

Clackamas Fire District Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: Clackamas Fire District

Effective: April XX, 2024 – April XX, 2029

Prepared for
Clackamas Fire District

Updated:
Date, 2024, (Resolution # 2024-xx)
September 16, 2019, (Resolution # 2020-02)



CLACKAMAS FIRE DISTRICT #1

This Natural Hazard Mitigation Plan was prepared by:



UNIVERSITY OF
OREGON

School of Planning, Public
Policy and Management

Institute for Policy
Research and Engagement

Planning grant funding provided by:

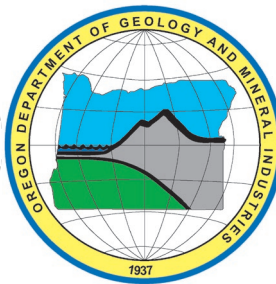


FEMA

Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

Additional Support Provided by:



This material is a result of tax-supported research and, as such, is not copyrightable.
It may be freely reprinted with the customary crediting of the source.

Table of Contents

PURPOSE	1
MITIGATION PLAN MISSION	1
MITIGATION PLAN GOALS.....	1
NHMP PROCESS, PARTICIPATION AND ADOPTION	3
Convener	3
NHMP IMPLEMENTATION AND MAINTENANCE	4
Implementation through Existing Programs	4
Governance Structure.....	5
MITIGATION STRATEGY	7
Action Items.....	7
RISK ASSESSMENT	10
Hazard Analysis	10
Community Characteristics.....	11
Transportation/Infrastructure.....	12
Economy	12
Community Assets	13
Critical Facilities	13
Essential Facilities	14
Hazard Characteristics	14
Drought.....	14
Earthquake (Cascadia Subduction Zone)	15
Earthquake (Crustal).....	16
Flood	21
Landslide.....	23
Severe Weather	24
Extreme Heat.....	24
Windstorm.....	25
Winter Storm (Snow/Ice).....	26
Volcanic Event	27
Wildfire	27
ATTACHMENT A: ACTION ITEM CHANGES.....	31
ATTACHMENT B: PUBLIC INVOLVEMENT SUMMARY	32

List of Tables

TABLE CFD-1 ACTION ITEMS.....	8
TABLE CFD-2 HAZARD ANALYSIS MATRIX – CLACKAMAS FIRE DISTRICT	11
TABLE CFD-5 CRITICAL FACILITIES IN CLACKAMAS FIRE DISTRICT	13
TABLE CFD-7 RAPID VISUAL SURVEY SCORES	18
TABLE CFD-5 STATUS OF ALL HAZARD MITIGATION ACTIONS IN THE PREVIOUS PLAN	31

List of Figures

FIGURE CFD-1 CLACKAMAS FIRE DISTRICT SERVICE AREA MAP	6
FIGURE CFD-2 UNDERSTANDING RISK	10
FIGURE CFD-3 CASCADIA SUBDUCTION ZONE EXPECTED SHAKING	16
FIGURE CFD-4 ACTIVE CRUSTAL FAULTS, EPICENTERS (2005-2023), AND SOFT SOILS.....	17
FIGURE CFD-5 SPECIAL FLOOD HAZARD AREA.....	22
FIGURE CFD-6 LANDSLIDE SUSCEPTIBILITY EXPOSURE	23
FIGURE CFD-7 WILDFIRE RISK.....	29

REVIEW DRAFT

Purpose

This is an update of the Clackamas Fire District (CFD, Fire District) addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Clackamas Fire District adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on **[DATE TBD, 2024]**. FEMA Region X approved the Clackamas County NHMP on **[DATE TBD, 2024]** and the Fire District's addendum on **[DATE TBD, 2024]**. With approval of this NHMP the Fire District is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through **[DATE TBD-1, 2029]**.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of the NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community's environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss-prevention, and identifying activities to guide the county towards building a safer, more sustainable community.

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that Clackamas County citizens, and public, and private partners can take while working to reduce the Fire District's risk from natural hazards. These statements of direction form a bridge between the broad mission statement, and serve as checkpoints, as agencies, and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

The Fire District concurs with the goals developed during the Clackamas County planning process (Volume I, Section 3). All NHMP goals are important and are listed below in no order of priority. Establishing community priorities within action items neither negates nor eliminates any goals, but it establishes which action items to consider implementing first, should funding become available.

Below is a list of the NHMP goals:

GOAL #1: PROTECT LIFE AND PROPERTY

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards.
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions and promote preventative measures for existing development in areas vulnerable to natural hazards.

GOAL #2: ENHANCE NATURAL SYSTEMS

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

GOAL #3: AUGMENT EMERGENCY SERVICES

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

GOAL #4: ENCOURAGE PARTNERSHIPS FOR IMPLEMENTATION

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

GOAL #5: PROMOTE PUBLIC AWARENESS

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

GOAL #6: ADVANCE EQUITY AND INCLUSION

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption* and 44 CFR 201.6(a)(3), *Participation*.

This Clackamas Fire District addendum was added to the Clackamas County NHMP in 2019. In addition to establishing a comprehensive community-level mitigation strategy, the Disaster Mitigation Act of 2000 (DMA2K), and the regulations contained in 44 CFR 201, require that jurisdictions maintain an approved NHMP to receive federal funds for mitigation projects. Local adoption, and federal approval of this NHMP ensures that the Fire District will remain eligible for pre- and post-disaster mitigation planning and project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Institute for Policy Research and Engagement (IPRE) collaborated with the Oregon Department of Emergency Management (OEM), Clackamas County, and the Fire District to update their NHMP.

The Clackamas County NHMP and Clackamas Fire District addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Clackamas Fire District HMAC guided the process of developing their NHMP addendum.

Convener

Clackamas Fire District's Assistant Chief of Strategic Operations served as the designated convener of the NHMP development and will take the lead in implementing, maintaining and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the Clackamas Fire District HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). This addendum reflects decisions made at the designated meetings and during subsequent work and communication between the Fire District's convener and OPDR.

The Clackamas Fire District HMAC was comprised of the following representatives:

- Convener, Brian Stewart, Assistant Chief
- Phil Schneider, Division Chief
- Brent Olson, Division Chief
- Shawn Olson, Battalion Chief

The HMAC served as the local review body for the NHMP's update.

NHMP Implementation and Maintenance

The CFD Board of Directors will be responsible for adopting the Clackamas Fire District addendum to the Clackamas County NHMP. This addendum designates the HMAC, and a convener to oversee the development, and implementation of action items. Because the Fire District addendum is part of the County's multi-jurisdictional NHMP, the Fire District will look for opportunities to partner with the County. The Fire District's HMAC will convene after re-adoption of the Clackamas Fire District NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities and Fire District to report on NHMP implementation, and maintenance during their meetings. The CFD Emergency Manager will serve as the convener and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing, and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating, and training new HMAC members on the NHMP, and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction's website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the Fire District; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other Fire District plans and programs including their [Strategic Plan](#) and the [Clackamas County Community Wildfire Protection Plan](#) as well as the [Clackamas County NHMP](#), and the [State of Oregon NHMP](#).

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the Fire District. Plans and policies already in existence have support from district residents, businesses, and policy makers. Where possible, Clackamas Fire District will implement the NHMP's recommended actions through existing plans and policies. Many land-use and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Future development without proper planning may result in worsening problems associated with natural hazards. In addition, Metro, the regional government for Clackamas, Multnomah, and Washington counties, determines many land use laws for the tri-county region and sets the urban growth boundary. The entire Portland Metro area is subject to tremendous growth pressures due to its desirable location and the restrictions on urban sprawl placed by urban growth boundary requirements.

Clackamas Fire District currently has the following plans that relate to natural hazard mitigation: [Clackamas County Community Wildfire Protection Plan: Clackamas Fire District \(CFD\)](#) and [Strategic Plan](#). For a complete list visit the Fire District's [website](#).

Governance Structure

Clackamas Fire District is governed by a Board of Directors. The Board of Directors consists of five members elected to staggered four-year terms by voters within the CFD Service Area (Figure CFD-1). The Board of Directors is responsible for identifying problems and opportunities within the Fire District and then addressing those issues through policy. The Board of Directors, in turn hire a fire chief, who serves as the administrative head of the Fire District.

The following divisions within the fire district have a role in natural hazards mitigation:

The **Office of Business Services** is comprised of support departments including Fire Prevention and the Fire Marshal's Office, Community Services, and Human Resources. The division provides support to other divisions and provides public education and community involvement regarding fire prevention and medical aid.

The **Office of Emergency Services** includes departments responsible for emergency response, fire suppression, and related function. It includes highly skilled and cross trained firefighter/paramedics and firefighters (EMTs) that respond to medical emergency alarms. The office operates from 24 fire stations and has approximately 300 career and volunteer firefighters.

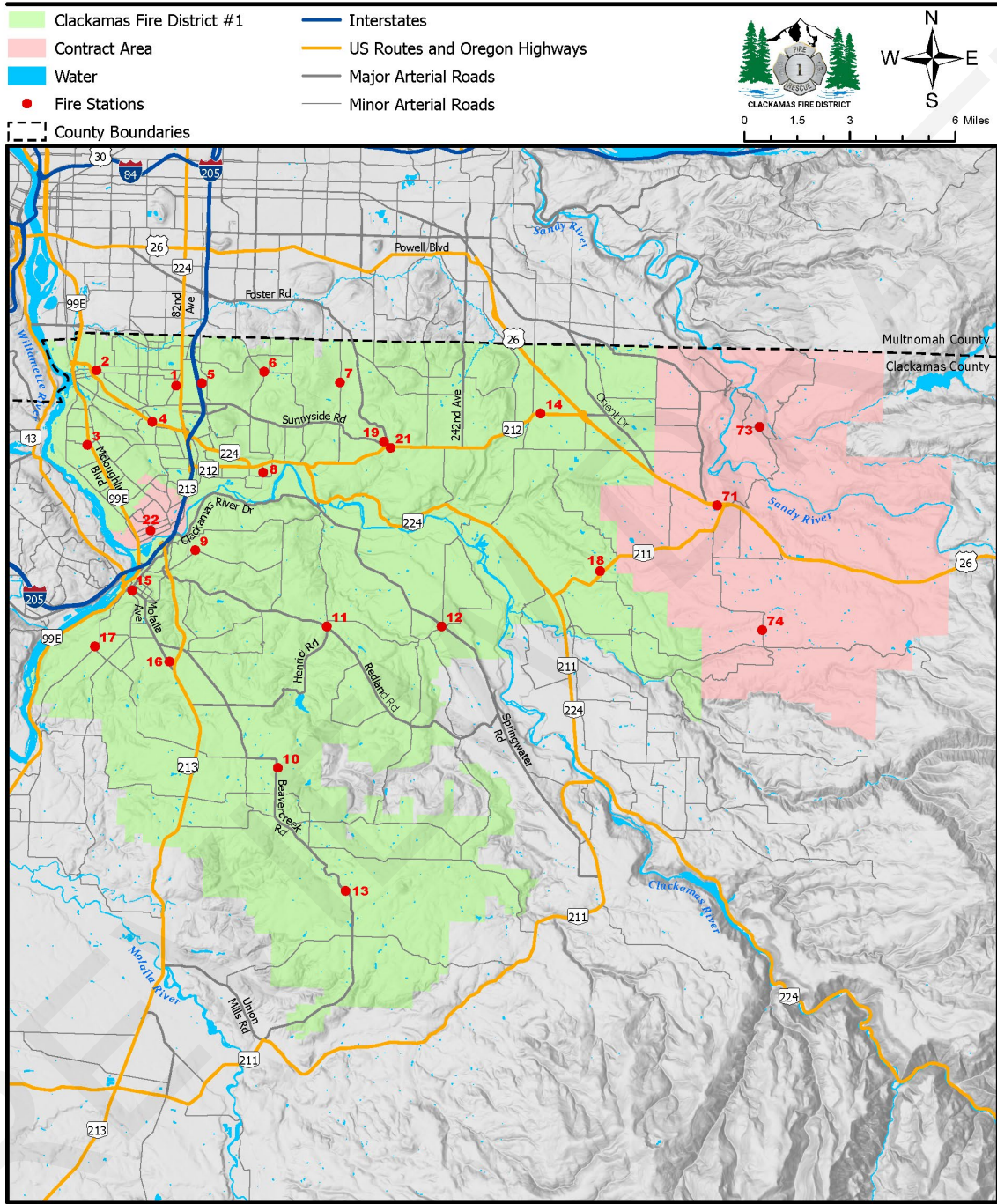
The **Office of Financial Services** is responsible for strategic financial planning, financial reporting, and accounting. Tasks of the office include financial forecasting and planning, budget development and administration, financial reporting, general accounting, payroll, and debt management. This office also includes Fleet and Logistics. The **Fleet Division** is responsible for maintaining the fleet of fire and emergency apparatus and staff vehicles. The division also maintains and repairs apparatus and vehicles from the Canby and Gladstone fire departments through intergovernmental agreements.

The **Office of Strategic Services** is comprised of support and planning functions including Technology Services, GIS Services, sUAS Operations, Planning, and Facilities. This office provides support for internal planning, community and district assessment, and operations.

Figure CFD-1 Clackamas Fire District Service Area Map

CLACKAMAS FIRE DISTRICT

FIRE DISTRICT AND CONTRACT AREA OVERVIEW



[Clackamas Fire District](#)

Source:

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The Fire District's mitigation strategy (action items) were first developed during the 2019 NHMP planning process and revised during the subsequent NHMP update. During these processes, the HMAc assessed the Fire District's risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table CFD-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAc decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity. High priority actions are shown in **bold** text with grey highlight. The Fire District will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAc in terms of implementation, the HMAc has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table CFD-1 Action Items

Action Item #	Statement	Impacted Hazard										Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost	
1	Continue to enhance education programs aimed at mitigating natural hazards and reducing risk.	X	X	X	X	X	X	X	X	X	X	Emergency Management/ Business Services	Ongoing	Local Resources, OEM, FEMA, DLCD	Low
2	Continue to conduct seismic evaluations and start projects implementing appropriate structural and non-structural mitigation strategies.		X									Facilities/ Emergency Services	Long	Local Resources, FEMA HMA, SRGP	Low to High
3	Continue to coordinate with the County and Cities to make stations a priority for plowing and ensure up-to-date knowledge of plowing routes.										X	Emergency Management/ Business Services	Short	Local Resources	Low
4	Continue to coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.										X	Fire Prevention / Business Services, Emergency Services	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low to High
5	Continue to promote legal, safe, and responsible debris collection and burning through public outreach and education.										X	Fire Prevention/ Business Services	Short	Local Resources	Low
6	Continue to promote fire-resistant strategies for new and existing developments.										X	Fire Prevention/ Business Services	Short	Local Resources	Low
7	Continue to increase participation in land use reviews of residential structures in the Timber/Agriculture Zone.										X	Fire Prevention/ Business Services	Long	Local Resources	Low

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
8	Continue to conduct a Community Meeting to educate community on defensible space, and measures that can be taken to reduce structural ignitability.							X			Fire Prevention/ Business Services	Short	Local Resources	Low
9	Continue to obtain structural ignitability data by conducting structural triage assessment data collection (including GPS points) for homes in Communities at Risk.							X			Fire Prevention/ Business Services	Ongoing	Local Resources	Low
10	Work with partners to develop redundant 911 and civilian communication network.							X			Fire Prevention/ Business Services	Short	Local Resources	Low
11	Sustain and expand Firewise adapted communities' program.							X			Fire Prevention/ Business Services	Short	Local Resources	Low

Source: Clackamas Fire District HMAP, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

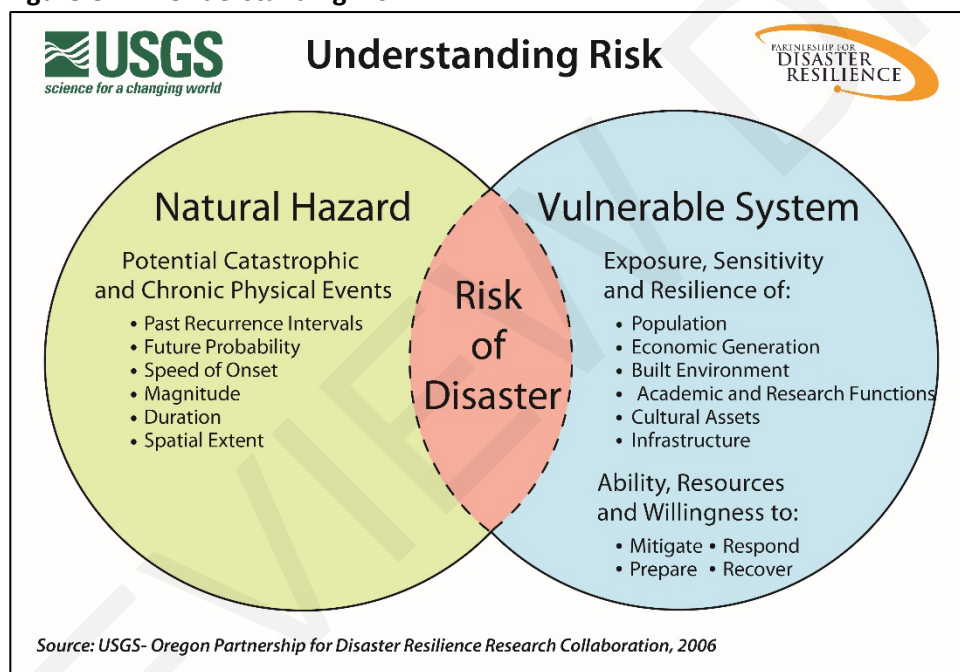
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. Assessing natural hazard risk has three phases:

- Phase 1: Identify hazards that can impact the jurisdiction. This includes an evaluation of potential hazard impacts – type, location, extent, etc.
- Phase 2: Identify important community assets, and system vulnerabilities. Example vulnerabilities include people, businesses, homes, roads, historic places, and drinking water sources.
- Phase 3: Evaluate the extent to which the identified hazards overlap with or have an impact on, the important assets identified by the community.

The local level rationale for the identified mitigation strategies (action items) is presented herein, and within Volume I, Section 2, and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure CFD-2. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure CFD-2 Understanding Risk



Hazard Analysis

The Clackamas Fire District HMAAC developed their hazard vulnerability assessment (HVA), using the County’s HVA as a reference. Changes from the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Clackamas Fire District, which are discussed throughout this addendum.

Table CFD-2 shows the HVA matrix for Clackamas Fire District listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with sense of hazard priorities but does not predict the occurrence of a hazard.

Two catastrophic hazards (Cascadia Subduction Zone earthquake and a Crustal earthquake event such as from the Portland Fault) and two chronic hazards (wildfire and winter storm) rank as the top hazard threats to the Fire District (Top Tier). The extreme heat, windstorm, drought, and flood hazards comprise the next highest ranked hazards (Middle Tier), while volcanic event and landslide comprise the lowest ranked hazards (Bottom Tier).

Table CFD-2 Hazard Analysis Matrix – Clackamas Fire District

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Wildfire	18	35	80	56	189	1	Top Tier
Earthquake - Cascadia	2	45	100	35	182	2	
Earthquake - Crustal	6	50	100	21	177	3	
Winter Storm	12	35	70	56	173	4	
Extreme Heat Event	10	35	70	35	150	5	Middle Tier
Windstorm	14	25	50	56	145	6	
Drought	10	15	50	56	131	7	
Flood	16	15	40	49	120	8	
Volcanic Event	2	35	50	7	94	9	Bottom Tier
Landslide	14	15	20	35	84	10	

Source: Clackamas Fire District HMAAC, 2023

Community Characteristics

Table CFD-4 and the following section provides information on Fire District specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the Fire District specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation. New development has complied with the standards of the [Oregon Building Code](#) per County and city development codes.

The Fire District’s service area is near the southern limits of the Portland metro-area. The Fire District serves the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City and the unincorporated areas of Barton, Beaver Creek, Boring, Carus, Carver, Central Point, Clackamas, Clarkes, Damascus, Eagle Creek, Highland, Hillsvie, Holcomb, Kelso, Jennings Lodge, Oak Grove, Redland, South End, Sunnyside, and Westwood.

The Fire District has grown in land area over the years as it merged with to provided expanded service levels and to expand the scope of services with the economies of scale of modern fire agencies.

Temperatures range from monthly average lows in the mid-30°F range in the winter months (December/January coldest) to average highs in the mid-80°F range in the summer months (July/August hottest). The average annual precipitation ranges within the district but is typically in the 40 to 50-inch range with most precipitation falling between October and April.

Transportation/Infrastructure

Transportation has played a major role in shaping the communities within the service area of the Fire District. Interstate 205 runs from the western edge through the Fire District and north; State Highway 99E (or McLoughlin Blvd.) runs along the western border of the Fire District; Highway 213 runs north to south through the central part of the Fire District; Highway 212/224 runs from Interstate 205 east towards the Fire Districts eastern boundary.

Today, mobility plays an important role in the area and the daily experience of its residents and businesses as they move from point A to point B. Motor vehicles represent the dominant mode of travel through, and within the Fire District. Most communities within the Fire District's service area are provided public transportation by Tri-Met which provides daily local bus services to numerous community transit centers. The Fire District's service area is also accessed by the Union Pacific Railroad main line and Amtrak, which travels northeast to southwest carrying both passengers and freight.

Economy

The Fire District is located within the greater Portland region, resulting in easy access to downtown Portland and surrounding communities. Fire District service area residents are mostly employed in professional and related occupations.¹

For additional information on the characteristics of the Fire District, in terms of geography, environment, population, demographics, employment and economics, as well as housing and transportation see Volume II addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City, and Volume III, Appendix C, *Community Profile*. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation.

¹ Social Explorer, Table B17008, U.S. Census Bureau, 2012-2016 American Community Survey Estimates.

Community Assets

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of Clackamas Fire District. It is important to note that the facilities identified as “critical” and “essential” are characterized differently than the structural code that identifies buildings as “essential” and “non-essential.” The structural code uses different language and criteria and therefore have completely different meanings than the buildings identified in this addendum. Considering the Fire District specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Critical Facilities

Facilities that are critical to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more.

Table CFD-3 Critical Facilities in Clackamas Fire District

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby- Molalla Fault Mw- 6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Channel Migration Zone	Wildfire High or Moderate Risk	Volcanic Lahar - 1% Annual Chance
Critical Facilities by Community	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed	Exposed	Exposed
Clackamas Fire District - Station 1	-	X	-	-	-	-	-
Clackamas Fire District - Station 2	-	X	-	-	na	-	na
Clackamas Fire District - Station 3	-	-	-	-	-	-	-
Clackamas Fire District - Station 4	-	-	-	-	-	-	-
Clackamas Fire District - Station 5	-	X	-	-	na	-	na
Clackamas Fire District - Station 6	-	X	-	-	na	-	na
Clackamas Fire District - Station 7	-	X	-	-	na	-	na
Clackamas Fire District - Station 8	-	X	-	-	na	-	na
Clackamas Fire District - Training Center	-	-	-	-	na	-	na
Clackamas Fire District - Station 9	-	-	-	-	na	-	na
Clackamas Fire District - Station 10	-	-	-	-	-	-	-
Clackamas Fire District - Station 11	-	-	-	-	-	-	-
Clackamas Fire District - Station 12	-	X	-	-	-	-	-
Clackamas Fire District - Station 13	-	-	-	-	-	-	-
Clackamas Fire District - Station 14	-	X	-	-	-	-	-
Clackamas Fire District - Station 15	-	X	X	-	na	-	na
Clackamas Fire District - Station 16	-	X	-	-	na	-	na
Clackamas Fire District - Station 17	-	-	-	-	na	-	na
Clackamas Fire District - Station 18	-	-	-	-	-	-	-
Clackamas Fire District - Station 19	-	-	-	-	-	-	-
Clackamas Fire District - Station 20	-	-	-	-	-	-	-
Clackamas Fire District - Station 21	-	-	-	-	-	-	-
Clackamas Fire District - Station 22	-	-	-	-	na	-	na

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby- Molalla Fault Mw- 6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Channel Migration Zone	Wildfire High or Moderate Risk	Volcanic Lahar - 1% Annual Chance
Critical Facilities by Community	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed	Exposed	Exposed
Clackamas Fire District - Station 71: Sandy	-	-	-	-	-	-	-
Clackamas Fire District - Station 73: Roslyn	-	-	-	-	-	-	-
Clackamas Fire District - Station 74: Dover	-	-	-	-	-	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-24.

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public’s ability to recover from the emergency.

- Fires Stations
- Fuel Cells
- Fleet Logistics
- Training and Wellness (Office)
- Training and Wellness (Facility)
- Administrative Building

Hazard Characteristics

Drought

The HMAC determined that the Fire District’s probability for drought is **high** and that their vulnerability to drought is **low**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent, and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

Vulnerability Assessment

Due to insufficient data and resources, Clackamas Fire District is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section. For specific information for communities within the Fire District’s service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Mitigation Activities

The existing drought hazard mitigation activities are conducted at the county, regional, state, and federal levels and are described in the Clackamas County NHMP.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”² drought, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation, is projected to become more frequent in Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the Fire District’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Clackamas Fire District as well. The causes and characteristics of an earthquake event are appropriately described within the Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Clackamas Fire District as well.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek-Newberg-Mt. Angel Structural Zone (discussed in the crustal earthquake section).

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.³

Figure CFD-3 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the Fire District is expected to experience very strong shaking (orange), while areas near rivers and streams will experience severe (light red) to violent (dark red) shaking in a CSZ event.

Ground shaking can mix groundwater and soil, liquefying and weakening the ground that supports buildings and severing utility lines. This is a special problem in low lying areas adjacent to rivers where the water table is shallow and the soils are subject to liquefaction. For example, the fine-grained alluvial soils along the banks of the Willamette and Clackamas Rivers and area creeks are likely subject to this hazard.

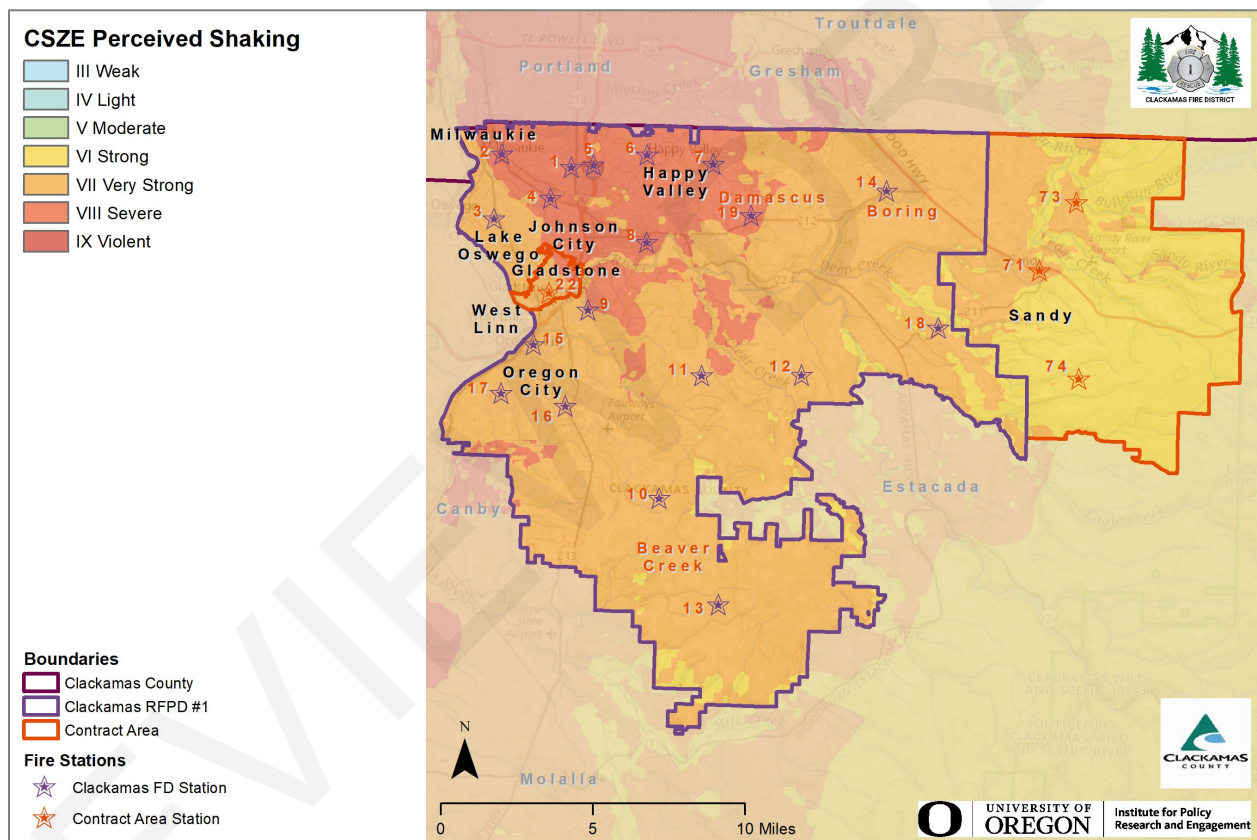
² Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

³ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

The Fire District's proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the Fire District a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the Fire District predominately within the "Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

Older buildings and the sewer system in the Fire District are most vulnerable to damage. Earthquakes shift soil that could cause landslides. Transportation routes and economic areas within the Fire District can also be affected. Demand on resources such as Emergency Service (Fire and Ambulance) would also increase.

Figure CFD-3 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

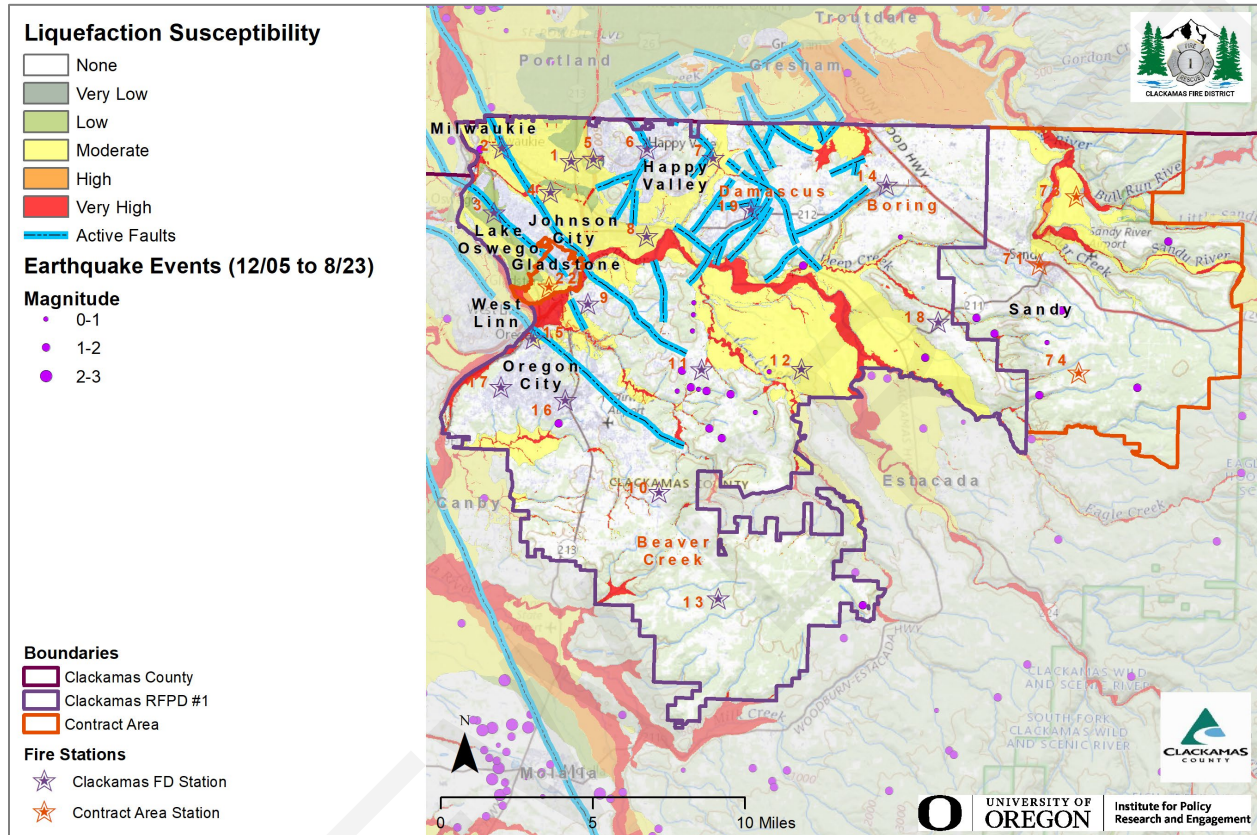
Earthquake (Crustal)

The HMAC determined that the Fire District's probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is

likely to affect the Fire District as well. Figure CFD-4 shows a generalized geologic map of the Fire District service area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the service area as red and orange.

Figure CFD-4 Active Crustal Faults, Epicenters (2005-2023), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.
 Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
 Note: To view hazard detail click this link to access Oregon HazVu

There are several potential crustal faults and/or zones near, or within, the Fire District’s service area that can generate high-magnitude earthquakes. These include the Gales Creek-Mt. Angel Structural Zone, Bolton Fault, Oatfield Fault, Canby-Molalla structural zones, Damascus-Tickle Creek fault zone, and Portland Hills Fault Zone (discussed in greater detail below). Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993 Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years

ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and extends into the Fire District service area through Milwaukie and near Oregon City.

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)), findings from that report relevant to the Fire District’s service area are provided in Volume I, Section 2 and within the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Seismic building codes were implemented in Oregon in the 1970s, however, stricter standards did not take effect until 1991 and the early 2000s. As noted in the community profile, approximately 64% of residential buildings (primarily single-family residential) with the Fire District service area were built prior to 1990 (30% before 1970), which increases the service areas vulnerability to the earthquake hazard. Information on specific public buildings’ (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table CFD-7; each “X” represents one building within that ranking category. Of the Fire District facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), none have a very high (100% chance) or a high (greater than 10% chance) collapse potential.

Table CFD-4 Rapid Visual Survey Scores

Facility	Location	Site ID*	Level of Collapse Potential			
			Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Station 1 – Town Center 11300 SE Fuller Rd (ca. 1983)	Milwaukie	Clac_fir09	X			
Station 2 – Milwaukie 3200 SE Harrison St (ca. 1993)	Milwaukie	Clac_fir26	X			
Station 3 – Oak Grove 2930 SE Oak Grove Blvd (ca. 1997)	Milwaukie	Clac_fir27	X			
Station 4 – Lake Road 6600 SE Lake Rd (ca. 1999)	Milwaukie	Clac_fir08	X			
Station 5 – Mt Scott 9339 SE Causey Ave (ca. 2003)	Happy Valley	None	<i>2007 RVS report did not include structural appendix for this facility.</i>			
Station 6 – Happy Valley 12901 SE King Rd (ca. 2000)	Happy Valley	Clac_fir13	X			
Station 7 – Pleasant Valley 10921 SE 172 nd (ca. 2004)	Happy Valley	None	<i>2007 RVS report did not include structural appendix for this facility.</i>			
Station 8 – Clackamas 16100 SE 130 th Ave (ca. 1985)	Happy Valley	Clac_fir11 Clac_fir12	X X			
Station 9 – Holcomb 300 Longview Way (ca. 1974)	Oregon City	Clac_fir29	X			

Facility	Location	Site ID*	Level of Collapse Potential			
			Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Station 10 - Beavercreek 22310 S Beavercreek Rd (ca. 2000)	County	Clac_fir14	X			
Station 11 – Redland 18265 S Redland Rd (ca. 2000)	County	Clac_fir25	X			
Station 12 – Logan 18081 S Harding Rd (ca. 1980)	County	Clac_fir24	Mitigated per 2013-2014 SRGP grant.			
Station 13 – Clarkes 25675 S Beavercreek Rd (ca. 1955)	County	Clac_fir04	Mitigated per 2013-2014 SRGP grant.			
Station 14 – Boring 28655 SE Hwy 212 (ca. 1969)	County	Clac_fir22	X			
Station 15 – John Adams 624 7t St (ca. 1921)	Oregon City	Clac_fir35	X			
Station 16 – Hilltop 19340 Molalla Ave (ca. 2018)	Oregon City	Clac_fir36	Mitigated/rebuilt per 2013-2014 SRGP grant.			
Station 17 – South End 19001 South End Rd (ca. 2004)	Oregon City	Clac_fir51	X			
Station 18 – Eagle Creek 32200 SE Judd Rd (ca. 1999)	County	Clac_fir47	X			
Station 19 - Damascus 19750 SE Damascus Ln (ca. 2019)	County	None	2007 RVS report did not include structural appendix for this facility.			
Station 20 – Highland 22295 S Lower Highland (ca. 1960) – storage only	County	Clac_fir28	X			
Station 21 – Centennial Park 20100 SE Hwy 212 (ca. 1976)	County	Clac_fir46	X			
Station 22 – Gladstone (555 Portland Ave) see mitigation successes	Gladstone	Clac_fir19	X			
Station 71 - Sandy (17460 Bruns Ave) see Mitigation Successes	Sandy	Clac_fir37	X			
Station 73 – Roslyn (13120 SE Ten Eyck Rd)	Sandy	Clac_fir42	X			
Station 74 - Dover (24545 SE Firwood Rd)	Sandy	Clac_fir43	X			

Source: DOGAMI 2007. Open File Report O-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.
“*” – Site ID is referenced on the RVS Clackamas County Map

Note 1: **Bold** indicates facilities that have been seismically retrofitted or rebuilt.

For a list of additional facilities and infrastructure vulnerable to this hazard see the Community Assets section. In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Their study focused on damage to buildings, and the people that occupy them, and to two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and night time (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damaged varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios, however, the impact is considerably less than it is to the transportation routes. Additional, capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts. For specific information for communities within the Fire District’s service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table CFD-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

Mitigation Activities

Many buildings in Clackamas Fire District have been seismically upgraded. A \$29 million general obligation bond was approved in 2015 and seismic retrofit grant awards per the [Seismic Rehabilitation Grant Program](#)⁴ were funded to retrofit Fire Station 12 (2013-2014 grant award, \$94,552), Fire Station 13 (2013-2014 grant award, \$71,582), and Fire Station #16 (2013-2014 grant award, \$483,062).

Future Projections

Future development (residential, commercial, industrial, and infrastructure) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

The HMAC determined that the Fire District's probability for flood is **moderate** and that their vulnerability to flood is **low**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent and probability of a potential event. Portions of Clackamas Fire District have areas of floodplains (special flood hazard areas, SFHA). These include areas along Willamette River, Clackamas River, and creeks within the service area (Figure CFD-5). Other portions of Clackamas Fire District, outside of the mapped floodplains, are also subject to flooding from local storm water drainage. Not all flood prone areas are subject to damage. Several valleys, such as the upper reaches of Abernethy Creek, are still in or near their natural state. Flooding of such areas causes no damage to human development and may help the riparian habitat.

Vulnerability Assessment

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage and economic loss from business interruption. It is important for the Fire District to be aware of flooding impacts and assess its level of risk.

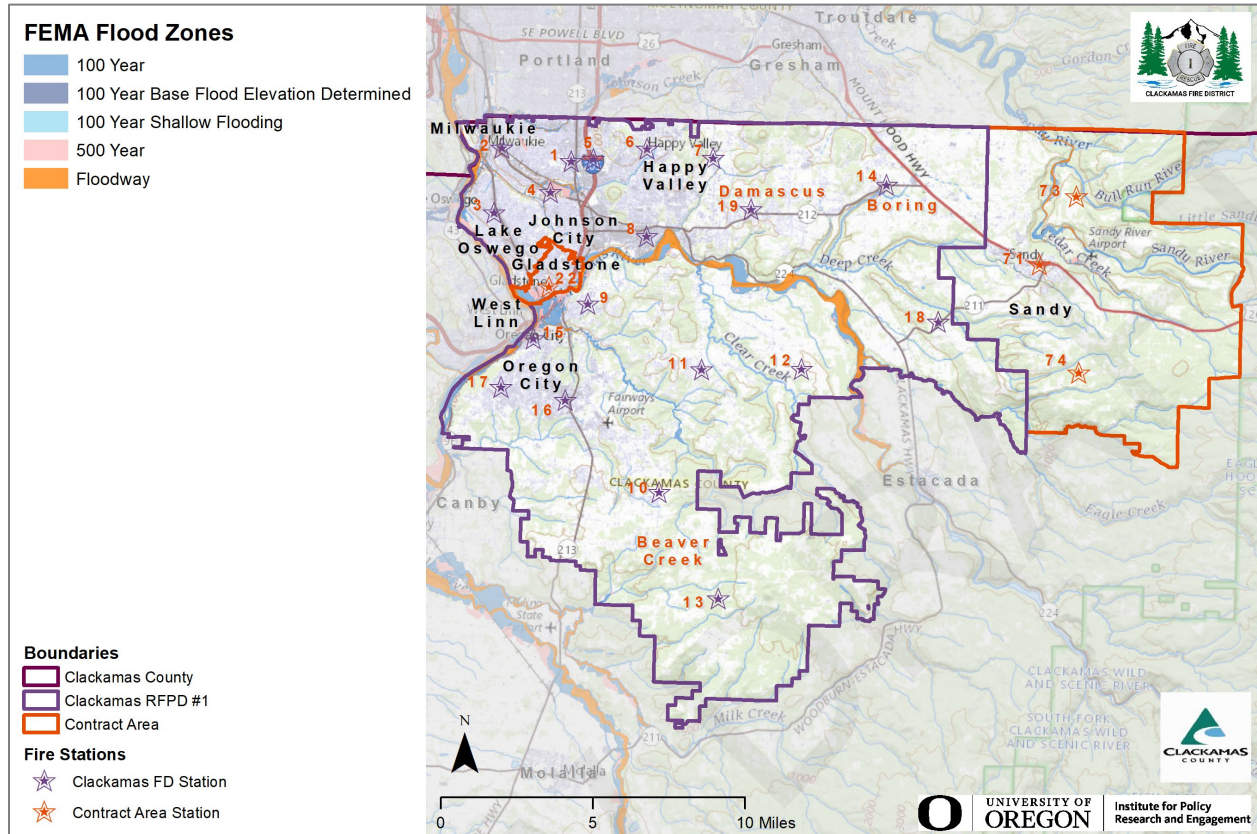
The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of the Fire District outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

Most of the buildings affected by flooding are in the lowest parts of the Fire District's service area. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section. For specific information for communities within the Fire District's service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

⁴ The Seismic Rehabilitation Grant Program (SRGP) is a state of Oregon competitive grant program that provides funding for the seismic rehabilitation of critical public buildings, particularly public schools and emergency services facilities.

Figure CFD-5 Special Flood Hazard Area



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this link to access Oregon HazVu

National Flood Insurance Program (NFIP)

FEMA updated the Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for Clackamas County in 2018 (effective January 19, 2018). The Fire District is not a community which has authority to adopt and enforce floodplain management regulations for the areas within its jurisdiction. The cities of Happy Valley, Johnson City, Milwaukie, Oregon City and Clackamas County participate in the National Flood Insurance Program (NFIP).

There are no repetitive loss or severe repetitive loss properties owned or operated by the Fire District. For specific information for communities within the Fire District’s service area see Volume I, Section 2 (Table 2.11 for more information) and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Mitigation Activities

The existing flood hazard mitigation activities are conducted at the city, county, regional, state, and federal levels and are described in the Clackamas County NHMP and city addenda.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁵ winter flood risk at mid- to low elevations in Clackamas County, where temperatures are near

⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

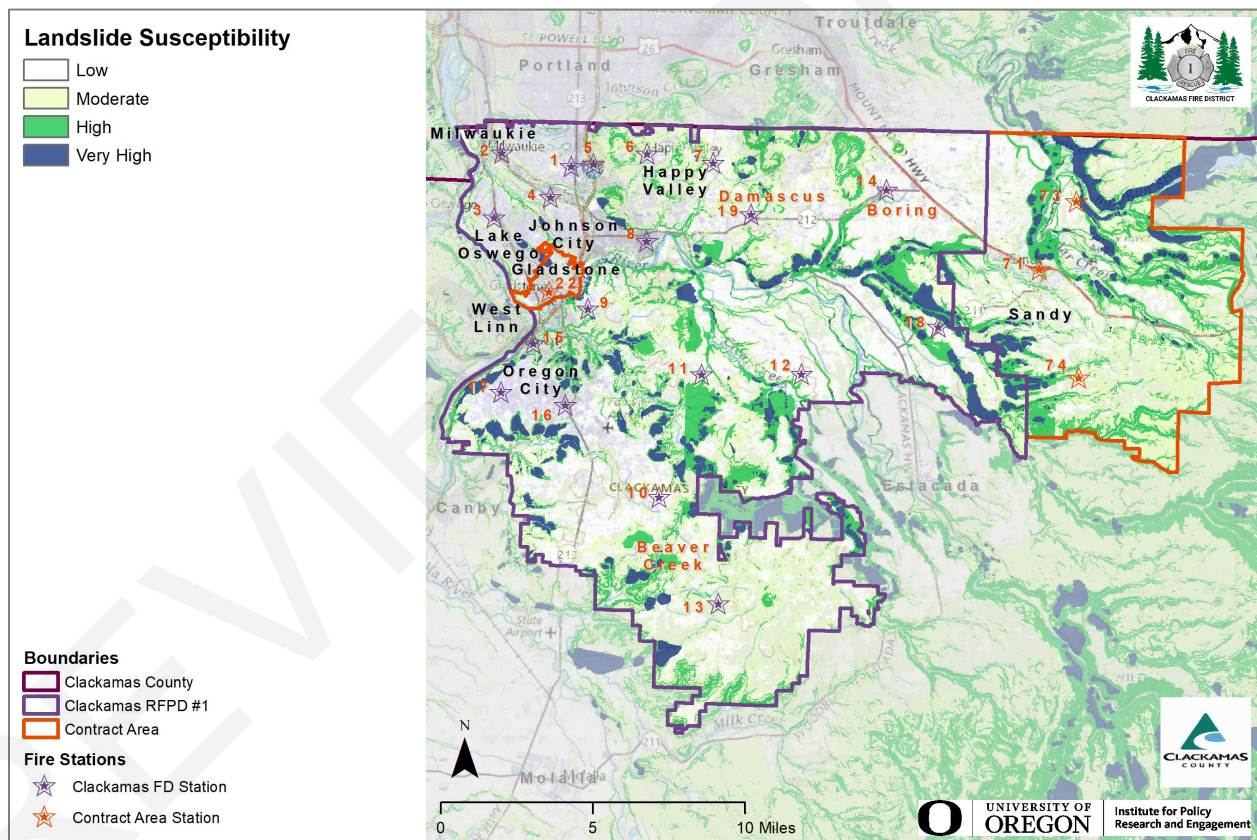
freezing during winter and precipitation is a mix of rain and snow, is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of precipitation falling as rain rather than snow. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the Fire District’s probability for landslide is **moderate** and that their vulnerability to landslide is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Landslide susceptibility exposure within the Fire District’s service area is shown in Figure CFD-6. Most of the Fire District’s service area demonstrates a low to moderate susceptibility to landslide exposure. *Note that even if an area has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard and assets.*

Figure CFD-6 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Landslides destroy or damage anything on the sliding hillside or in the path of the slide. This includes buildings, houses, and streets. Sometimes, a small amount of settlement occurs, giving the owner time to shore up or retrofit the building to prevent further damage. Many property owners in the Fire

District's service area have built retaining walls and replaced slide prone soils with rock to help prevent landslides. However, if an entire hillside fails, the buildings may be destroyed, and the streets washed out or covered in debris.

The most common type of landslides in Clackamas County are slides caused by erosion and flooding. Slides move in contact with the underlying surface, are generally slow moving and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided above and within Figure CFD-6. For specific information for communities within the Fire District's service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Potential landslide-related impacts are adequately described within Volume I, Section 2 and include infrastructural damages, economic impacts (due to isolation and/or arterial road closures), property damages and obstruction to evacuation routes. Rain-induced landslides and debris flows can potentially occur during any winter in Clackamas County and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section.

Mitigation Activities

Clackamas Fire District works to mitigate future landslide hazards to its fire stations and other critical facilities. Additional landslide hazard mitigation activities are conducted at the city, county, regional, state, and federal levels and are described in the Clackamas County NHMP and city addenda.

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on the 15 days prior to the previous 3 days). By the 2050s under the higher emissions scenario, the average number of days per year in Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

Severe weather in can account for a variety of intense and potentially damaging weather events. These events include windstorms and winter storms. The following section describes the unique probability and vulnerability of each identified weather hazard. Other more abrupt or irregular events such as hail are also described in this section.

Extreme Heat

The HMAC determined that the Fire District's probability for extreme heat events is **moderate** and that their vulnerability is **moderate**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the Fire District as well.

A severe heat episode or "heat wave" occurs about every two to three years and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days we have temperatures greater than or equal to 90-degrees Fahrenheit and 100-degrees Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The Fire District has not experienced any life-threatening consequences from the few extreme heat events in the past, though with the changing climate expect to see more extreme heat events with potentially greater risk to the Fire District's service area population.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"⁶ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the hottest day of the year is projected to increase by an average of about 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the Fire District's probability for windstorm is **high** and that their vulnerability to windstorm is **moderate**. *These ratings did not change since the previous NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by ice, freezing rain, flooding and very rarely, snow. Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes and tornadoes are generally negligible for the Fire District.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages and storm-related debris. Additionally, transportation and economic disruptions result as well.

Damage from high winds generally has resulted in downed utility lines and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves and debris clog drainage-ways, which in turn causes localized urban flooding.

⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAP determined that the Fire District's probability for winter storm is **high** and that their vulnerability to winter storm is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter and early spring months. Severe winter storms affecting the Fire District's service area typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Most winter storms typically do not cause significant damage; however, they are frequent and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter and commercial traffic.

Vulnerability Assessment

Due to insufficient data and resources, Clackamas Fire District is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets section. For specific information for communities within the Fire District's service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Mitigation Activities

Clackamas Fire District has made progress to reduce the effects of storms. Most utilities leading to fire stations are underground, but in case of power outages the Fire District's critical facilities have back up power generation. Clackamas County Public Health operates heating and cooling centers for the region. Additional severe weather hazard mitigation activities are conducted at the city, county, regional, state, and federal levels and are described in the Clackamas County NHMP and city addenda.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"⁷ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the coldest night of the year is projected to increase by an average of 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. However, by the 2050s, the amount of precipitation on the

⁷ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

wettest day and wettest consecutive five days per year is projected to increase by an average of 15% (range 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Volcanic Event

The HMAC determined that the Fire District’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of volcanic hazards, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the Fire District service area as well. Clackamas Fire District is unlikely to experience anything more than volcanic ash during a volcanic event.

Vulnerability Assessment

Due to insufficient data and resources, Clackamas Fire District is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section.

Due to the Fire District’s relative distance from volcanoes, its service area is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the service area may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the service area could experience a heavier coating of ash.

Mitigation Activities

The existing volcano hazard mitigation activities are conducted at the county, regional, state, and federal levels and are described in the Clackamas County NHMP.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the Fire District’s probability for wildfire is **high** and that their vulnerability to wildfire is **moderate**. *These ratings did not change since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan \(CWPP\)](#) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Clackamas Fire District is found in the following chapter: Chapter 9.3: Clackamas Fire District, Chapter 9.6: Gladstone Fire Department, and Chapter 9.11: Sandy Fire District.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location, and extent of a wildland fire vary depending on fuel, topography, and weather conditions. Weather, and urbanization conditions are

primarily at cause for the hazard level. Clackamas Fire District does not regularly experience wildfire within its urbanized service area, but the Fire District service area has abundant wooded areas, particularly in the south, southeast, and east that are a concern in the case of a wildfire event.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes the Fire District's service area, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

The forested hills within and surrounding the Fire District service area are interface areas. High and medium Priority Communities at Risk (CARs) within the Fire District service area include the following high priority areas: Forest Park/Leisure Woods, Diane Drive Shelly Road, Redland Road/Fishers Mill area/Logan, Clarkes/Beavercreek, Beaver Lake, Canemah Bluffs, Scouters Mountain, and Mount Talbert; Gladstone area high priority CARs: Parkway Woods, Billy Goat Island, Dahl Beach; Sandy area high priority CARs: Wildcat Mountain, Hope Lake, Cedar Creek/Sandy Rim, Firwood, Bull Run Area. Medium priority CARs: 3 Creeks, Holcomb; Gladstone area: Risley Wetlands.⁸

Most of the Fire District service area has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four-feet under normal weather conditions. However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Vulnerability Assessment

Due to insufficient data and resources, Clackamas Fire District is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section.

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the Fire District service area as well. Clackamas Fire District's fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. Figure CFD-7 shows overall wildfire risk in the Fire District service area. The Fire District will update their wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP). For specific information for communities within the Fire District's service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

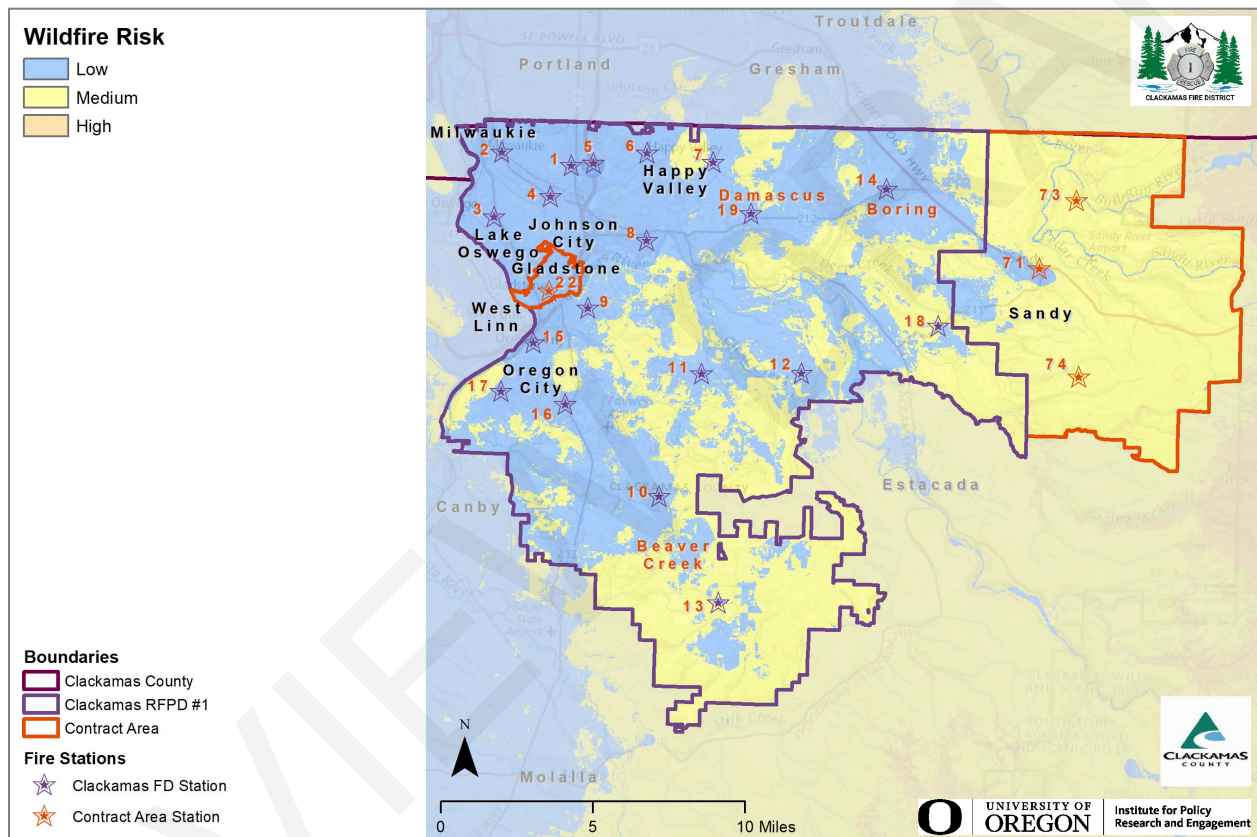
Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

⁸ Clackamas County Community Wildfire Protection Plan, *Clackamas Fire District* (2018), Table 18, 24, 33.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁹ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

Figure CFD-7 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

Mitigation Activities

Clackamas Fire District uses several mitigation tools to reduce the service area’s risk to wildfires. Clackamas Fire District’s offers numerous education opportunities including school programs, public presentations, media events, and safety fairs. They work with Clackamas County and Happy Valley, Johnson City, Milwaukie, and Oregon City to review pre-construction plans and develop fire codes. They promote the use of defensible space, fire-resistant building materials and roofing, and community

⁹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

preparedness. Additionally, the Fire District inspects buildings for fire code compliance, enforces open burning regulations, and offers juvenile fire setter counseling and follow-up.

Please review the [Clackamas County Community Wildfire Protection Plan \(CWPP\)](#), Volume I, Section 2 for additional information on this hazard.

REVIEW DRAFT

Attachment A: Action Item Changes

Table MO-8 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. Actions identified as still relevant are included in the updated action plan (Table MO-1).

Previous NHMP Actions that are Complete:

Severe Weather #1: “Continue to ensure that all response vehicles have chains for driving on snow and ice.” This is considered part of normal operations.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

None identified.

Table CFD-5 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Earthquake #1	#2	Not Complete	Yes
Severe Weather #1	-	Complete	No
Severe Weather #2	#3	Not Complete	Yes
Wildfire #1	#4	Not Complete	Yes
Wildfire #2	#5	Not Complete	Yes
Wildfire #3	#6	Not Complete	Yes
Wildfire #4	#7	Not Complete	Yes
Wildfire #5	#8	Not Complete	Yes
Wildfire #6	#9	Not Complete, revised	Yes
-	#10	New	-
-	#11	New	-

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from February XX through February XX on the District's website. The plan was also posted and announced on the County's website. There were X comments provided that have been reviewed and integrated into the NHMP as applicable. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting

To be provided

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1: May 30, 2023

During this meeting, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the district.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: August 1, 2023 and again on November 13, 2024 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the district's capabilities assessment.
- Reviewed, confirmed, and prioritized the district's mitigation strategies.