Skipped: 0

EL CÓDIGO POSTAL	NÚMERO DE RESPUESTAS
97229	1
97006	1
97123	1

Which of the following includes your age?

Q23

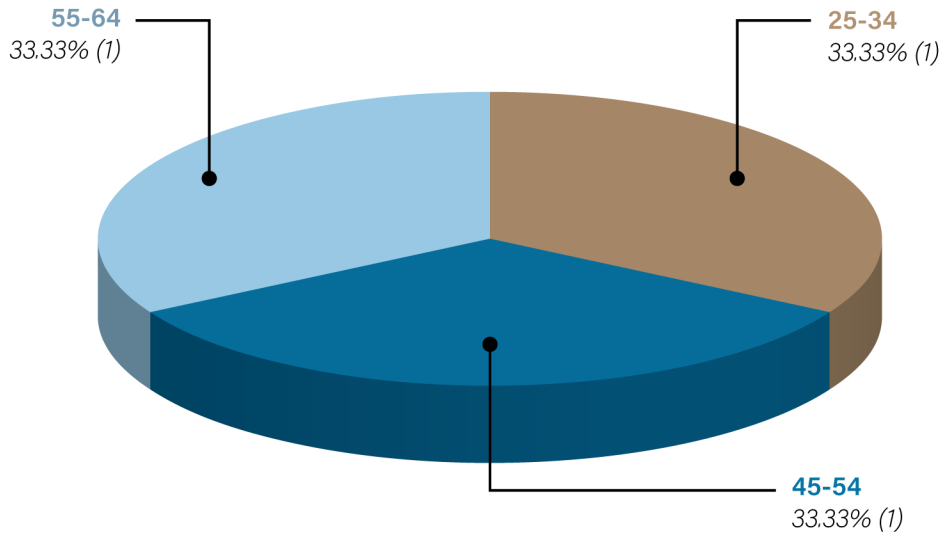
Answered | 240 Skipped | 0



¿Cuál de las siguientes incluye su edad?

Q23

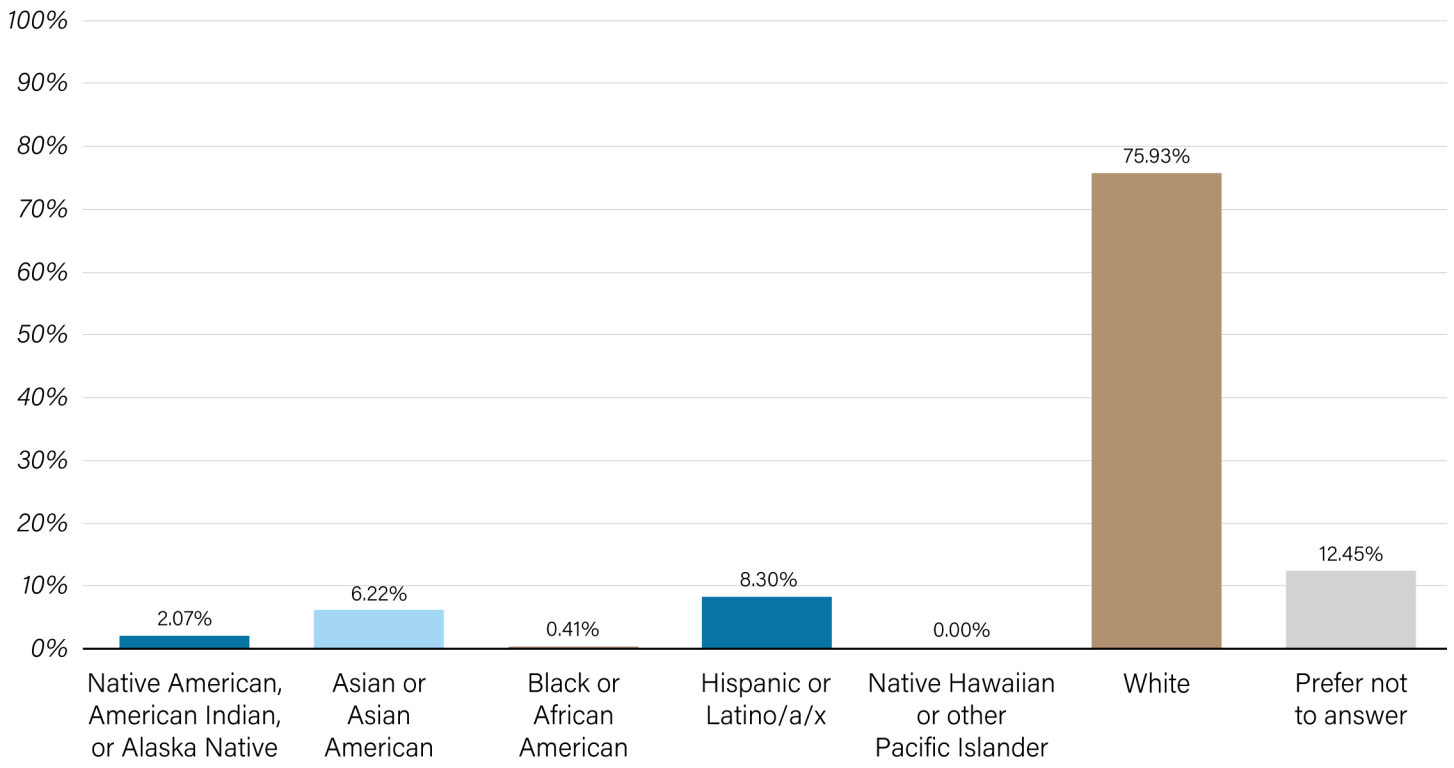
Answered | 3 Skipped | 0



Answered | 240
Skipped | 0

Within these categories, where do you place your racial or ethnic identity? (Select all that apply.)

Q24

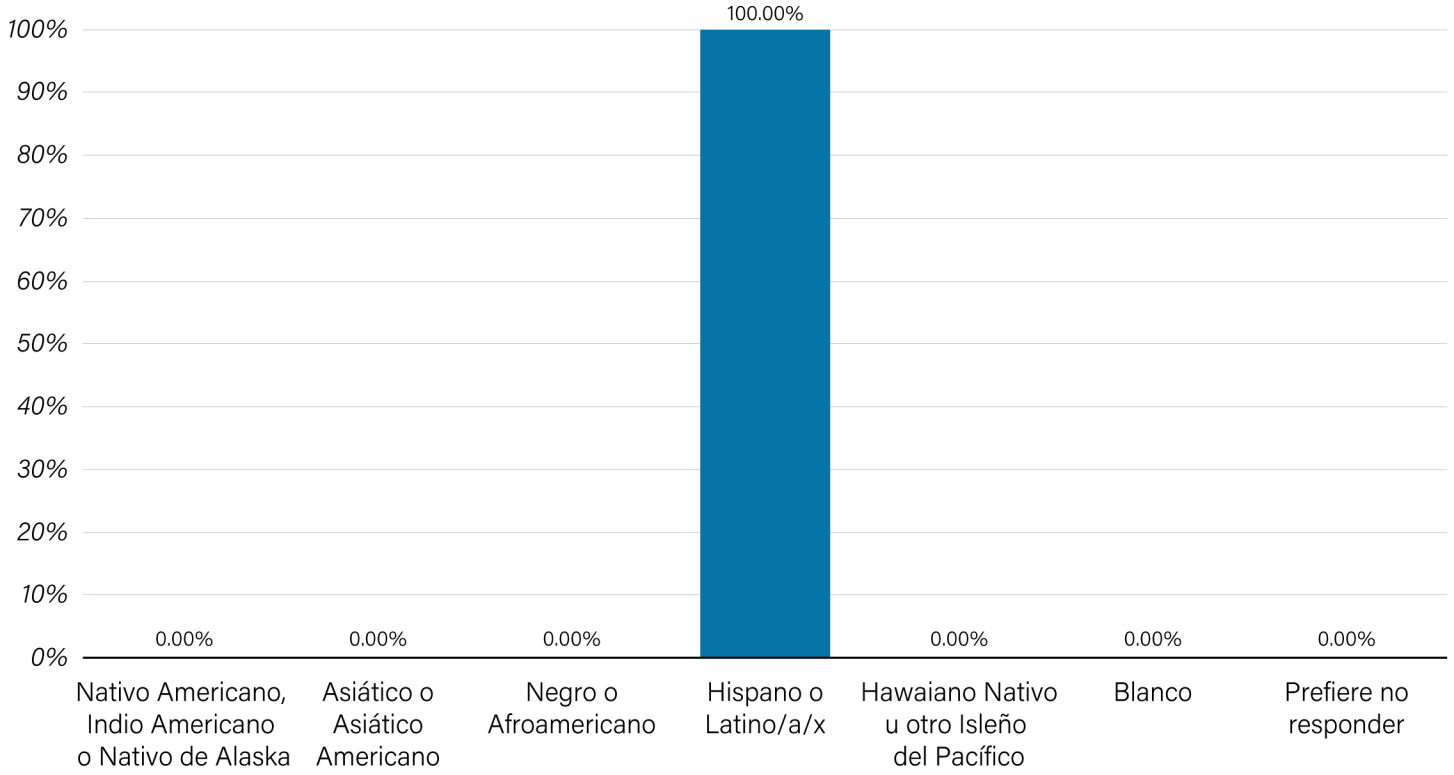


#	OTHER (PLEASE SPECIFY)
1	Middle Eastern
2	Mixed American melting pot
3	European Mutt
4	Slavic / Middle Eastern
5	My category is not listed :(
6	Human

Answered | 3
Skipped | 0

Dentro de estas categorías, ¿dónde colocas tu identidad racial o étnica? (Seleccione todo lo que corresponda.)

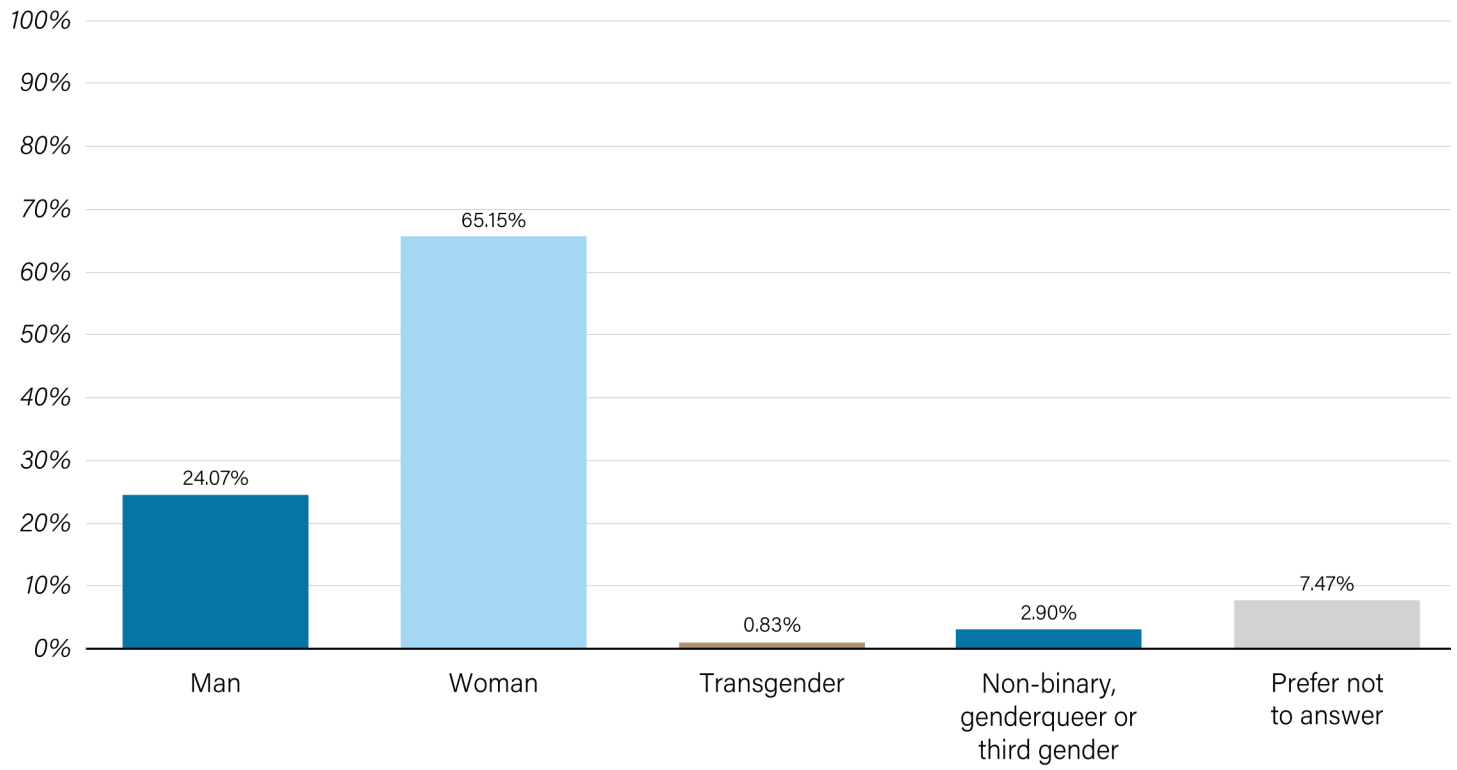
Q24



How do you identify your gender? (Select all that apply.)

Answered | 240 Skipped | 0

Q25

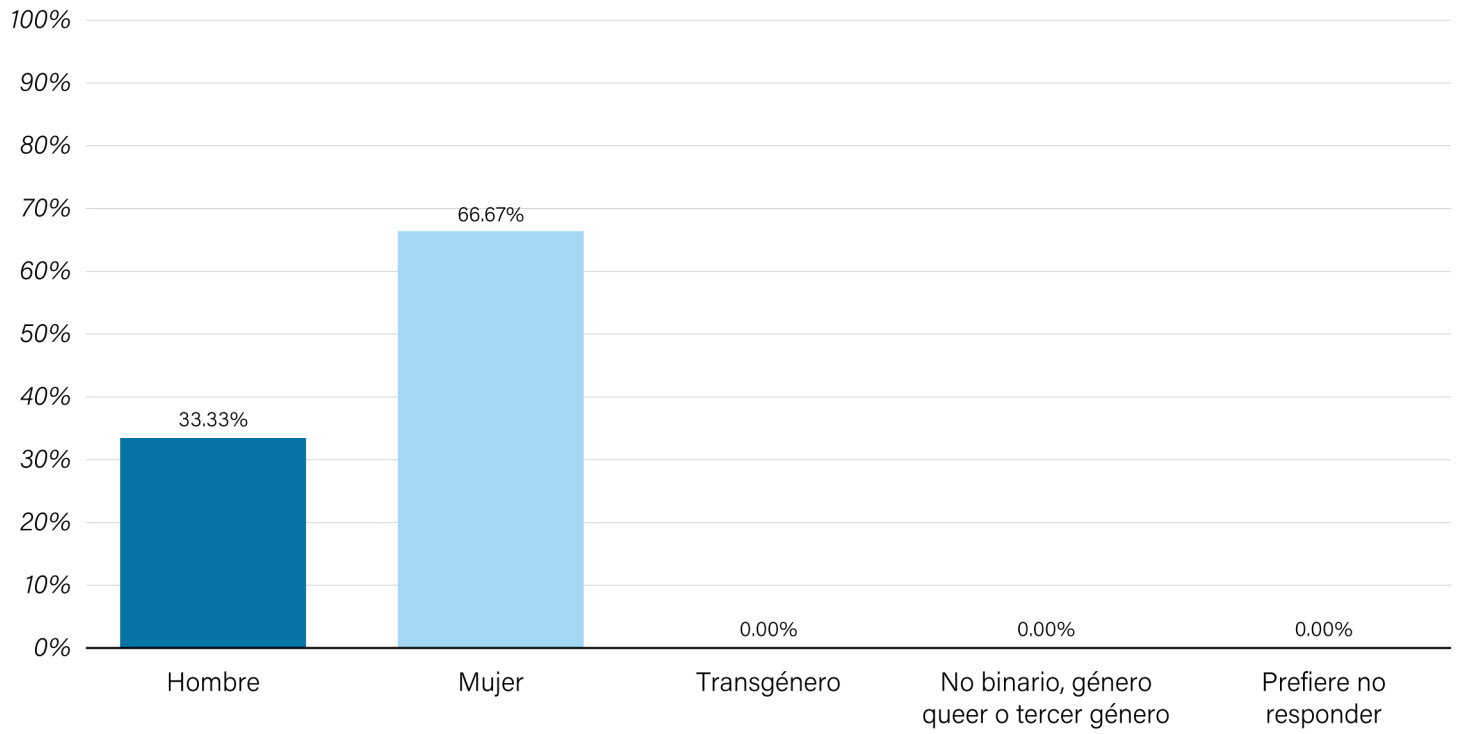


#	A GENDER NOT LISTED ABOVE (PLEASE DESCRIBE)
1	Man or woman
2	Do not lump transgender. Trans men and trans women have VERY different experiences and genders. And, are you not going to ask about sexuality/LGB+ identity?

¿Cómo identificas tu género? (Seleccione todo lo que corresponda.)

Answered | 3 Skipped | 0

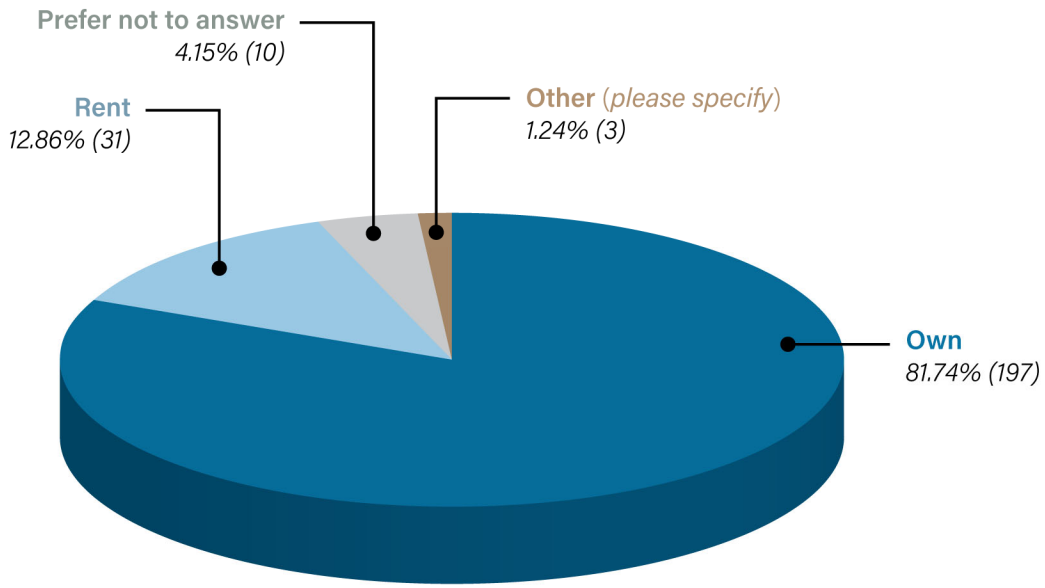
Q25



Answered | 240
Skipped | 0

If you live within Washington County, what is your housing status?

Q26

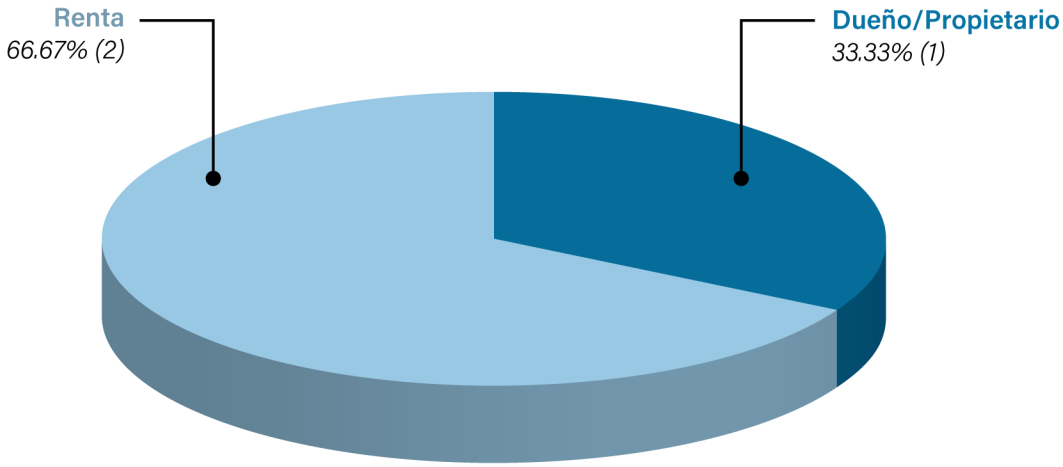


#	OTHER (PLEASE SPECIFY)
1	Disabled. Living with parents, otherwise I'd be homeless.
2	Occupy home owned by family member, but no rent paid.
3	Own in Condo Community.

Answered | 3
Skipped | 0

Si vive dentro del condado de Washington, ¿cuál es su estado de vivienda?

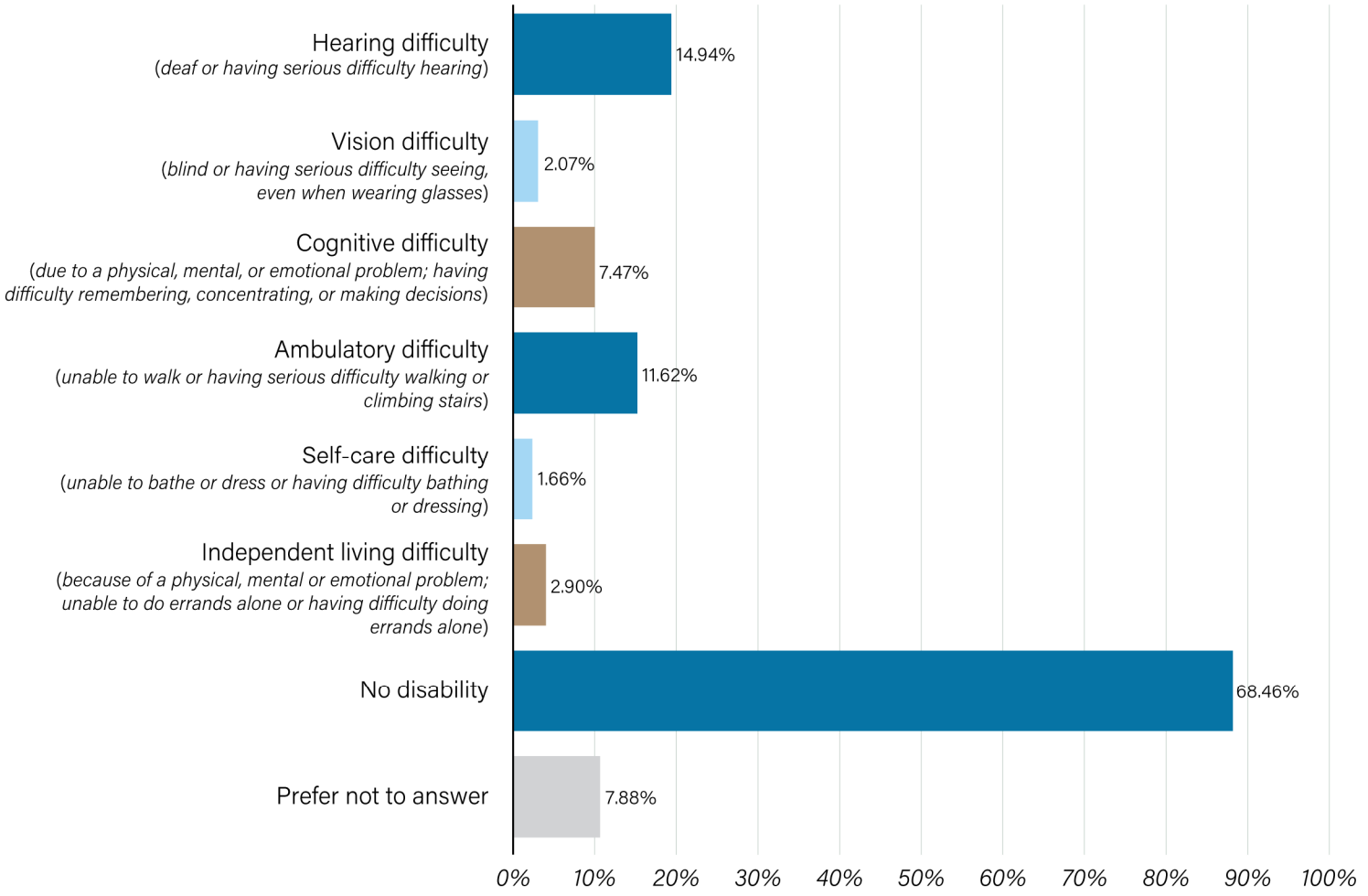
Q26



Answered | **240**
Skipped | **0**

Do you or someone living in the household have one or more of the following disabilities that should be considered in mitigation planning projects, such as for mobility access or evacuation alerts?
(Select all that apply.)

Q27



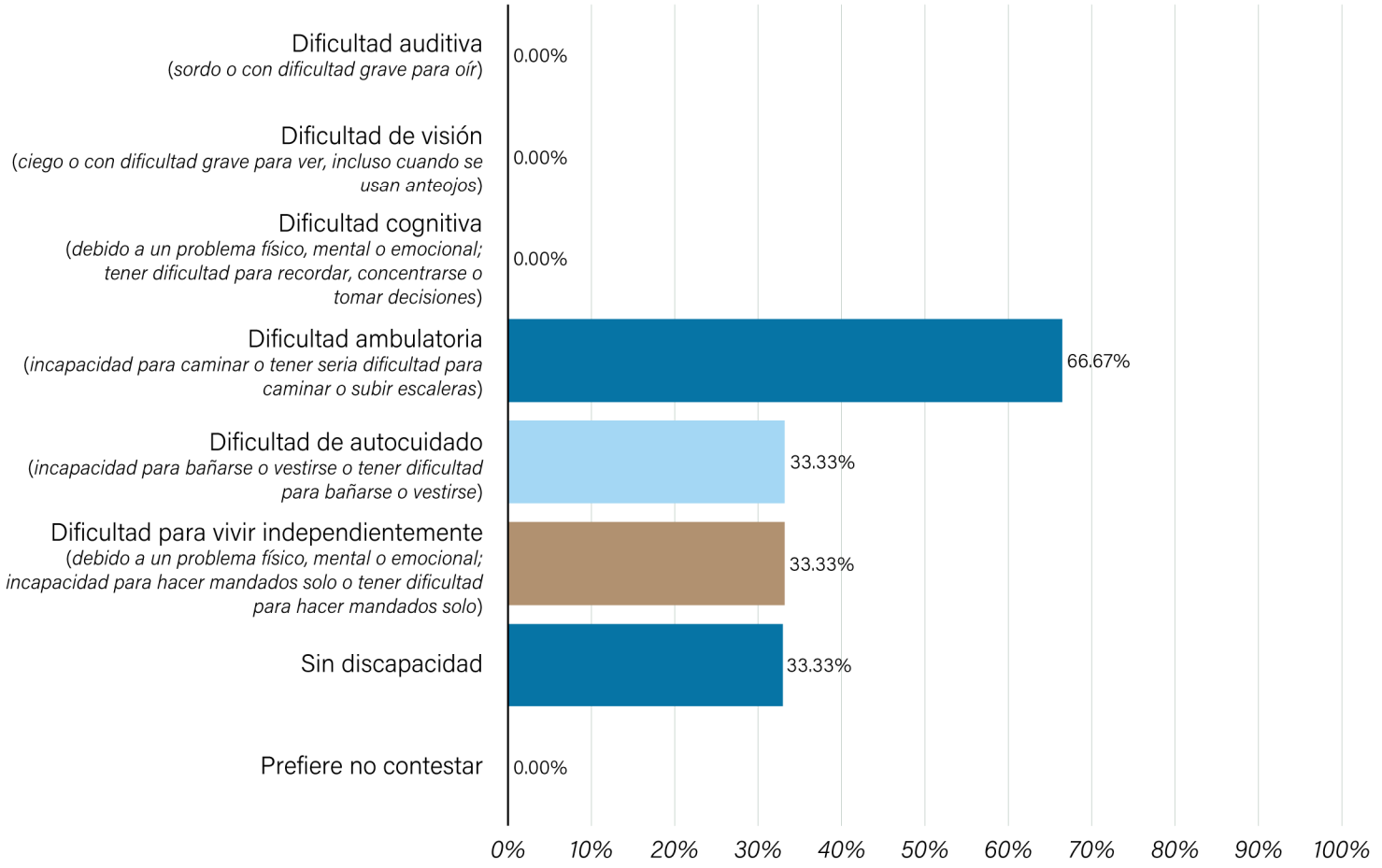
#	A DISABILITY NOT LISTED ABOVE (PLEASE DESCRIBE)
1	PTSD (post-traumatic stress disorder)
2	Some hearing loss
3	Epilepsy; scheduled drugs—cannot get more than one month at a time. I know that pharmacies don't fall under disaster mitigation, but is there a plan for getting meds out to people?
4	Asthma from poor air quality
5	Complex post-traumatic stress disorder
6	Physical disability, difficulty walking
7	Difficult to walk or climb stairs without cane, but not impossible
8	Permanent loss of sense of smell

Answered | 3
Skipped | 0

¿Usted o alguien que vive en el hogar tiene una o más de las siguientes discapacidades que deben considerarse en los proyectos de planificación de mitigación, como para el acceso a la movilidad o las alertas de evacuación?

(Seleccione todo lo que corresponda.)

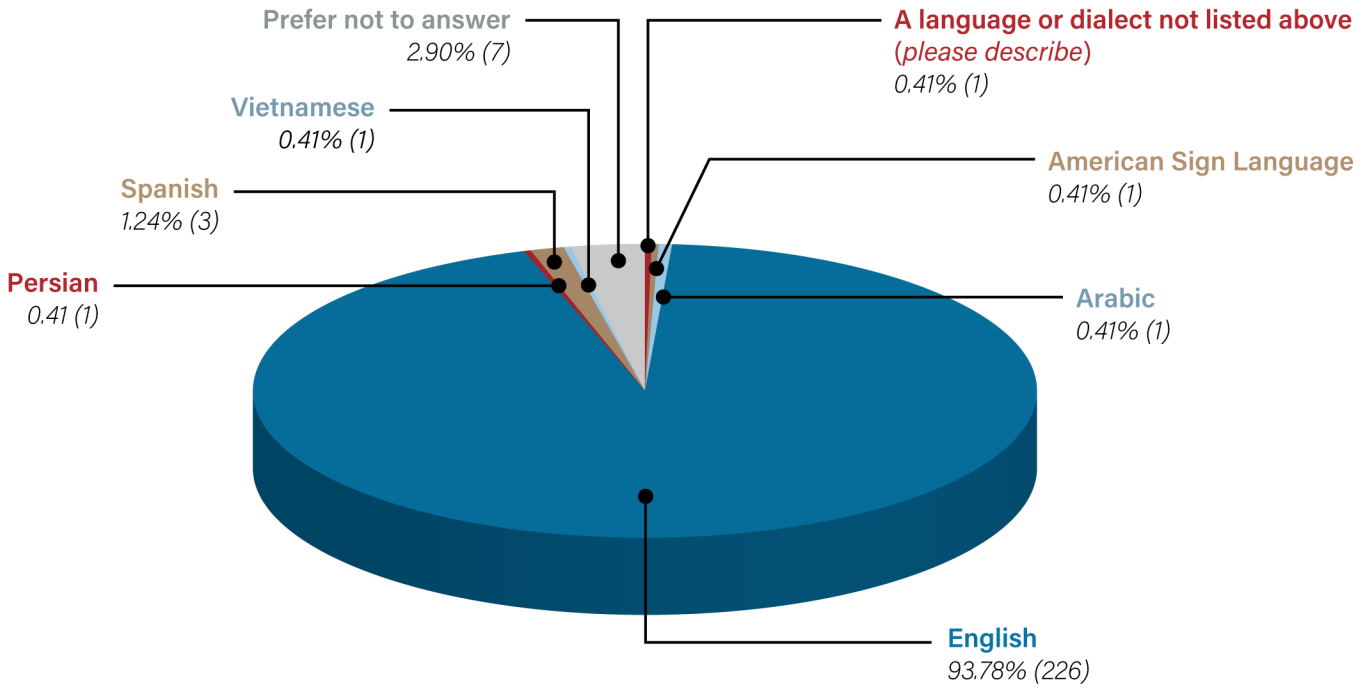
Q27



What language or dialect is used most in your home?

Q28

Answered | 240 Skipped | 0

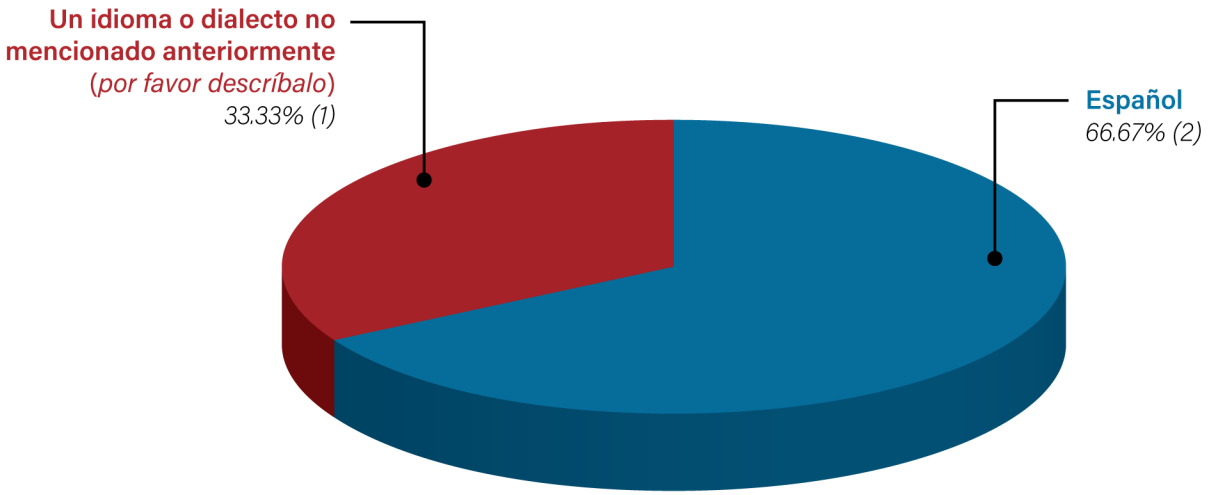


#	A LANGUAGE OR DIALECT NOT LISTED ABOVE (PLEASE DESCRIBE)
1	German

¿Qué idioma o dialecto se usa más en su hogar?

Answered | 3 Skipped | 0

Q28

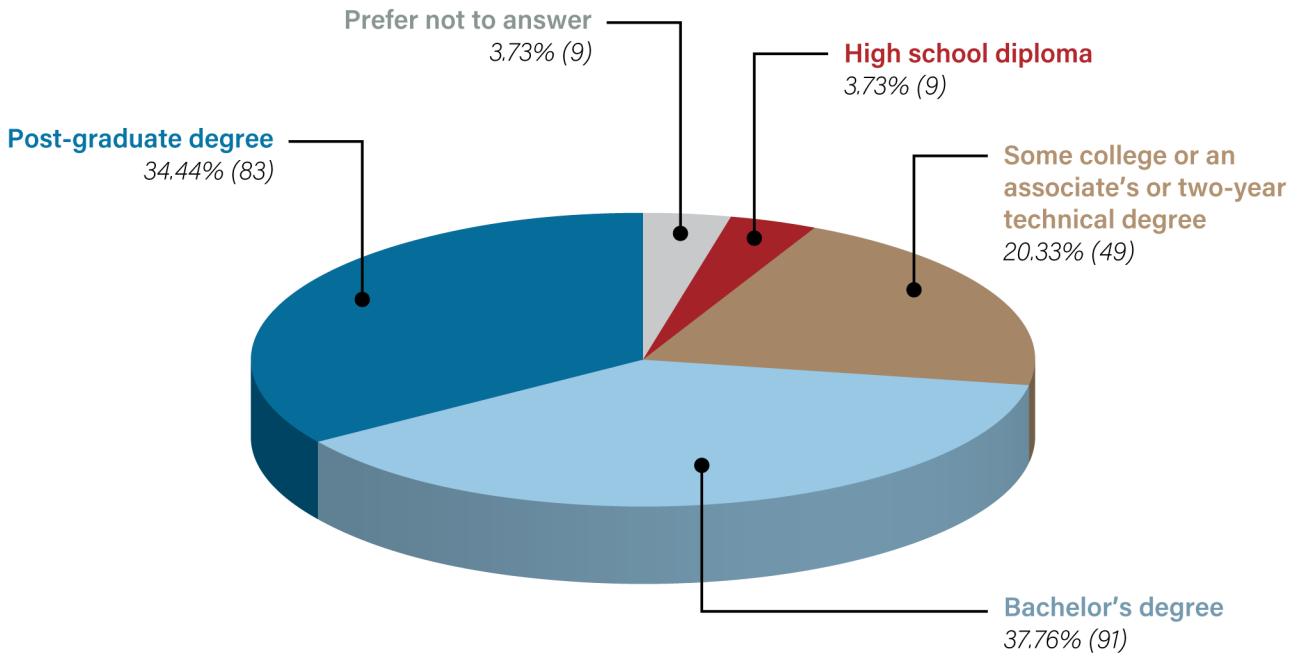


#	RESPUESTAS
1	Mixteco y Español (Mixtec and Spanish)

What is your education experience?

Q29

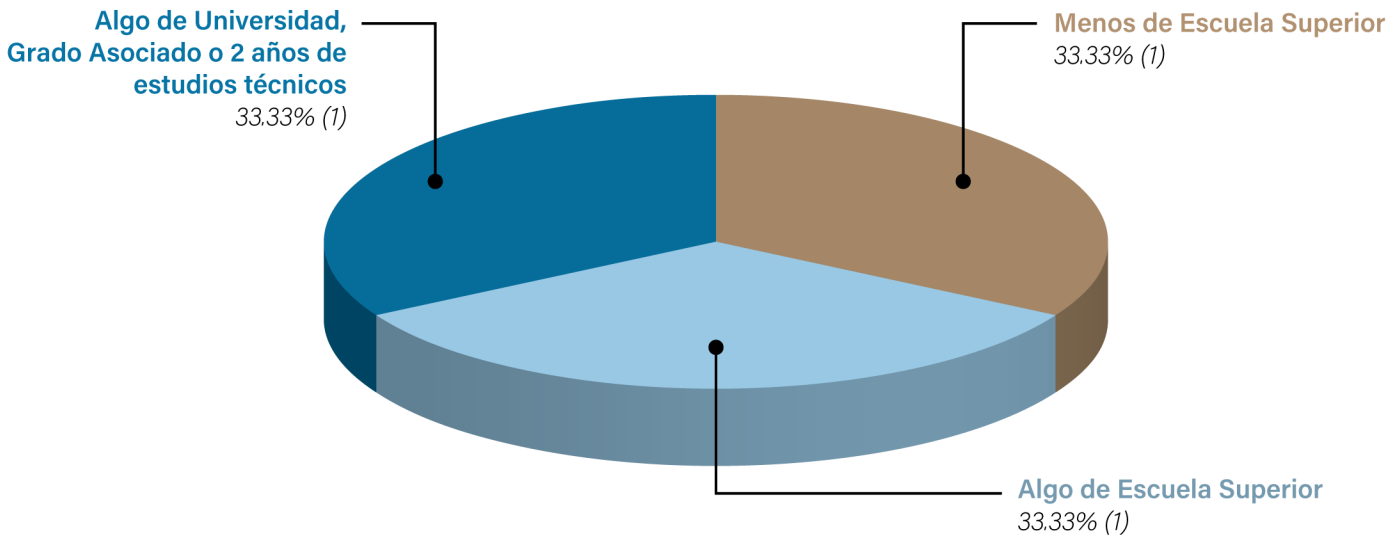
Answered | 240 Skipped | 0



¿Cuál es su experiencia educativa?

Q29

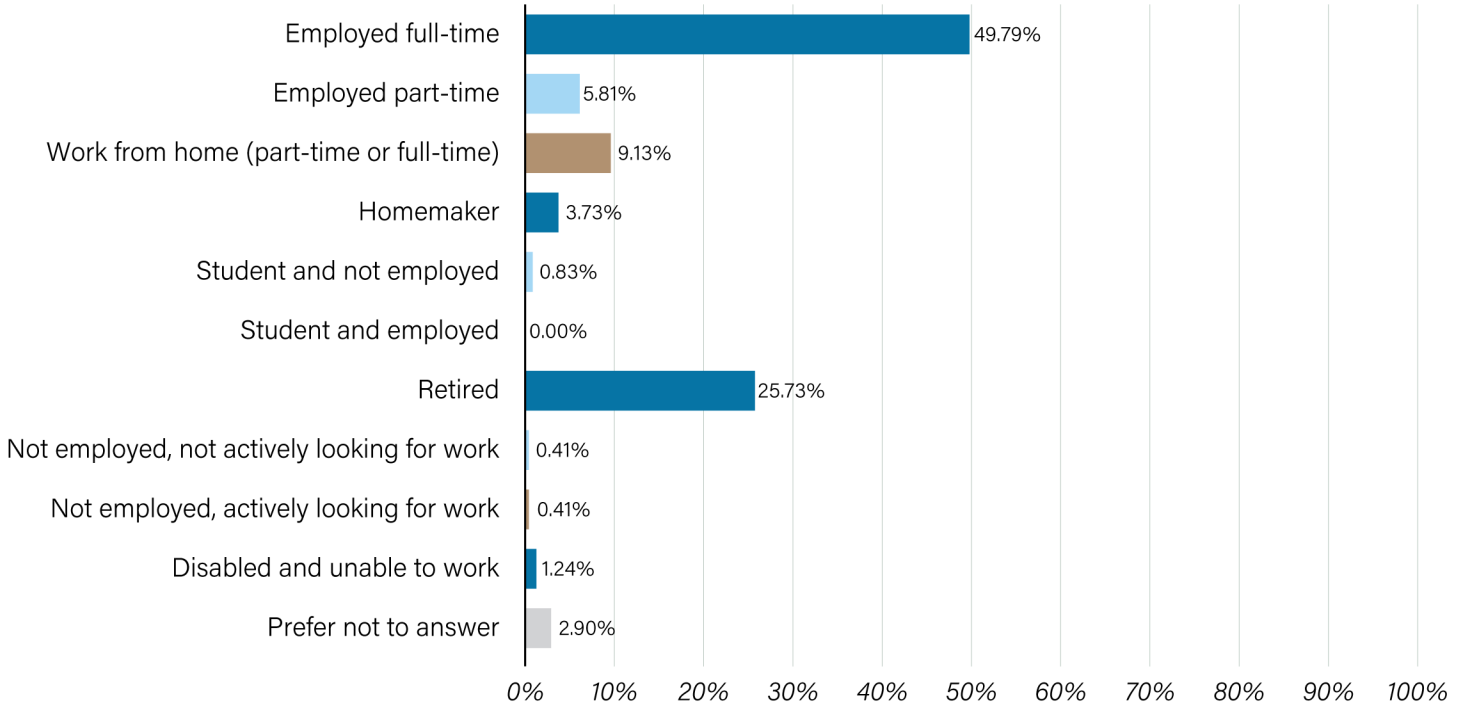
Answered | 3 Skipped | 0



Answered | **240**
Skipped | **0**

Which of the following best describes your current employment status?

Q30

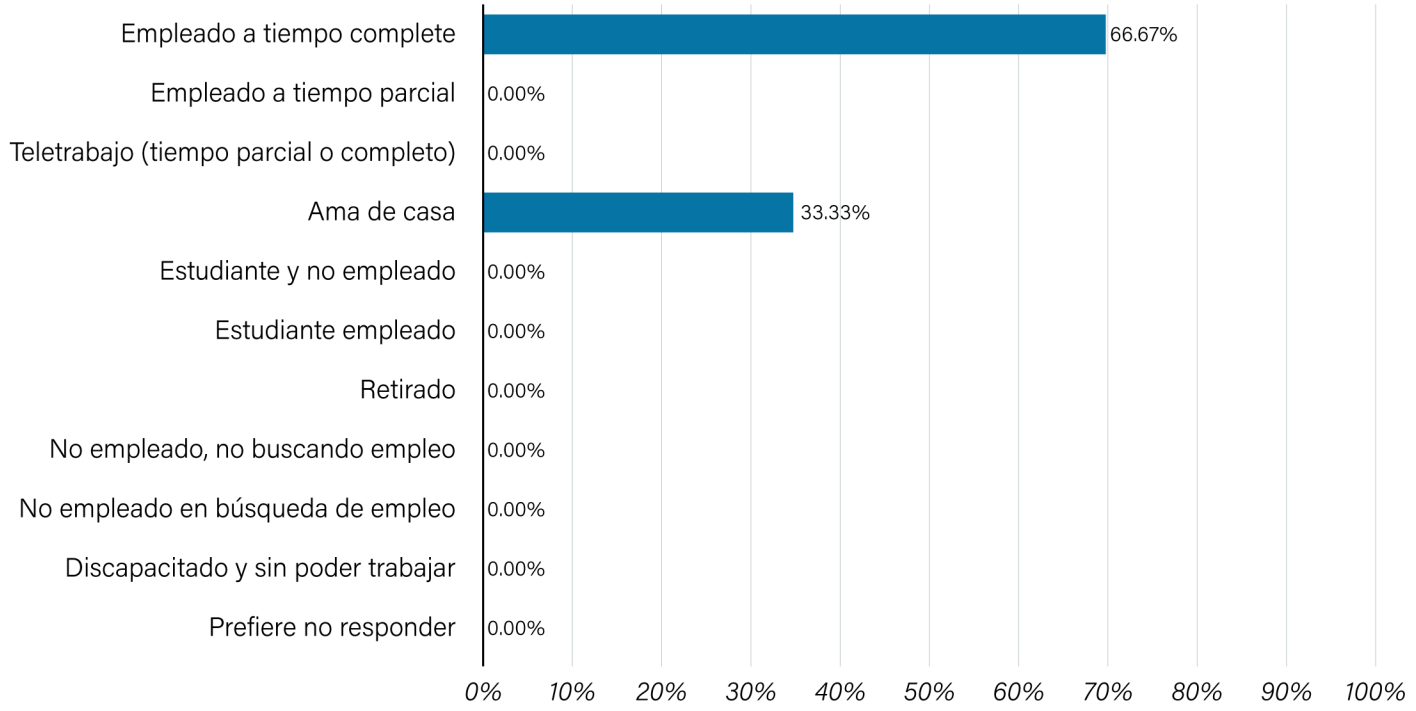


#	OTHER (PLEASE DESCRIBE)
1	Question 30 didn't have an "other option button" so I guess I have to click a button which will not be true. Also, add “Self-Employed.” (How is that not on your list??!!!)
2	Self-employed
3	Semi-retired
4	Hybrid work environment. Half week in office, half at home
5	Filbert orchard owner
6	Self-employed

Answered | 3
Skipped | 0

¿Cuál de las siguientes opciones describe mejor su situación laboral actual?

Q30



Q31. To which zip code do you travel to for school? If this is not applicable, please type N/A.

Answered: 240 Skipped: 0

ZIP CODE	NUMBER OF RESPONSES
97005	2
97006	2
97078	1
97116	2
97123	1
97124	2
97140	1
97207	1
97229	1
97330	1
97123, 97124	1
N/A	223
Pcc	1
Uncertain	1

Q31. ¿A qué código postal viajas para la escuela? Si esto no es aplicable, escriba N/A.

Answered: 3 Skipped: 0

EL CÓDIGO POSTAL	NÚMERO DE RESPUESTAS
N/A	3

Q32. To which zip code do you travel to for work? If this is not applicable, please type N/A.

Answered: 240 Skipped: 0

ZIP CODE	NUMBER OF RESPONSES
97003	2
97005	9
97006	4
97007	1
97008	6
97032	1
97035	2
97040	1
97062	4
97068	1
97070	2
97076	2
97113	1
97116	3
97123	14
97124	30
97140	3
97202	1
97204	2
97205	2
97207	1
97208	1
97209	3
97223	3

ZIP CODE	NUMBER OF RESPONSES
97224	5
97225	1
97230	1
97232	2
97266	2
97305	1
98683	1
Business is at home	1
Hillsboro?	1
N/A	129

Q32 ¿A qué código postal viajas por trabajo? Si esto no es aplicable, escriba N/A.

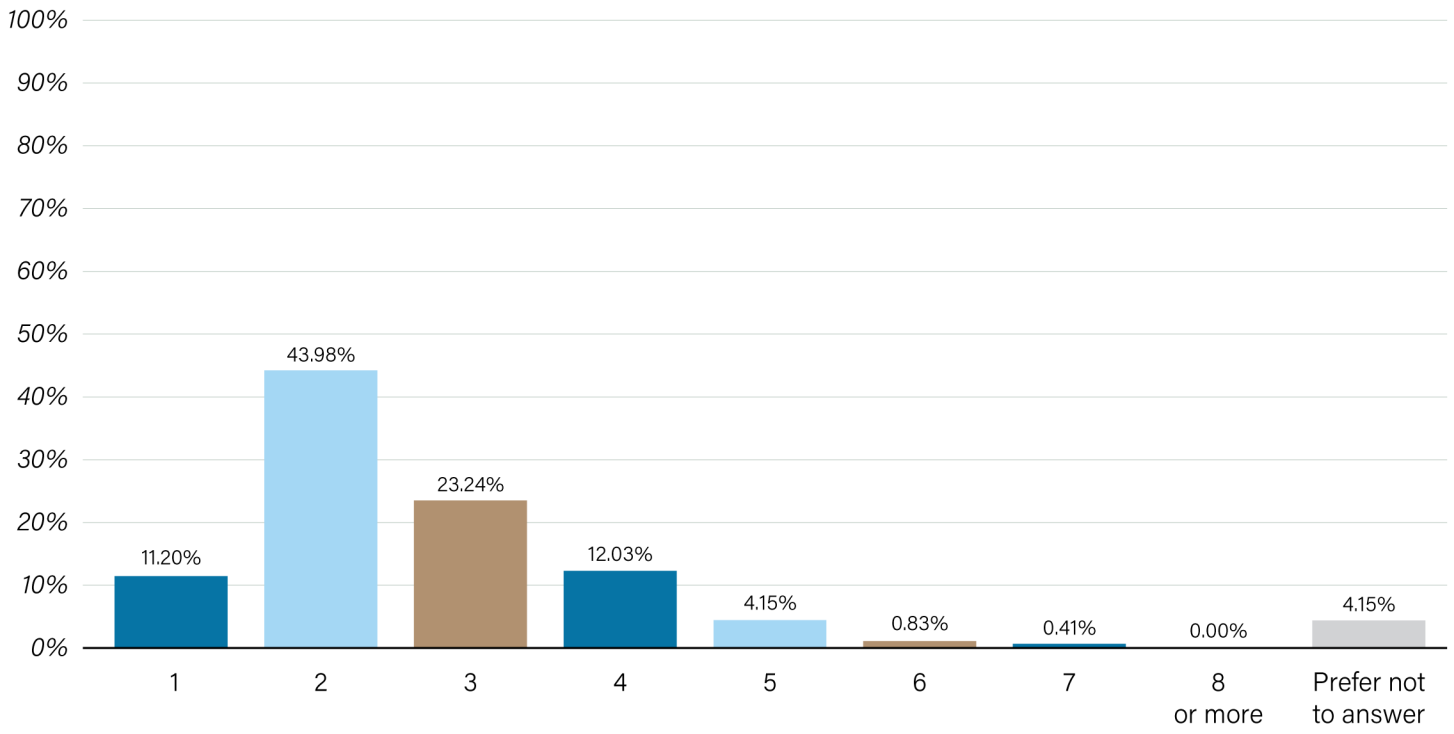
Answered: 3 Skipped: 0

CÓDIGO POSTAL	NÚMERO DE RESPUESTAS
97113	1
N/A	2

Including yourself, how many people live in your household?

Q33

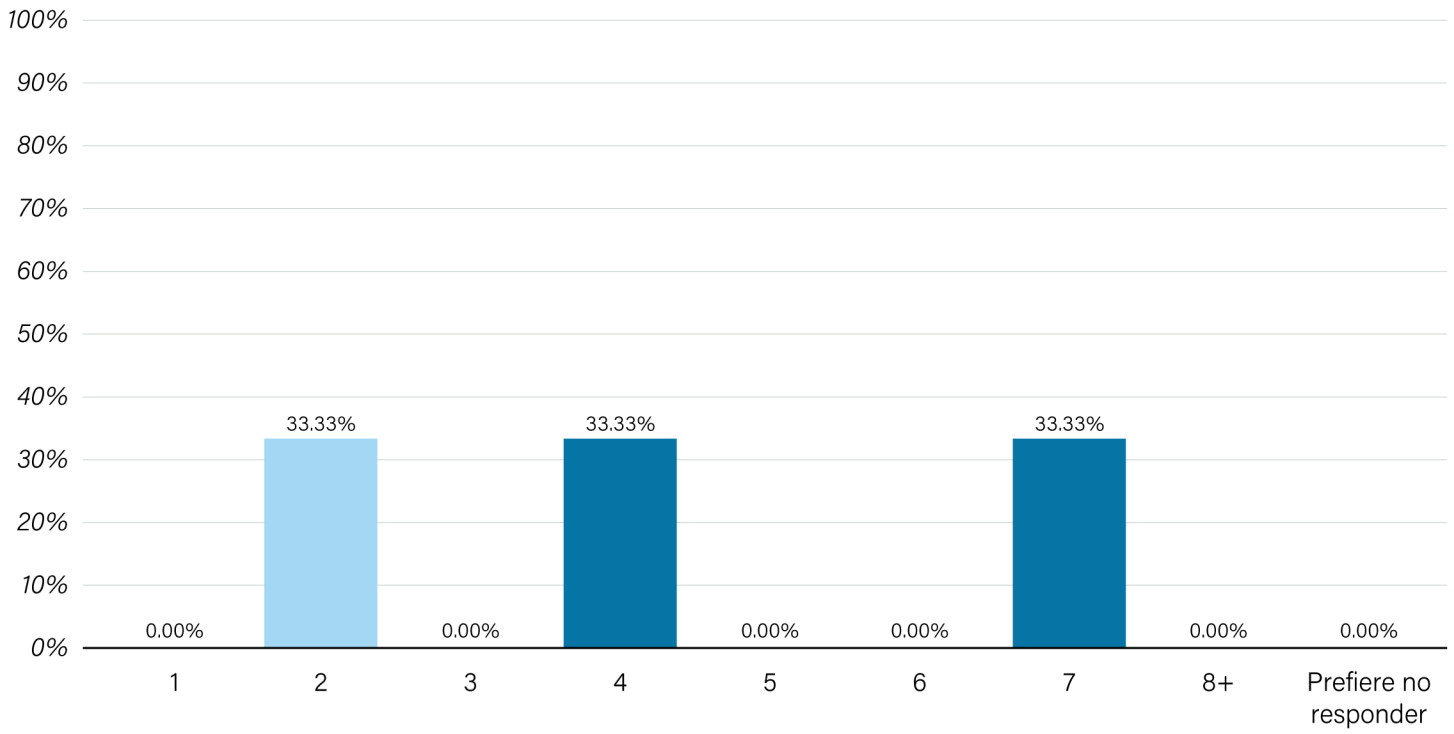
Answered | 240 Skipped | 0



Incluyéndote a ti mismo, ¿cuántas personas viven en tu hogar?

Answered | 3 Skipped | 0

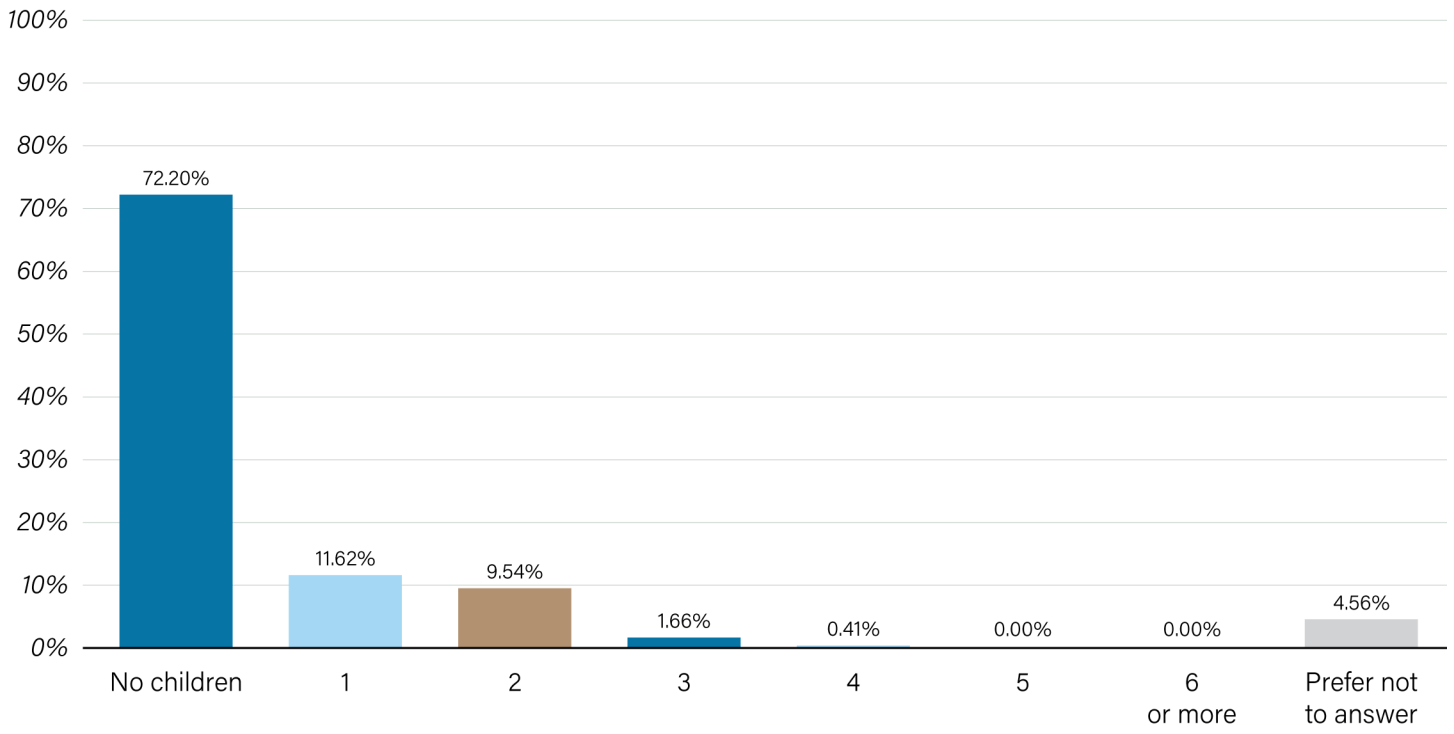
Q33



How many children under the age of 18 live in your household?

Q34

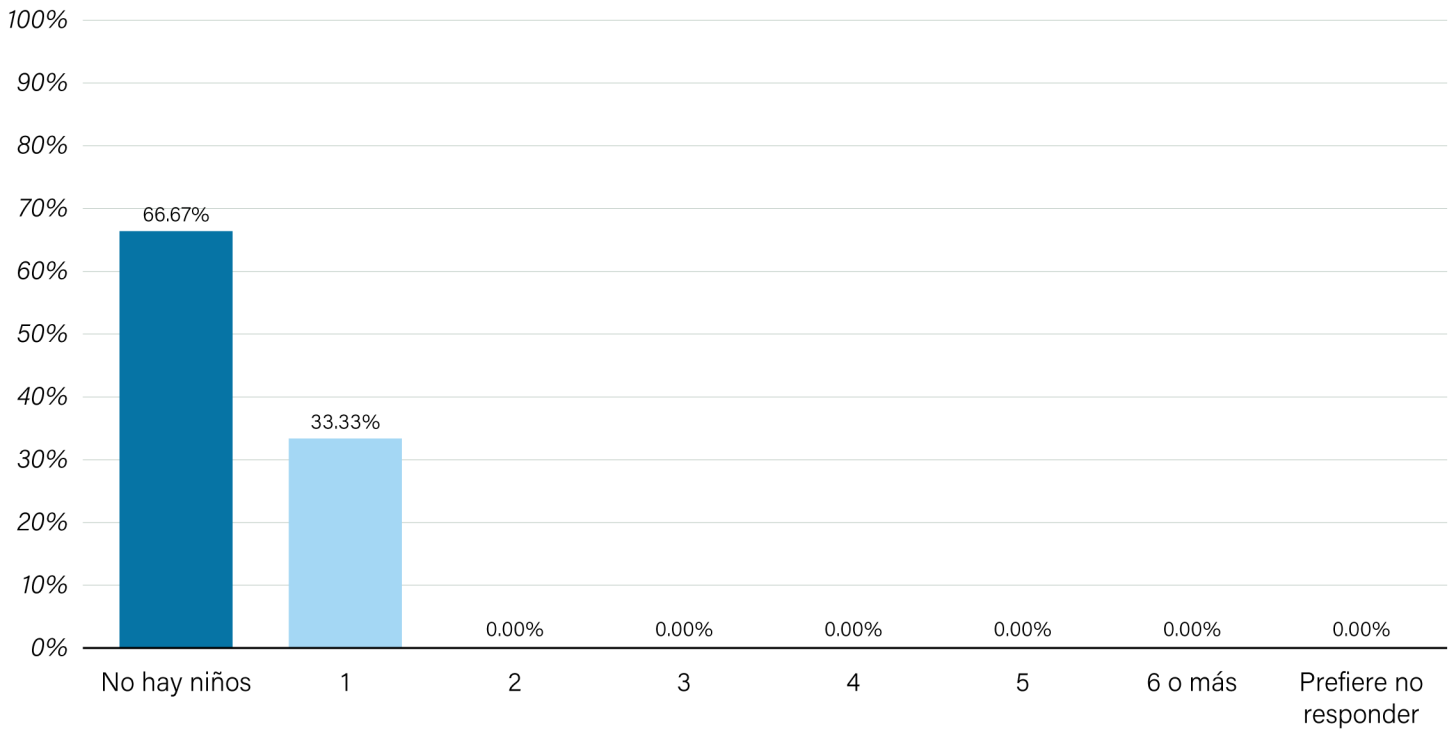
Answered | 240 Skipped | 0



¿Cuántos niños menores de 18 años viven en su hogar?

Q34

Answered | 3 Skipped | 0



Q35. Would you like to receive updates on mitigation projects and information? If so, please provide your email address.

Answered: 108 Skipped: 132

Q35. ¿Le gustaría recibir actualizaciones sobre proyectos de mitigación e información? Si es así, proporcione su dirección de correo electrónico.

Answered: 3 Skipped: 0

Answers are being kept on file but will not be published.

1.3.5. Draft NHMP Comment Form

A total of 16 responses to the comment form posted with the draft NHMP were received from February 3, 2023, to March 5, 2023. The comment form is below in its entirety with questions and answer choices.[2]

Natural Hazard Mitigation Plan Comment Form

1. Based on the summary, do you agree that the County and other jurisdictions are taking reasonable steps to identify natural hazards and for lessening how they may impact the community? (The answer option was an open text field.)
2. Does the summary address the natural hazards in the County you are concerned with? (The answer option was an open text field.)
3. Are you aware of any natural hazard events that have happened in the County that are not listed? (The answer option was an open text field.)
4. Do you know where to find and read the hazard mitigation plan? ((The answer option was an open text field.)
5. How might you use the information in this plan in your daily life(The answer option was an open text field.)

The next few questions ask about different types of people in the community. We want to know if different groups in our community are being heard. We encourage you to answer these questions, but if you prefer not to, please select "prefer not to answer."

6. Did you participate earlier this year in completing a survey about this project (the NHMP Public Survey)?
   a. Yes
   b. No
   c. Not sure/don't remember
   d. Prefer not to answer

7. Where do you live?
   a. Unincorporated Washington County (such as areas like Cherry Grove, Garden Home, Bethany, etc., and rural areas)
   b. City of Beaverton
   c. City of Cornelius
   d. City of Forest Grove
   e. City of Hillsboro
   f. City of North Plains
   g. City of Sherwood
   h. City of Tigard
   i. Other (please specify)
   j. Prefer not to answer

8. Do you live within any of these Special Districts? (Mark all that apply.)
   a. Clean Water Services
   b. Tualatin Valley Water District
   c. Tualatin Hills Parks and Recreation District
   d. No, I do not live within any of the above Special Districts
   e. Prefer not to answer

9. What zip code do you live in? If you prefer not to answer, please type N/A. (The answer option was an open text field.)

[2] The comment form replicated in this plan includes minor edits to language and format.

10. Which of the following includes your age?
    a. Under 18
    b. 18–24
    c. 25–34
    d. 35–44
    e. 45–54
    f. 55–64
    g. 65–74
    h. 75 or older
    i. Prefer not to answer

11. Within these categories, where do you place your racial or ethnic identity? (Select all that apply.)
    a. Native American, American Indian, or Alaska Native
    b. Asian or Asian American
    c. Black or African American
    d. Hispanic or Latino/a/x
    e. Native Hawaiian or other Pacific Islander
    f. Caucasian
    g. Prefer not to answer
    h. Other (please specify)

12. How do you identify your gender? (Select all that apply.)
    a. Man
    b. Woman
    c. Transgender
    d. Non-binary, genderqueer, or third gender
    e. Prefer not to answer
    f. A gender not listed above (please describe)

13. If you live within Washington County, what is your housing status?
    a. Own
    b. Rent
    c. Currently houseless
    d. Prefer not to answer
    e. Other (please specify)

14. Do you or someone living in the household have one or more of the following disabilities that should be considered in mitigation planning projects, such as for mobility access or evacuation alerts? (Select all that apply.)
    a. Hearing difficulty (deaf or having serious difficulty hearing).
    b. Vision difficulty (blind or having serious difficulty seeing, even when wearing glasses).
    c. Cognitive difficulty (due to a physical, mental, or emotional problem; having difficulty remembering, concentrating, or making decisions).
    d. Ambulatory difficulty (unable to walk or having serious difficulty walking or climbing stairs).
    e. Self-care difficulty (unable to bathe or dress or having difficulty bathing or dressing).
    f. Independent living difficulty (because of a physical, mental, or emotional problem; unable to do errands alone or having difficulty doing errands alone).
    g. No disability.
    h. Prefer not to answer.
    i. A disability not listed above (please describe)

15. What language or dialect is used most in your home?
    a. American Sign Language
    b. Arabic
    c. Cantonese
    d. Chuukese
    e. English
    f. Japanese

g. Karen
h. Korean
i. Mandarin
j. Mon-Khmer
k. Nepali
l. Persian
m. Romanian
n. Russian
o. Somali
p. Spanish
q. Tagalog
r. Ukrainian
s. Vietnamese
t. Prefer not to answer
u. A language or dialect not listed above (please describe)

16. What is your education experience?
    a. Less than high school
    b. Some high school
    c. High school diploma
    d. Some college or an associate's or two-year technical degree
    e. Bachelor's
    f. Post-graduate
    g. Prefer not to answer
    h. Other (please describe)

17. Which of the following best describes your current employment status?
    a. Employed full-time
    b. Employed part-time
    c. Work from home (part-time or full-time)
    d. Homemaker
    e. Self-employed
    f. Student and not employed
    g. Student and employed
    h. Retired
    i. Not employed, not actively looking to work
    j. Not employed, actively looking for work
    k. Disabled and unable to work
    l. Prefer not to answer
    m. Other (please describe)

18. To which zip code do you travel to for school? If this is not applicable, please type N/A. (Answer option was an open text field).

19. To which zip code do you travel to for work? If this is not applicable, please type N/A. (Answer option was an open text field).

20. Including yourself, how many people live in your household?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5
    f. 6
    g. 7
    h. 8 or more
    i. Prefer not to answer

21. How many children under the age of 18 live in your household?
    a. No children
    b. 1
    c. 2
    d. 3
    e. 4
    f. 5
    g. 6 or more
    h. Prefer not to answer

22. Would you like to receive updates on mitigation projects and information? If so, please provide your email address. (The answer option was an open text field.)

1.3.6. Existing Data and Plans

Existing hazard mitigation information, data and studies, NHMPs, and relevant reports and technical information were reviewed during the development of this plan. Data was gathered through numerous sources, including geographic information systems (GIS) and the Oregon Department of Geology and Mineral Industries (DOGAMI).

The intent of reviewing existing material was to identify existing data and information, shared objectives, and past and ongoing activities that could help inform the mitigation plan. It also helped identify the existing capabilities and planning mechanisms to implement the mitigation strategy. The documents and data used are cited throughout the NHMP.

1.4. Planning Workshops and Meetings

Workshops and one-on-one meetings were held so plan participants could be involved and have ample opportunity to provide input on the plan. Twelve meetings or workshops were held for all plan participants and at least one representative from each participating jurisdiction or special district attended to actively engage in discussions. Meeting and workshop documentation is on file at the Washington County Office of Emergency Management.

All meetings were held virtually, and a virtual engagement plan was created and approved by Washington County, OEM, and FEMA. The engagement plan framework detailed the outreach strategy used throughout the planning process, including with planning participants. The engagement plan implemented meets FEMA requirements outlined in Code of Federal Regulations (CFR) Title 44, Part 201.6 (44 CFR §201.6), including requirements §201.6(b)(1) and (2), as outlined in Section 4.1 of the *Local Mitigation Plan Review Guide.*"[3]

Table 4: Planning Workshops

Date	Meeting or Workshop	Discussion Topics
January 21, 2022	Initial Project Management Meeting with Washington County	• Introductions of project staff • Project phases and proposed workshop schedule • Administration and logistics

[3] Federal Emergency Management Agency. (2011, October 1). *Local Mitigation Plan Review Guide.* https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-plan-review-guide_09_30_2011.pdf

Date	Meeting or Workshop	Discussion Topics
February 10, 2022	NHMP Kick-Off Workshop	• Mitigation overview • Intent of plan update • Plan participants • Hazards covered • Planning expectations • Planning roles and responsibilities • Planning documents • Project phases • Proposed outline • Use of SharePoint
March 10, 2022	Risk Assessment Workshop 1	• Risk assessment overview • Significant natural hazard events • Significant infrastructure, facilities, and resources • Hazard information • Risk ranking • Planning documents
April 14, 2022	Risk Assessment Workshop 2	• Project timeline • Hazard analysis/risk ranking • Hazard Analysis Methodology presentation by Joseph Murray, Planner, OEM • Public engagement strategy • Stakeholder engagement • GIS component of the NHMP
May 12, 2022	GIS Strategy Workshop	• NHMP overview • Hazards covered • Feedback from 2017 NHMP • Workshop goals • Maps and analysis • Data collection • DOGAMI report
May 18, 2022	Public Engagement Strategy Workshop 1	• NHMP overview • Hazards covered • Workshop goals • Feedback from 2017 NHMP • Updated FEMA guidance • What do you want to know? • Who do you want to reach out to? • How do you want to reach out? • Documentation requirement • Next steps
May 23, 2022	OEM Hazard Analysis Worksheet Workshop	• Review of terminology • Prioritization • FEMA and OEM requirements • Intent of scoring and ranking • Using common scores for countywide hazards

Date	Meeting or Workshop	Discussion Topics
May 27, 2022	Mitigation Strategy Workshop 1	• Mitigation strategy overview • 2017 mitigation mission • Mitigation goals • Capability assessment • NFIP survey • Incorporation into existing plans and procedures • Review of previous action items
June 3, 2022	Public Engagement Strategy Workshop 2	• Workshop goals • What do you want to know? • Who do you want to reach out to? • How do you want to reach out? • Documentation requirement • Continued public engagement
June 23, 2022	Mitigation Strategy Workshop 2	• Stakeholder engagement • Mitigation strategy • New action items • Potential funding sources • Action item prioritization • Mitigation project successes
July 26, 2022	Stakeholder Engagement and Education Workshop	• Stakeholder engagement • Mitigation strategy • New action items • Potential funding sources • Action item prioritization • Mitigation project successes
September 27, 2022	NHMP Implementation and Maintenance Process Workshop	• NHMP implementation • Monitoring and evaluating NHMP • NHMP maintenance • NHMP adoption

In addition to workshops, one-on-one planning meetings were held with plan participants throughout the planning process. Thirty-five individual meetings were held with plan participants to gather information and to provide guidance for the jurisdictions throughout the planning stages. Additionally, two meetings were held with Tualatin Valley Fire & Rescue, an NHMP external stakeholder, to collect data and information about wildfires and high-water rescues.

Table 5: Plan Participant Meetings

Date	Participant	Discussion Topic(s)
March 10, 2022	Tualatin Valley Water District	• How the Willamette Water Supply Program fits into the NHMP
March 11, 2022	Washington County	• GIS strategy for NHMP
March 23, 2022	Tualatin Valley Water District	• Planning process contacts • Phases of the planning process • Significant infrastructure, facilities, and resources

Date	Participant	Discussion Topic(s)
March 24, 2022	Tualatin Valley Water District	• Planning process contacts • Critical infrastructure • Critical customers
March 24, 2022	City of Tigard	• Significant hazard events • Significant infrastructure, facilities, and resources • Hazard information
April 5, 2022	Tualatin Valley Fire & Rescue	• Participation as an external stakeholder in the plan • Wildfire and high-water rescue data
April 5, 2022	Cities of Cornelius and Forest Grove	• Planning process phases • Significant hazard events • Significant infrastructure, facilities, and resources • Hazard information
April 6, 2022	Tualatin Valley Water District	• GIS information
April 7, 2022	City of Beaverton	• Planning process contacts • Significant hazard events • Significant infrastructure, facilities, and resources • Hazard information
April 29, 2022	Tualatin Valley Fire & Rescue	• Participation as an external stakeholder in the plan • Wildfire and high-water rescue data
May 6, 2022	Cities of Cornelius and Forest Grove	• Significant hazard events • Significant infrastructure, facilities, and resources • Hazard information
May 9, 2022	Tualatin Valley Water District	• Significant hazard events • Significant infrastructure, facilities, and resources • Hazard information • OEM Hazard Risk Analysis Worksheet
May 11, 2022	City of North Plains	• Significant hazard events • Significant infrastructure, facilities, and resources • Hazard information • OEM Hazard Risk Analysis Worksheet
June 28, 2022	Tualatin Valley Water District	• New action items • Tualatin Valley Water District Seismic Master Plan and America's Water Infrastructure Act of 2018 compliance
June 28, 2022	City of North Plains	• New action items
June 30, 2022	City of Sherwood	• Capabilities assessment • Implementation and integration plan • New action items

Date	Participant	Discussion Topic(s)
June 30, 2022	Tualatin Hills Park and Recreation District	• New action items
July 6, 2022	Cities of Cornelius and Forest Grove	• Capabilities assessment • Implementation and integration plan • New action items • Previous action items • Mitigation project successes
July 6, 2022	Washington County	• New action items
July 7, 2022	City of Hillsboro	• New action items
July 11, 2022	Tualatin Valley Water District	• New action items
July 12, 2022	Tualatin Valley Water District	• Planning documentation review • New action items
July 19, 2022	Tualatin Valley Water District	• New action items
July 20, 2022	City of Beaverton	• Capabilities assessment • Implementation and integration plan • New action items
August 10, 2022	Tualatin Valley Water District	• Information to include in participant annex and formatting details
August 30, 2022	City of Hillsboro	• Draft participant annex review
August 30, 2022	City of Tigard	• Planning documentation review
September 19, 2022	City of Hillsboro	• STAPLEE method for action item prioritization
October 12, 2022	City of Sherwood	• Draft participant annex review
October 14, 2022	Washington County	• First draft of participant annex review
October 18, 2022	City of Beaverton	• Draft participant annex review
October 18, 2022	City of North Plains	• Draft participant annex review
October 19, 2022	Tualatin Valley Water District	• Implementation and maintenance process
October 21, 2022	Cities of Cornelius and Forest Grove	• Draft participant annex review
October 21, 2022	Clean Water Services	• Draft participant annex review
October 26, 2022	Tualatin Hills Park and Recreation District	• Draft participant annex review
November 1, 2022	Washington County	• Second draft of participant annex review
November 30, 2022	Tualatin Valley Water District	• Discussed adding a Willamette Water Supply System-specific section to TVWD annex
December 14, 2022	Tualatin Valley Water District	• Final review of participant annex
December 16, 2022	Clean Water Services	• Review of participant annex

1.5. Summary of Changes to the NHMP

The 2023 NHMP is a comprehensive review and update of the 2017 Washington County NHMP and includes the addition of eight new participants. Changes to the plan's format and contents involved a multi-step process that included best practices research and an assessment of jurisdiction planning needs. Changes are included in plan sections, as applicable.

Table 6: Summary of Changes to the NHMP

Section(s)	Changes
All	• Eight new plan participants added. • Reorganized and streamlined. • Reformatted to be consistent with FEMA planning guidance. • Comprehensive review and update of all information and data. • Addition of maps and graphics. • Acronyms and abbreviations list added.
Volume I	
Executive Summary	• Renamed section from Plan Summary to Executive Summary. • Shortened to make more streamlined, per request of State Hazard Mitigation Officer. • Added release statement, record of distribution, and record of change. • Relocated plan adoption resolutions and FEMA's completed Local Mitigation Plan Review Tool to Appendix B.
Section 1: Introduction	• Shortened to make more streamlined, per request of State Hazard Mitigation Officer.
Section 2: Hazard Identification and Risk Assessment	• Detailed information on the OEM hazard analysis methodology included. • Dam failure, extreme heat, and wildfire smoke added as hazards impacting the planning area. • Disaster declarations expanded to include federal, state, and local declarations. • Summary table of participant hazard risk scores for all hazards added. • Information on characteristics, location, extent, history, probability of future events, vulnerabilities, and how climate change may impact frequency and severity added for all natural hazards in the planning area. • Updated all tables and figures to reflect current information. • Inclusion of additional maps and graphics showing hazard information. • Drought hazard profile expanded to include ecological drought, cascading hazards and impacts, and measure of drought extent. • Earthquake hazard profile expanded to include information about liquefaction and coseismic landslides. Information about the Portland Hills, Gales Creek, and Beaverton fault zones and Hazus®-MH event scenarios with damage data for these faults added to the hazard profile. • Flooding hazard profile expanded to include streambank and riverbed erosion and channel migration. • Volcano hazard profile streamlined to focus on volcanic ash. • Wildfire smoke impacts included in wildfire hazard profile. • Enhanced Fujita scale added to illustrate extent of tornados in windstorm, including tornado hazard profile.

Section(s)	Changes
Section 3: Mitigation Strategy	• Mitigation goals updated and expanded. • Description of STAPLEE evaluation criteria used for mitigation actions added. • Mitigation actions relocated to participant annexes.
Section 4: Plan Execution, Maintenance, and Adoption	• Expanded detail on plan monitoring, evaluating, and updating to include roles and responsibilities and description of specific methods and schedule.
Volume II	
Participant Annexes	• Reorganized into distinct sections and subsections. • Updated data and information incorporated into annexes for each participant. • Changes in development included for participants with previous mitigation plans. • Detailed information about critical facilities and infrastructure included. • Dam failure, extreme heat, and wildfire smoke added as hazards of planning significance. • Volcano hazard information streamlined to focus on volcanic ash. • Maps added, as applicable. • Information on vulnerabilities and how climate change may impact the frequency and severity of hazards included. • Updated capabilities assessments conducted for all participants. • Status of previous action items identified, as applicable. • Detailed action item planning worksheets for 2023 action items included in each annex.
Volume III	
Appendix A: Planning Area Profile	• Plan format reorganized. Appendix A became a Planning Area Profile (formerly Appendix C), and participant action items were relocated to participant annexes. • Data and information were updated.
Appendix B: Planning Process and Public Engagement	• Plan format reorganized. Participant action item status and changes relocated to participant annexes. • Detailed information about the planning process and public engagement included.
Appendix C: Implementation Resources and Funding Opportunities	• Plan format reorganized. Community Profile relocated to Appendix A and renamed Planning Area Profile. Appendix C now includes Implementation Resources and Funding Opportunities information for plan participants.

1.6. NHMP Approval Letter and Adoption Resolutions

The NHMP was approved by OEM on February 21, 2023, and by FEMA on March 17, 2023. Plan participants began the local adoption process soon after. The NHMP will remain valid for five years, until April 17, 2028.

Below is the FEMA approval letter and the adoption resolutions for NHMP participants. In addition to being in this appendix, a copy of each adoption resolution will be held on file at FEMA, OEM, and the Washington County Office of Emergency Management.

U.S. Department of Homeland Security
FEMA Region 10
130 228th Street, SW
Bothell, WA 98021-8627

FEMA

August 8, 2023

The Honorable Kathryn Harrington
At-Large Chair, Washington County Board of Commissioners
155 N. First Avenue
Hillsboro, Oregon 97124

Dear Commissioner Harrington:

On April 18, 2023, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10, approved the Washington County Natural Hazard Mitigation Plan as a multi-jurisdictional local plan as outlined in Code of Federal Regulations Title 44 Part 201. This approval provides the below jurisdictions eligibility to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's Hazard Mitigation Assistance grants projects through April 17, 2028, through your state:

Washington County	City of Hillsboro	City of Tigard
Tualatin Valley Water District	City of North Plains	City of Sherwood
Clean Water Services	Tualatin Hills Park and Recreation District	City of Beaverton

The updated list of approved jurisdictions includes the City of North Plains, City of Sherwood, Clean Water Services, Tualatin Hills Park and Recreation District, and the City of Beaverton that recently adopted the Washington County Natural Hazard Mitigation Plan. FEMA individually evaluates all application requests for funding according to the specific eligibility requirements of the applicable program. Though a specific mitigation activity or project identified in the plan may meet the eligibility requirements, it may not automatically receive approval for FEMA funding under any of the programs.

Approved mitigation plans may be eligible for points under the National Flood Insurance Program's Community Rating System. For additional information regarding the Community Rating System, please visit: www.fema.gov/national-flood-insurance-program-community-rating-system or contact your local floodplain manager.

Over the next five years, we encourage your communities to follow the plan's schedule for monitoring and updating, and to develop further mitigation actions. To continue eligibility, jurisdictions must review, revise as appropriate, and resubmit the plan within five years of the original approval date.

www.fema.gov

The Honorable Commissioner Harrington
August 8, 2023
Page 2

If you have questions regarding your plan's approval or FEMA's mitigation grant programs, please contact Joseph Murray, Planner with Oregon Office of Emergency Management, at (503) 378-2911, who coordinates and administers these efforts for local entities.

Sincerely,

Digitally signed by KRISTEN C MEYERS
Date: 2023.08.09 18:58:31 -06'00'

Kristen Meyers, Director
Mitigation Division

Enclosures

cc: Anna Feigum, Oregon Office of Emergency Management

EC:vl

1.7. Local Mitigation Plan Review Tool

The NHMP was reviewed by OEM and FEMA using FEMA's Local Mitigation Plan Review Tool.[4] This tool was used to evaluate how the plan meets 44 CFR §201.6 requirements and offers state and federal mitigation planners an opportunity to provide feedback.

Figure 67: Local Mitigation Plan Review Tool

FEMA REGION 10 LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to participating jurisdictions.

1. The Multi-Jurisdiction Summary Sheet is used to document how each jurisdiction met the requirements in the Plan.
2. The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
3. The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.

The FEMA Mitigation Planner must reference the *Local Mitigation Plan Review Guide* when completing this *Local Mitigation Plan Review Tool*.

Jurisdiction: Washington County, Oregon	**Title of Plan:** Washington County Natural Hazards Mitigation Plan	**Date of Plan:** February 2023
Local Point of Contact: Ken Schlegel	**Address:** 1400 SW Walnut St, Ste. 241 Hillsboro, OR 97123	
Title: Emergency Management Coordinator		
Agency: Washington County		
Phone Number: 503-846-7584	**E-Mail:** Ken_Schlegel@washingtoncountyor.gov	

State Reviewer: Jason Gately	**Title:** Mitigation Planner	**Date:** 4/18/2023

FEMA Reviewer:	**Title:**	**Date:**
Josh Vidmar	CERC Planner	2/23/2023
Erin Cooper	Lead Planner	3/17/23
Jennifer Adleman	Community Planner	4/18/2023
Date Received in FEMA Region 10		
Plan Not Approved		
Plan Approvable Pending Adoption	3/17/23	
Plan Approved	4/18/2023	

[4] Federal Emergency Management Agency. (2011, October 1). *Local Mitigation Plan Review Guide.* https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-plan-review-guide_09_30_2011.pdf

SECTION 1: MULTI-JURISDICTION SUMMARY SHEET (used only for multi-jurisdictional plans)

INSTRUCTIONS: The Multi-Jurisdiction Summary Spreadsheet is completed by listing each participating jurisdiction and which required Elements for each jurisdiction were 'Met' or 'Not Met,' and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it is used to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

MULTI-JURISDICTION SUMMARY SHEET (Add additional pages if necessary)											
#	Jurisdiction Name	Jurisdiction Type (city, district, etc.)	POC	Required Revisions / Comments	Requirements Met (Y/N)					
					A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
1	Washington County				Y	Y	Y	Y	Y	n/a
2	City of Beaverton				Y	Y	Y	Y	Y	n/a
3	City of Cornelius				Y	Y	Y	Y	Y	n/a
4	City of Forest Grove				Y	Y	Y	Y	Y	n/a
5	City of Hillsboro				Y	Y	Y	Y	Y	n/a
6	City of North Plains				Y	Y	Y	Y	Y	n/a
7	City of Sherwood				Y	Y	Y	Y	Y	n/a
8	City of Tigard				Y	Y	Y	Y	Y	n/a
9	Clean Water Services				Y	Y	Y	Y	Y	n/a

MULTI-JURISDICTION SUMMARY SHEET (Add additional pages if necessary)										
#	Jurisdiction Name	Jurisdiction Type (city, district, etc.)	POC	Required Revisions / Comments	Requirements Met (Y/N)					
					A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
10	Tualatin Hills Park and Recreation District				Y	Y	Y	Y	Y	n/a
11	Tualatin Valley Water District				Y	Y	Y	Y	Y	n/a
12										
13										

SECTION 2: 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 **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan** **(section and/or**	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Ex. Summary, pp. iv-v App. B, pp. 1249-1405	X	
A2. Does the Plan document an opportunity for neighboring communities, local 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 §201.6(b)(2))	Ex. Summary, pp. iv-v App. B, pp. 1249-1405	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Ex. Summary, pp. iv-v App. B, pp. 1249-1405	X	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Footnotes found throughout document.	X	
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Sec. 4, pp. 142	X	
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Sec. 1, p. 6 Sec. 4, pp. 134-142	X	
ELEMENT A: REQUIRED REVISIONS None			

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or	Met	Not Met
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	**Location** Dam Failure, pp. 16-19 Drought, pp. 24-27 Earthquake, pp. 34-42 Extreme Heat, pp. 53 Flooding, pp. 64-79 Landslide, pp. 90-92 Volcanic Ash, pp. 96-98 Wildland Fire, pp. 103-107 Windstorm, p. 115 Winter Storm, pp. 121-122 **Extent** Dam Failure, pp. 17-18 Drought, pp. 24-27 Earthquake, pp. 34-35 Extreme Heat, pp. 53-55 Flooding, pp. 64-79 Landslide, pp. 90-92 Volcanic Ash, pp. 96-98 Wildland Fire, pp. 101-106 Windstorm, pp. 115-116 Winter Storm, pp. 121-122	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan** **(section and/or**	**Met**	**Not Met**
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	**History** Dam Failure, p. 19 Drought, pp. 27-28 Earthquake, pp. 42 Extreme Heat, pp. 56-57 Flooding, pp. 78-79 Landslide, p. 92 Volcanic Ash, p. 97 Wildland Fire, pp. 106-109 Windstorm, pp. 116-117 Winter Storm, pp. 122-123 **Probability** Dam Failure, pp. 19-20 Drought, pp. 28-29 Earthquake, pp. 43 Extreme Heat, pp. 57-58 Flooding, pp.79-80 Landslide, pp. 92-93 Volcanic Ash, pp. 97-99 Wildland Fire, pp. 109-110 Windstorm, pp. 117-118 Winter Storm, p. 124	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan** **(section and/or**	**Met**	**Not Met**
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	**Impact** Dam Failure, pp. 19-22 Drought, pp. 27-31 Earthquake, pp. 42-52 Extreme Heat, pp. 56-63 Flooding, pp. 73-87 Landslide, pp. 93-95 Volcanic Ash, pp. 99-100 Wildland Fire, pp. 110-114 Windstorm, pp. 118-120 Winter Storm, pp. 124-125 **Vulnerability** Dam Failure, pp. 19-22 Drought, pp. 29-31 Earthquake, pp. 43-52 Extreme Heat, pp. 58-63 Flooding, pp. 80-87 Landslide, pp. 93-95 Volcanic Ash, pp. 99-100 Wildland Fire, pp. 110-114 Windstorm, pp. 118-120 Winter Storm, pp. 124-126 *Vulnerability information is also found in each jurisdictional annex.*	X	
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Sec. 2, pp. 86-87	X	
ELEMENT B: REQUIRED REVISIONS None			

ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	**Sec. 4 of each Jurisdictional Annex** Beaverton, pp. 202-207 Cornelius, pp. 260-264 Forest Grove, pp. 348-352 Hillsboro, pp. 450-454 North Plains, pp. 665-669 Sherwood, pp. 712-716 Tigard, pp. 802-806 Clean Water Services, pp. 854 THPRD, pp. 906-910 TVWD, pp. 1001-1005 Washington County, pp. 1120-1127	X	
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Sec. 2, pp. 85-87 Sec. 4.1.1 of each Jurisdictional Annex Beaverton, pp. 204-205 Cornelius, pp. 262 Forest Grove, pp. 350 Hillsboro, pp. 452 North Plains, pp. 666-667 Sherwood, pp. 713-714 Tigard, pp. 804-805 Clean Water Services, pp. 854 THPRD, pp. N/A TVWD, pp. N/A Washington County, pp. 1122-1123	X	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Sec. 3, p. 128	X	

C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Beaverton, pp. 210-228 Cornelius, pp. 268-315 Forest Grove, pp. 356-403 Hillsboro, pp. 458-630 North Plains, pp. 672-682 Sherwood, pp. 719-758 Tigard, pp. 810-853 Clean Water Services, pp. 854 THPRD, pp. 914-963 TVWD, pp. 1010-1076 Washington County, pp. 1130-1199	X	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Sec. 3, pp. 130-133 Beaverton, pp. 210-228 Cornelius, pp. 268-315 Forest Grove, pp. 356-403 Hillsboro, pp. 458-630 North Plains, pp. 672-682 Sherwood, pp. 719-758 Tigard, pp. 810-853 Clean Water Services, pp. 854 THPRD, pp. 914-963 TVWD, pp. 1010-1076 Washington County, pp. 1130-1199	X	
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Beaverton, pp. 208-209 Cornelius, pp. 265-267 Forest Grove, pp. 252-255 Hillsboro, pp. 455-457 North Plains, pp. 669-671 Sherwood, pp. 716-718 Tigard, pp. 807-809 Clean Water Services, pp. 854 THPRD, pp. 912-913 TVWD, pp. 1008-1009 Washington County, pp. 1127-1129	X	
ELEMENT C: REQUIRED REVISIONS None			

ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Appendix A, pp. 1201-1248	X	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Beaverton, pp. 210-228 Cornelius, pp. 268-315 Forest Grove, pp. 356-403 Hillsboro, pp. 458-630 North Plains, pp. 672-682 Sherwood, pp. 719-758 Tigard, pp. 810-853 Clean Water Services, pp. 854 THPRD, pp. 914-963 TVWD, pp. 1010-1076 Washington County, pp. 1130-1199	X	
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Executive Summary, pp. iii-vi Sec. 2, pp. 8-15	X	
ELEMENT D: REQUIRED REVISIONS None			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Forthcoming Sect. III.I. Adoption Resolutions pp.322	X	
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	Forthcoming Sect. III.H. APA letter, J. Approval letter pp.321,324	X	
ELEMENT E: REQUIRED REVISIONS None			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS **(OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)**			

SECTION 3: PLAN ASSESSMENT

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

Plan Strengths

- Surveys were made available in Spanish as well as English. This is a good way to make sure more parts of the population can have a say in the process.
- The appendix includes an analysis of all the answers that were given during the survey. This also lists some of the raw answers that were given.
- Social media was used as a major part of the public engagement process. This is a good way to get the word out about the plan. This is often the main source of news and can spread awareness that the plan is undergoing an update.

Opportunities for Improvement

- Continue to reach out to underserved and vulnerable communities in the next plan update. This will be required under the updated 2022 Local Mitigation Planning Policy Guide.

Element B: Hazard Identification and Risk Assessment

Plan Strengths

- Each jurisdictional annex includes specific vulnerable assets. This is a great way to make sure that each community knows exactly what is most at risk.
- A wide variety of resources were used to create the risk assessment for the main plan and the annexes. This includes local, state and federal resources. All resources are noted in footnotes throughout the plan. Links are included where applicable.

Opportunities for Improvement

- Consider including jurisdictional-specific maps where possible. This can better show where there may be future issues for each participant.

Element C: Mitigation Strategy

Plan Strengths

- There is an action plan for all actions identified in the plan for each jurisdiction. This allows for each action to be easily maintained throughout the plan's approval period.
- Each annex clearly states how the plan will be integrated into other existing community capabilities. These are applicable for each type of community. For example, the special districts identify their own particular types of plans, like water system master plans. The incorporated communities then will integrate it into their comprehensive and master plans.

Opportunities for Improvement

- None identified.

Element D: Plan Update, Evaluation, and Implementation (Plan Updates Only)

Plan Strengths

- Table 2 is a description of changes that will be used to capture changes during the plan maintenance process. This helps make sure the plan is a living document.
- Each action has a section on its implementation status. Those responsible for each action can use this to monitor them during the maintenance cycle.

Opportunities for Improvement

- None identified.

B. Resources for Implementing Your Approved Plan

Ideas may be offered on moving the mitigation plan forward and continuing the relationship with key mitigation stakeholders such as the following:

- *What FEMA assistance (funding) programs are available (for example, Hazard Mitigation Assistance (HMA)) to the jurisdiction(s) to assist with implementing the mitigation actions?*
- *What other Federal programs (National Flood Insurance Program (NFIP), Community Rating System (CRS), Risk MAP, etc.) may provide assistance for mitigation activities?*
- *What publications, technical guidance or other resources are available to the jurisdiction(s) relevant to the identified mitigation actions?*
- *Are there upcoming trainings/workshops (Benefit-Cost Analysis (BCA), HMA, etc.) to assist the jurisdictions(s)?*
- *What mitigation actions can be funded by other Federal agencies (for example, U.S. Forest Service, National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA) Smart Growth, Housing and Urban Development (HUD) Sustainable Communities, etc.) and/or state and local agencies?*

Appendix C: Implementation Resources and Funding Opportunities

1.1. Overview

Determining current and/or potential implementation resources and funding opportunities for each identified action item is a vital part of the mitigation strategy planning process. By exploring, identifying, and designating funding sources now, jurisdictions are poised to complete identified action items as implementation and funding opportunities arise.

Under the Code of Federal Regulations (CFR) Title 44, Part 201.6 (44 CFR §201.6), Local Mitigation Plans, local governments must have a Federal Emergency Management Agency (FEMA)-approved local mitigation plan in order to apply for and/or receive hazard mitigation project grant funds for the following federal Hazard Mitigation Assistance (HMA) programs:

- Hazard Mitigation Grant Program (HMGP)
- HMGP Post Fire Program
- Building Resilient Infrastructure and Communities (BRIC)
- Flood Mitigation Assistance (FMA)
- Repetitive Flood Claims
- Severe Repetitive Loss

Figure 115 illustrates the FEMA hazard mitigation funding programs available for eligible facilities, such as water treatment plants and transportation systems, under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) of 1988, HMA, and the National Flood Insurance Act (NFIA) of 1968.

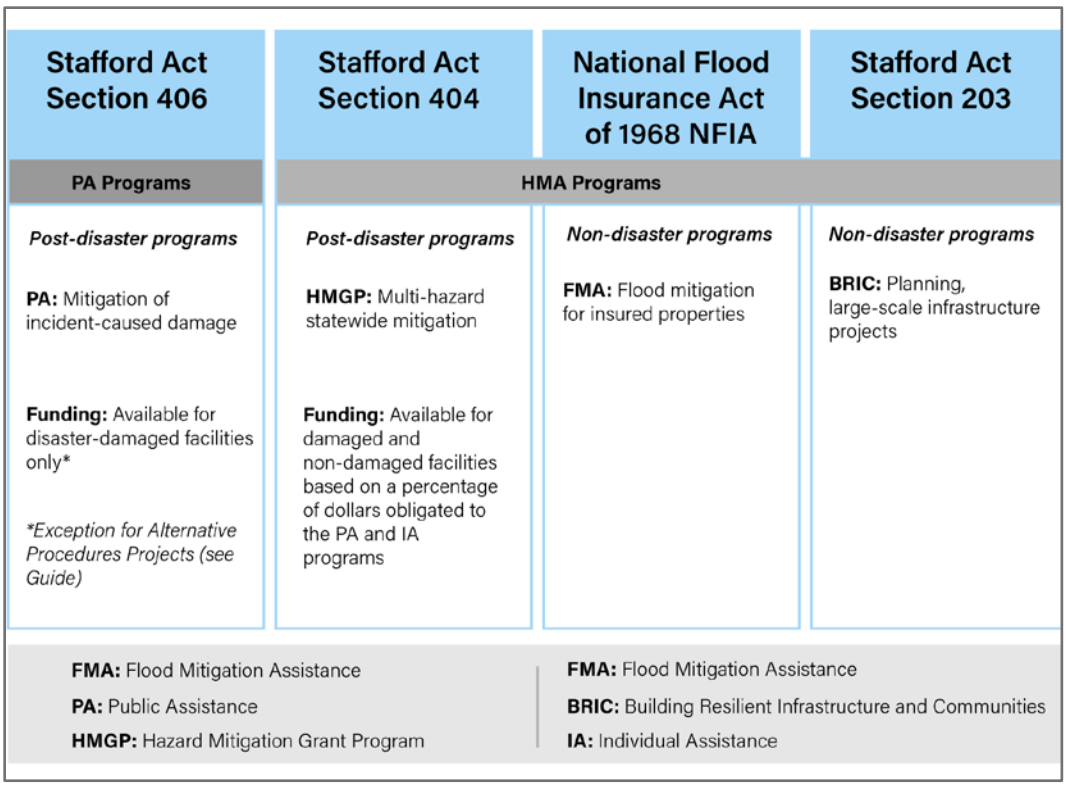


Figure 115: Federal Programs That Provide Funding for Local Hazard Mitigation

The Oregon Department of Emergency Management (OEM) administers HMA grants on behalf of FEMA. When local jurisdictions in Oregon are interested in applying for non-disaster and post-disaster federal funds, the State Hazard Mitigation Officer (SHMO) can provide guidance and education about available grants and the grant application process. Local jurisdictions should contact the SHMO for additional information.

Mitigation activities can and should be implemented through a variety of funding streams. FEMA funding sources, including Public Assistance, HMGP, the BRIC program, the FMA program, and Sections 404 and 406 of Hazard Mitigation Funding, tend to be relied on heavily for mitigation action completion. However, it is important to research and leverage other available funding opportunities and not to limit funding sources to FEMA assistance programs. Funding opportunities may include other federal agencies; state, local, and tribal programs, as applicable; or private funding (see Table 378 and Table 379). In addition to funding, mitigation implementation resources, such as regulatory and technical assistance, are available to assist jurisdictions in completing action items and integrating mitigation into planning and resilience efforts.

HMA Program Comparison



HMGP
Hazard Mitigation Grant Program



HMGP Post Fire
Hazard Mitigation Grant Program Post Fire



BRIC
Building Resilient Infrastructure and Communities



FMA
Flood Mitigation Assistance

	HMGP	HMGP Post Fire	BRIC	FMA
Program Type	Post-disaster	Post-disaster	Pre-disaster	Pre-disaster
Funding Availability	Presidentially declared disaster	Fire Management Assistance Grant (FMAG)-declared	6% set aside from federal post-disaster grant funding	Annual appropriations
Competitive	No	No	Yes	Yes
Eligible Applicants	States, federally recognized tribes, territories, and DC	States, federally recognized tribes, territories, and DC	States, federally recognized tribes, territories, and DC	States, federally recognized tribes, territories, and DC
Eligible Supplicants	State agencies, local governments, tribes, and private nonprofit (PNP) organizations	State agencies, local governments, tribes, and PNP organizations	State agencies, local governments, and tribes	State agencies, local governments, and tribes
Hazard Mitigation Plan Requirement	Yes	Yes	Yes	Yes
National Flood Insurance Program (NFIP)	Communities with projects in Special Flood Hazard Areas (SFHAs)	Communities with projects in SFHAs	Communities with projects in SFHAs	Subapplicants and properties

Figure 116: Federal Emergency Management Agency's Hazard Mitigation Assistance Programs

1.2. Hazard Mitigation Grant Program

The HMGP is authorized under 44 CFR §206 and Section 404 of the Stafford Act. The purpose of the HMGP is to provide funds to states, territories, tribal governments, and communities to significantly reduce or permanently eliminate future risk to lives and property from natural hazards. Entities pursuing HMGP funding must have a FEMA-approved hazard mitigation plan.

Because the State of Oregon has an enhanced hazard mitigation plan, they are eligible for HMGP funding, which equates to 20% of the federal share of disaster assistance provided after a federally declared disaster. The HMGP funding is broken down into three categories:

- Initiative projects (5%)
- Plan development and revision (7%)
- Regular projects (88%)

The grant application period is open for 12 months after the declaration date. All applications are made through and reviewed by the state and approved by FEMA.

1.3. Flood Mitigation Assistance Program

The Oregon Department of Emergency Management (OEM) administers the FMA program. Its purpose is to implement cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program (NFIP).

The FMA funds planning activities that assess a community's flood risk and identify actions to reduce risk. Additionally, FMA funds property acquisitions, structure demolition, structure relocation, and other flood mitigation activities. FEMA may contribute up to 90% federal cost share for eligible costs for activities or projects that address repetitive loss properties and/or are in communities with a social vulnerability index score of 0.5 or more.

1.4. Building Resilient Infrastructure and Communities

The newest FEMA pre-disaster hazard mitigation program replaced the Pre-Disaster Mitigation program. FEMA opened the first BRIC application period during the fiscal year 2020.

BRIC supports communities through capability- and capacity-building, encouraging and enabling innovation, promoting partnerships, enabling large projects, maintaining flexibility, and providing consistency.

Priorities are to fund public infrastructure projects and projects that mitigate risk to one or more community lifelines, incentivize projects that incorporate nature-based solutions, and provide funding to applicants that facilitate the adoption and enforcement of the latest published editions of building codes.

1.5. Stafford Act Sections 404 and 406 Allowable Mitigation Activities

Sections 404 and 406 of the Stafford Act established mitigation activities for facilities requiring repair, restoration, or replacement as a result of a federally declared disaster. Although Sections 404 and 406 are distinct programs with key differences in their scope, purpose, and funding, both support hazard mitigation goals.

- **Section 404:** HMGP funding is used to provide protection to undamaged parts of a facility or to prevent or reduce damages caused by future disasters.
- **Section 406:** Public Assistance Program funding provides authority to fund mitigation measures in conjunction with the repair of the disaster-damaged public and private nonprofit facilities only. This assistance is also limited to declared counties and eligible damaged facilities.

Table 377: Eligible Activities by Hazard Mitigation Assistance Program[636, 637]

Eligible Activities	HMGP	FMA	BRIC
3. Mitigation Projects	x	x	x
▪ Property Acquisition and Structure Demolition	x	x	x
▪ Property Acquisition and Structure Relocation	x	x	x
▪ Structure Elevation	x	x	x
▪ Mitigation Reconstruction	x	x	x
▪ Dry Floodproofing of Historic Residential Structures	x	x	x
▪ Dry Floodproofing of Non-Residential Structures	x	x	x
▪ Generators	x		x
▪ Localized Flood Risk Reduction Projects	x	x	x
▪ Non-Localized Flood Risk Reduction Projects	x		x
▪ Structural Retrofitting of Existing Buildings	x	x	x
▪ Non-Structural Retrofitting of Existing Buildings and Facilities	x	x	x
▪ Safe Room Construction	x		x
▪ Wind Retrofit for One- and Two-Family Residences	x		x
▪ Infrastructure Retrofit	x	x	x
▪ Soil Stabilization	x	x	x
▪ Wildfire Mitigation	x		x
▪ Post-Disaster Code Enforcement***	x		x
▪ Advance Assistance	x		x
▪ 5 Percent Initiative Projects*	x		
▪ Aquifer and Storage Recovery**	x	x	x
▪ Flood Diversion and Storage**	x	x	x
▪ Floodplain and Stream Restoration**	x	x	x
▪ Green Infrastructure**	x	x	x
▪ Building Code Adoption and Enforcement***			x
▪ Partnership Expansion***			x
▪ Project Scoping***			x
▪ Miscellaneous/Other**	x	x	x
4. Hazard Mitigation Planning	x	x	x
5. Technical Assistance		x	x
6. Management Costs	x	x	x

* FEMA allows increasing the 5 percent initiative amount up to 10 percent for a Major Federal Disaster Declaration under the HMGP. The additional 5 percent initiative funding can be used for activities that promote hazard-resistant

[636] Federal Emergency Management Agency. (2015, February 27). *Hazard Mitigation Assistance Guidance.* https://www.fema.gov/sites/default/files/2020-04/HMA_Guidance_FY15.pdf

[637] Federal Emergency Management Agency. (2021, November 12). Building Resilient Infrastructure and Communities (BRIC). https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/before-apply

building codes and standards. As a condition of the award, either a disaster-resistant building code must be adopted or an improved Building Code Effectiveness Grading Schedule is required.
** Indicates that any proposed action will be evaluated on its own merit against program requirements. Eligible projects will be approved provided funding is available.
*** Activities are eligible for funding only under the BRIC State/Territory Allocation and BRIC Tribal Set-Aside; they are not eligible for funding under the BRIC National Competition.

1.6. Recently Authorized Federal Funding Sources

Recent sources of federal funds that can be used for mitigation actions are the Infrastructure Investment and Jobs Act that was passed by Congress on November 5, 2021, and the Inflation Reduction Act signed into law on August 16, 2022. These acts authorized new and continued infrastructure funding, with a focus on climate resiliency. Transportation investments will repair and rebuild roads and bridges, and new infrastructure investment, primarily to energy infrastructure, will protect against droughts, floods, and wildfires, in addition to extreme weather events.[638,639] The ways in which this legislation will be administered is still being determined at the time this plan was written.

[638] The White House. (2021, November 6). Fact Sheet: The Bipartisan Infrastructure Deal. https://www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal/
[639] The White House. (2022, August 17). Fact Sheet: Inflation Reduction Act Advances Environmental Justice. https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/17/fact-sheet-inflation-reduction-act-advances-environmental-justice/

Table 378: Sources for Mitigation Funding and Assistance from Federal Agencies and Organizations

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
Grants.gov	Searchable catalog of federal grant opportunities across agencies.	U.S. Department of Health and Human Services	http://www.grants.gov/web/grants/home.html	x	x	x
Federal Grant Programs for State and Local Governments	Website that lists types of FEMA grant programs, and includes policies, eligibility, agencies, and type of funding instrument.	Federal Emergency Management Agency (FEMA)	https://www.grants.gov/web/grants/search-grants.html?keywords=FEMA		x	x
National Earthquake Hazards Reduction Program	Provides research to advance understanding of earthquakes, their impact, and risk-reduction opportunities.	National Institute of Standards and Technology, National Science Foundation (NSF), and U.S. Geological Survey (USGS)	http://www.nehrp.gov/index.htm		x	
Emergency Relief Program	Provides funding for repair or reconstruction of federal-aid highways and roads on federal lands that have suffered serious damage because of natural disasters or catastrophic failures from an external cause.	U.S. Department of Transportation Federal Highway Administration	https://www.fhwa.dot.gov/programadmin/erelief.cfm			X
Decision, Risk, and Management Science Program	Scientific research directed at increasing the understanding and effectiveness of decision making by individuals, groups, organizations, and society.	NSF	https://beta.nsf.gov/funding/opportunities		x	
Aquatic Ecosystem Restoration	This program helps to restore significant ecosystem function, structure, and dynamic processes that have been degraded.	U.S. Army Corps of Engineers (USACE)	http://www.nae.usace.army.mil/Missions/Public-Services/Ecosystem-Restoration-Authorities/	x	x	x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
Water Grants	A variety of grants related to water and wastewater infrastructure projects, including a catalog of federal funding for watershed protection projects.	EPA	https://www.epa.gov/nps/watershed-funding		x	x
Urban Waters Small Grants Program	Programs that protect and restore urban waters by improving water quality through activities that also support community revitalization and other local priorities.	EPA	https://www.epa.gov/urbanwaterspartners/urban-waters-small-grants		x	x
Funding and Technical Assistance for Climate Adaptation	Multiple resources about technical and funding assistance for green infrastructure, Smart Growth, and creating resilient water utilities.	EPA	https://www.epa.gov/arc-x/federal-funding-and-technical-assistance-climate-adaptation		x	x
Community Development Block Grant (CDBG)	Grants to states and local governments to develop viable communities (e.g., housing, suitable living environment, expanded economic opportunities) and recover from federally declared disasters. Principally for low- and moderate-income areas.	U.S. Department of Housing and Urban Development (HUD)	https://www.hud.gov/program_offices/comm_planning/cdbg	x	x	x
Disaster Housing Assistance Program	Emergency assistance for housing, including minor repair of homes to establish livable conditions, and mortgage and rental assistance.	HUD	https://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/publications/dhap			x
HOME Investment Partnerships Program	Grants to state and local government and consortia for permanent and transitional housing, including financial support for property acquisition and rehabilitation for low-income persons.	HUD	https://www.hud.gov/program_offices/comm_planning/home			x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
HUD Disaster Resources	Grants and a variety of disaster assistance related to housing, including mortgage assistance.	HUD	https://portal.hud.gov/hudportal/HUD?src=/info/disasterresources			x
Community Development Block Grant (CDBG) Section 108 Loan Guarantee	Offers states and local governments financing for certain community development activities, such as housing rehabilitation, economic development, and large-scale physical development projects.	HUD	https://portal.hud.gov/hudportal/HUD?src=/hudprograms/section108			x
NFIP	Formula grants to states to assist communities in complying with NFIP floodplain management requirements; Community Assistance Program–State Support Services Element.	FEMA	https://www.fema.gov/national-flood-insurance-program	x		
High Hazard Potential Dam Grant Program	Provide technical, planning, design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams.	FEMA	https://www.fema.gov/emergency-managers/risk-management/dam-safety/rehabilitation-high-hazard-potential-dams	x	x	x
HMA Grant Program	Grants to provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages. **Includes FMA, HMGP, HMGP Post Fire, and BRIC, which are detailed below.**	FEMA	http://www.fema.gov/hazard-mitigation-assistance		x	x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
FMA Grant Program	Grants to states and communities for pre-disaster mitigation planning and projects to help reduce or eliminate the long-term risk of flood damage to structures insurable under the NFIP.	FEMA	http://www.fema.gov/flood-mitigation-assistance-program		x	x
HMGP	Grants to states and communities for planning and projects providing long-term hazard mitigation measures following a major disaster declaration.	FEMA	http://www.fema.gov/hazard-mitigation-grant-program		x	x
HMGP Post Fire	Grants available to help communities implement hazard mitigation measures after wildfire disasters.	FEMA	https://www.fema.gov/grants/mitigation/post-fire			x
BRIC Grant Program	Grants for mitigation activities that support priorities including natural hazard risk reduction activities that mitigate risk to public infrastructure and community lifelines.	FEMA	https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities	x	x	x
Public Assistance: Hazard Mitigation Funding under Sections 404 and 406 of the Stafford Act	Hazard mitigation discretionary funding available under Sections 404 and 406 of the Stafford Act following a federally declared disaster.	FEMA	https://www.fema.gov/assistance/public/process#eligibility			x
Assistance to Firefighters Grant Program	Assists in local funding for fire equipment, staffing, facility construction, and emergency response costs.	FEMA	https://www.fema.gov/welcome-assistance-firefighters-grant-program			x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
Emergency Watershed Protection	Provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events.	U.S. Department of Agriculture (USDA)–National Resources Conservation Service (NRCS)	http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp		x	x
Public Assistance Grant Program	The objective of the FEMA PA Grant Program is to provide assistance to state, tribal, and local governments and certain types of private non-profit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President.	FEMA	http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit			x
Partners for Fish and Wildlife	Financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats.	U.S. Fish and Wildlife Service (FWS)	https://www.fws.gov/program/partners-fish-and-wildlife		x	x
Historic Preservation Grants	Federal financial assistance specifically for historic preservation grants.	Oregon Heritage State Historic Preservation Office	https://www.oregon.gov/oprd/OH/Pages/Grants.aspx		x	x
Federal Highway Administration Emergency Relief Program	Funding for the repair or reconstruction of federal-aid highways that have suffered serious damage as a result of natural disasters or catastrophic failures from an external cause.	U.S. Department of Transportation (DOT)	http://www.fhwa.dot.gov/programadmin/erelief.cfm			x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
Rebuilding American Infrastructure with Sustainability and Equity (RAISE)	Investing in surface transportation infrastructure for roads, bridges, transit, rail, ports, or intermodal transportation. Replaces previous TIGER and BUILD programs.	DOT	https://www.transportation.gov/RAISEgrants/about		x	x
Emergency Farm Loans Program	USDA's Farm Service Agency provides emergency loans to help producers recover from production and physical losses due to drought, flooding, other natural disasters, or quarantine.	USDA	https://www.fsa.usda.gov/programs-and-services/farm-loan-programs/emergency-farm-loans/			x
Landscape Planning Programs	Planning and programs that help improve natural resource management. Includes the Emergency Watershed Protection Program, the Watershed and Flood Prevention Operations Program, and the Watershed Rehabilitation Program.	USDA–NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/		x	x
Regional Conservation Partnership Program	Co-investment funding for partners to implement projects that address on-farm, watershed, and regional natural resource concerns.	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/	x	x	x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
Environmental Quality Incentives Program	Provides financial and technical assistance to agricultural producers and non-industrial forest managers to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, increased soil health and reduced soil erosion and sedimentation, improved or created wildlife habitat, and mitigation against drought and increasing weather volatility.	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/	x	x	x
Conservation Innovation Grants (CIG)	A competitive program that supports the development of new tools, approaches, practices, and technologies to further natural resource conservation on private agricultural lands. CIG works to address water quality, air quality, soil health, and wildlife habitat challenges.	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/			x
Conservation Technical Assistance Program	Provides farmers, ranchers, and forestland owners with the knowledge and tools they need to conserve, maintain, and restore the natural resources on their lands and improve the health of their operations for the future.	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/		x	

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
Financial Assistance	Financial assistance to help plan and implement conservation practices that address natural resource concerns or opportunities to help save energy and improve soil, water, plant, air, animal and related resources on agricultural lands and non-industrial private forestland.	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/		x	x
Easement Programs	Programs that provide financial and technical assistance to help landowners conserve agricultural lands and wetlands and their related benefits.	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/		x	x
Healthy Forests Reserve Program	Helps landowners restore, enhance, and protect forestland resources on private lands through easements and financial assistance.	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/forests/		x	x
Land and Water Conservation Fund	Funding allows four federal agencies to acquire and develop private lands for public outdoor recreation areas and facilities, and congressional appropriation for matching funds for state and local government land acquisition projects.	U.S. Bureau of Land Management (BLM), U.S. Forestry Service, FWS, and National Park Service (NPS)	http://www.lwcfcoalition.org/		x	x
Flood Risk Management Program	Fosters public understanding of the options for dealing with flood hazards and promotes prudent use and management of the nation's floodplains. Types of assistance include general technical services and general planning guidance.	USACE	https://www.iwr.usace.army.mil/Missions/Flood-Risk-Management/Flood-Risk-Management-Program/	x	x	x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
Missions and Appropriations	Federal budget and funding to support USACE missions, including research, feasibility studies, construction, and disaster relief.	USACE	https://www.usace.army.mil/Missions/	x	x	x
U.S. Small Business Administration (SBA) Disaster Loan Assistance	SBA provides low-interest, long-term loans for physical and economic damage caused by a declared disaster. These include home and personal property loans, business physical disaster loans, economic injury disaster loans, and military reservist economic injury loans.	SBA	https://www.sba.gov/loans-grants/see-what-sba-offers/sba-loan-programs/disaster-loans			x
National Dam Safety Program, High Hazard Potential Dam Grant Program	The primary purpose of the National Dam Safety Program is to provide financial assistance to states to strengthen their dam safety programs.	FEMA	https://www.fema.gov/emergency-managers/risk-management/dam-safety/grants			x
Community Emergency Response Team	Nine-week citizen training program for disaster preparedness and basic disaster response skills for individuals, families, neighborhoods, community organizations, and businesses.	FEMA and state and local governments	https://community.fema.gov/PreparednessCommunity/s/welcome-to-cert		x	
Forest Legacy Program	Encourages the protection of privately owned forestlands through conservation easements or land purchases.	U.S. Forest Service and USDA	https://www.fs.usda.gov/managing-land/private-land/forest-legacy			x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
Historic Preservation Fund Disaster Recovery Grant Program	Provides financial assistance for the immediate needs of historic-property owners after a disaster. The program is designed to foster partnerships between local, state, and federal community planners to ensure that important cultural resources are integrated with statewide hazard mitigation planning efforts.	NPS	https://www.nps.gov/subjects/historicpreservationfund/disaster-recovery.htm		x	x
National Trust for Historic Preservation Grants	Offers grants that are primarily for planning preservation projects, though some special programs focus on preservation planning in particular fields or geographic regions or allow for the funding of physical preservation work.	National Trust for Historic Preservation	https://forum.savingplaces.org/build/funding/grant-seekers			x
North American Wetlands Conservation Act	Offers grants to protect wetlands that provide valuable benefits such as flood control, reducing coastal erosion, improving water and air quality, and recharging ground water.	FWS	https://fws.gov/service/north-american-wetlands-conservation-act-nawca-grants-us-standard			x
Homeland Security Grant Program	Supports efforts to build and sustain core capabilities across the five mission areas of Prevention, Protection, Mitigation, Response, and Recovery based on allowable costs.	U.S. Department of Homeland Security	https://www.fema.gov/homeland-security-grant-program		x	x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
National Fire Plan (NFP)	The NFP provides technical, financial, and resource guidance and support for wildland fire management across the United States. Addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability.	Forest Service, U.S. Department of the Agriculture	https://www.fs.usda.gov/detail/r2/landmanagement/projects/?cid=stelprdb5199587		x	x

Table 379: Sources for Mitigation Funding and Assistance from National Non-Profit Organizations

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
American Red Cross	Shelter, food, support, supplies, and direct assistance to populations impacted by disaster.	American Red Cross, Northwest Oregon Chapter	https://www.redcross.org/local/oregon/about-us/locations/northwest-oregon-chapter.html		x	x
The Nature Conservancy	Conservation organization partnering with communities, business, government, and other nonprofits to protect ecologically important lands and waters for nature and people.	The Nature Conservancy	https://www.nature.org/en-us/		x	x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
The Trust for Public Land	Assistance to state and local governments, including land conservation transactions, conservation finance, and park design and development.	The Trust for Public Land	http://www.tpl.org/services/conservation-finance		x	x
Public Health Programs	Provides funding, expertise, information, leadership, and/or connections to specific groups of people for projects addressing priority public health challenges.	CDC Foundation	http://www.cdcfoundation.org		x	x

Table 380: Sources for Mitigation Funding and Assistance from State Agencies and Organizations

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
Oregon Department of Emergency Management	Grant guidance on federal HMA.	Oregon Department of Emergency Management	http://www.oregon.gov/OEM/emresources/Grants/Pages/HMA.aspx		x	x

Program or Source	Description	Lead Agency or Agencies	Internet Resource	Type		
				Regulatory	Technical	Financial
Oregon Watershed Enhancement Board (OWEB)	While OWEB's primary responsibilities are implementing projects addressing coastal salmon restoration and improving water quality statewide, these projects can sometimes also benefit efforts to reduce flood and landslide hazards.	Oregon Watershed Enhancement Board	https://www.oregon.gov/oweb/grants/Pages/grant-programs.aspx		x	x
Urban Area Security Initiative (UASI) Program	Supports efforts to build capabilities to prevent terrorism in high-density urban areas with high threat levels.	OEM and Regional Disaster Preparedness Organization (RDPO)	https://www.oregon.gov/oem/emresources/Grants/Pages/HSGP.aspx		x	x
State Homeland Security Program	Supports local government efforts in building capacity to prevent terrorism.	OEM	https://www.oregon.gov/oem/emresources/Grants/Pages/HSGP.aspx		x	x
Nonprofit Security Grant Program (NSGP)	Provides funding support for target hardening and other physical security enhancements and activities to non-profit organizations that are at high risk of terrorist attack.	OEM	https://www.oregon.gov/oem/emresources/Grants/Pages/HSGP.aspx		x	x
Emergency Management Performance Grant Program	Assists local, tribal, territorial, and state governments in enhancing and sustaining all-hazards emergency management capabilities.	OEM	https://www.oregon.gov/oem/emresources/Grants/Pages/EMPG.aspx		x	x
AOregon Department of State Lands	Provides grants for acquisitions, easements, rights of way, and other methods of protecting open space for farming, forestry, recreation, wildlife, water quality, and more.	Oregon Department of State Lands	https://www.oregon.gov/dsl/WW/Pages/Mitigation.aspx	x	x	x