

City of Canby Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



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The City of Canby



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Purpose

This is an update of the Canby 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).

Updates to Canby's addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Canby 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 City's addendum on [DATE TBD, 2024]. With approval of this NHMP the City 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, 2024].

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.

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 city will remain eligible for pre- and post-disaster mitigation 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 Office of Emergency Management (OEM), Clackamas County, and Canby to update their NHMP.

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

Convener

The Canby Economic Development Director and Communications Specialist serves as the NHMP addendum convener. The convener of the NHMP 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 City of Canby HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAC reviewed and revised the City's addendum, with focus on the NHMP's risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City's risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Canby HMAC was comprised of the following representatives:

- Convener Jamie Stickel, Economic Development Director & Communications Specialist
- Jerry Nelzen, Public Works Director
- Jorge Tro, Canby Police Chief
- Eileen Stein, City Administrator

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

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the Molalla addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County's multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City's HMAC will convene after re-adoption of the Molalla NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners 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 HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

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 city; (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 city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, 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 city. Plans and policies already in existence have support from residents, businesses and policy makers. Where possible, Canby will implement the NHMP's recommended actions through existing plans and policies. Many land-use, comprehensive 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 applied. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Canby to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources.

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards. Canby addresses Statewide Planning Goal 7 Natural Hazards as part of their Comprehensive Plan Element, Natural Hazards. This plan was originally adopted in 1984. Chapter 4, Environmental Concerns, includes findings related to natural hazards. This chapter establishes the H overlay zone, which restricts development in areas of identified flood hazards. Other hazards discussed are steep slopes (along riverbanks), expansive soils, high water tables, and shallow topsoil.

The City of Canby is pursuing updating this Comprehensive Plan in 2023-2024, following the adoption of new Housing Needs and Economic Opportunity analyses in 2023.

Planned updates to the jurisdiction's Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community's long-range plans.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

Canby Development Code

[Chapter 16.40 Hazard Overlay Zone \(H\)](#) assures that the development will not result in an unacceptable level of risk because of hazardous conditions. It is intended to be applied only to those specific properties which have been identified as having steep slopes or potential for flooding. It utilizes the flood insurance study, including the flood insurance rate map, dated June 17, 2008.

[Chapter 15.12 Flood Hazard Protection Ordinance](#) complies with federal and state regulations related to flood hazard protection. It was last updated in 2008 and is based upon the Oregon Model Flood Hazard Prevention code of that time and includes provisions addressing substantial improvement/substantial damage.

The Planning Division is responsible for processing all land use applications within the City of Canby which includes subdivisions, partitions, and site and design review. We also provide development services, zoning reviews, and provide the public with information on all property-related issues within the City limits. City approval is required before Clackamas County can issue a building permit.

They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

[Clackamas County](#) currently issues all building, plumbing, and electrical permits for the City of Canby. The Clackamas County Building Department administers and enforces the 2022 Oregon Structural Specialty Code and the 2022 Oregon Fire Code. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

Public Works

The City of Canby Public Works Department is responsible for streets, including street lighting, storm drains, parks, building maintenance, Zion Memorial Cemetery, and the Wastewater Treatment Plant. Water and electric are administered by Canby Utility.

Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

2019 Canby Public Works Standards

The [Canby Public Works Standards](#) provide guidance for the development of public infrastructure (streets, sanitary sewer, and storm drainage).

City Administration

The City Council of Canby has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

Policies and Programs

This Plan directs Canby and Clackamas County to explore integration into other planning documents and processes. Canby has made progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

Housing Needs Analysis, 2023

The [Housing Needs Analysis](#) deducted the following lands from the residential land inventory:

- Open water of at least one-half acre in size.
- Land within the 100-year floodplains. This includes lands in flood-hazard areas as identified by the Flood Prone classification of Canby's Comprehensive Plan
- Wetlands identified by the City and identified in the Comprehensive Plan as a barrier for future development
- Land within Metro's ORCA (Outdoor Recreation & Conservation Areas) data set
- Land in public ownership with no development potential
- Land with slopes greater than 25%

The Housing Need Analysis found that population growth in Canby will require the addition of 2,286 new dwelling units between 2023 and 2043. After removing constrained lands from the vacant land inventory, the current Canby UGB is not sufficient to accommodate these future housing needs.

Urban Growth Boundary Expansion

The City has identified a need for a potential Urban Growth Boundary (UGB) expansion in the next five years, to add approximately 100 acres for housing and 440 acres for employment to the City's planning area. The Preliminary UGB expansion study area includes 1,600 acres of land surrounding the current UGB. Known hazards will be reviewed as part of this study to help determine the most resilient areas for expansion/development.

Stormwater Master Plan Update, 2023

This Stormwater Master Plan updates Canby's guiding principles for stormwater system design, the 2014 Capital Improvement Plan, and all project costs, and provides guidance for compliance with the Water Pollution Control Facility Permit issued to the City of Canby. The existing conveyance systems throughout the City are comprised of gravity storm drainage pipes, open drainage ways or ditches, trench drains, and UICs.

The City of Canby does not currently have stormwater water quality treatment requirements and the City is not a "regulated" small Municipal Storm Sewer System (MS4) subject to the EPA Phase II Stormwater Rule. The primary basis for adopting a Capital Improvement Plan for the City of Canby is to improve stormwater collection and disposal deficiencies in the system.¹ This plan identifies stormwater areas of concern, including localized/urban flooding, and recommends projects to address these issues (through 2043), including some long-range projects in anticipation of future classification as an EPA regulated MS4.

Parks and Recreation Master Plan, 2022

This update to the 2002 Parks Master Plan addresses a growing need for recreational resources within the community. It includes acquisition and development goals that include protection and restoration of sensitive riparian resources and wetlands along the Molalla River (“Molalla River Greenway” concept).

Community Wildfire Protection Plan (2024)

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex. The NHMP will also be integrated into the City’s Capital Improvement Plan, to be adopted by early 2024.

Personnel

The following Canby personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Jorge Tro, Police Chief

Public Information Officer: Jamie Stickel, Economic Development Director | Communications Specialist

Floodplain Manager: Planning Director

Grant writing (for Public Works or emergency management): Jamie Stickel, Economic Development Director | Communications Specialist

Capital improvement planning: Jerry Nelzen, Public Works Director

Capital improvement execution: Jerry Nelzen, Public Works Director

Canby does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

Canby has implemented recommendations from the last NHMP into its capital improvement projects over the last 5 years, including:

The following mitigation-related or resilience projects have been completed since 2018:

Ongoing projects that enhance the City’s resilience include:

- Emergency Operations Plan Update (expected 2024)

Proposed projects that relate to hazard mitigation and resilience within the next five years include:

- Wastewater Treatment Plant site improvements
- New wastewater treatment pump station
- Storm water system upsizing/capacity projects

Federal or State Funded Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority's [Seismic Rehabilitation Grant Program](#)¹.

FEMA Funded Mitigation Successes

- 2014: PDMC-PJ-10-OR-2011-001, Canby Water Reservoir Seismic Retrofit
- 2007: DR-1510-0005-R, Highway 99E Undergrounding Project, Canby Utility Board
- 2004: PDMC-PJ-10-OR-2003-003, City of Canby/Canby Telephone Central Offices Seismic Upgrade

Seismic Rehabilitation Grant Program Mitigation Successes

- none identified.

Capital Resources

Canby maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Critical facilities with power generators for use during emergency blackouts: Canby Public Works, Canby Police Department, and Canby Fire Station (main station and northside station). NOTE: Planned upgrades to emergency power to the Canby Civic Center and the Canby Adult Center. Schools: Trost Elementary School, Baker Prairie Middle School, and Canby Highschool

Warming/Cooling Shelters: Canby Public Library, Zoar Lutheran Church, the Canby Center, Canby Adult Center, Denny's Restaurant – open hours and days vary by location.

Food pantries: The Canby Center serves as the food pantry in Canby. NOTE: The Canby Center is expanding and the plans are consolidate the food pantry to a single location at the Canby Center, so I have removed St. Patrick's Church

Fueling storage: Public Works has plans to upgrade the City of Canby's fueling storage in 2024 to include 12,000 gallons of diesel, 12,000 gas.

Findings

Several important findings from this capability assessment informed the design of the Plan's mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Canby staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

Canby operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and

¹ 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.

federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City's ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAP 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 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 residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAP, 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.

All the 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.

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.

Mitigation Strategy

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

The City’s mitigation strategy (action items) were first developed during the 2003 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAC assessed the City’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 what accomplishments had been made and whether the actions were still relevant; any new action items were identified at this time (see Attachment A for more information on changes to action items).

Action Items

Table CA-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 with orange highlight. The City 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 CA-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	Update and revise the Canby Emergency Operations Plan.	X	X	X	X	X	X	X	X	X	X	City of Canby/Canby Fire District, Canby Utility	Short	Local Resources. DLCDC TA	Low
2	Ensure there are adequate shelter facilities in hazard-free zones to serve Canby residents. Identify potential shelter sites and evaluate their relative structural risks/structural deficiencies. Seek funding for upgrades on shelter sites if needed.		X	X	X	X		X	X	X	Hazard Mitigation Advisory Committee (HMAC)/ Public Works, Planning, Building	Short	Local Resources	Low	
3	Develop, enhance, and implement education programs designed to reduce the losses from natural hazards.	X	X	X	X	X	X	X	X	X	HMAC/ Canby Fire District, Canby Utility, Administration	Medium	Local Resources. DLCDC TA, FEMA HMA	Low	
4	Integrate the goals and action items from the Canby Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	HMAC/ Planning, Public Works	Medium	Local Resources. DLCDC TA, FEMA HMA-C&CB	Low to High	
5	Identify, plan, and establish an alternate potable water source on the Willamette River.	X			X	X					Canby Utility/ HMAC	Short	Local, State, Federal Grants FEMA HMA-C&CB	High	

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
6	Conduct seismic evaluations and upgrades on identified critical and essential facilities (e.g., Public Works Center, Canby Adult Center) and infrastructure for implementing appropriate structural and non-structural mitigation strategies.		X								HMAC/ Administration, Planning, Public Works, Police, Canby Fire District, Canby Utility	Long	Local, State and Federal Grants and BRIC	High
7	Evaluate and upgrade surface water management infrastructure when expanding the UGB and identify appropriate mitigation strategies.	X			X			X			Public Works/ Planning, Administration	Medium	Local, State, Federal Grants FEMA HMA-C&CB	High
8	Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.				X						Planning/ Public Works	Ongoing	Local Resources. DLCDC TA, FEMA HMA (FMA)	Low
9	Reduce the vulnerability of property owners in landslide-prone areas.					X					Planning/ Public Works	Long	Local Resources, FEMA HMA	Medium
10	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.							X			Canby Fire District/ Public Works, Planning	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low to High

Source: Canby NHMP HMAC, 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. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. 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 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure CA-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure CA-1 Understanding Risk



Hazard Analysis

The Canby HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Molalla, which are discussed throughout this addendum. Table CA-2 shows the HVA matrix for Molalla

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 a sense of hazard priorities but does not predict the occurrence of a hazard. Two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) and two chronic hazards (winter storm and flood) rank as the top hazard threats to the City (Top Tier). Landslide, wildfire, extreme heat, and drought comprise the next highest ranked hazards (Middle Tier), while windstorm and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table CA-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Earthquake - Cascadia	4	45	100	49	198	1	Top Tier
Earthquake - Crustal	6	50	100	21	177	2	
Winter Storm	18	30	70	49	167	3	
Flood	16	20	70	56	162	4	
Landslide	14	35	30	63	142	5	Middle Tier
Wildfire	12	25	70	21	128	6	
Extreme Heat Event	16	15	40	56	127	7	
Drought	10	15	50	42	117	8	Bottom Tier
Windstorm	14	15	30	42	101	9	
Volcanic Event	2	15	50	7	74	10	

Source: Canby HMAc, 2023.

Community Characteristics

Table CA-3 and the following section provides information on City 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 City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Canby has grown substantially since its incorporation in 1893 and has an area today of about 4 square miles. Canby lies in the heart of very productive agricultural lands.

Canby’s climate is consistent with the Marine west coast climate zone, with warm summers and cool, wet winters. Canby receives most of its rainfall between October and May, and averages 45 inches of rain.² Snowfall is rare but can occur annually.

The City of Canby is located on a relatively flat terrain and, with few exceptions, has only gentle changes in the topography of less than 30 feet within the city limits and Urban Growth Boundary (UGB), between 140 to 170 feet above mean sea level. The southwest portion of the city drops abruptly at the Molalla River to an elevation of approximately 80 feet. At the northern border of the UGB, the topography gradually slopes to the Willamette River, dropping from an elevation of approximately 130 feet to 100 feet at the city’s wastewater treatment facility. To the east of Canby, the topography changes very little until beyond the urban growth boundary, where the ground has undulating gentle hills in the southeastern areas and steep rocky cliffs in the northeastern areas along the Willamette River.

² “[Monthly Average for Canby, OR](#)” The Weather Channel Interactive, Inc. Retrieved April 11, 2019.

Population, Housing, and Income

Between 2016 and 2022 the City grew by 2,559 people (16%; as of 2022 the population was 18,979). Between 2022 and 2045 the population is forecast to grow by 22% to 23,104.

Most of the population is White/Caucasian (76%) and about 18% of the population is Hispanic or Latino. The poverty rate is 9% (8% of children under 18, 7% for people 65 and older), 9% do not have health insurance, and 51% of renters pay more than 30% of their household income on rent (35% for owners). About 29% of the population has a bachelor's degree or higher (10% do not have a high school degree). Approximately 14% of the population lives with a disability (34% of population 65 and older), and 22% are either below 15 (24%) or over 65 (19%) years of age. About 11% of the population are 65 or older and living alone and 9% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 72% of housing units are single-family, 23% are multifamily, and 5% are mobile homes. Less than one-fifth of homes (16%) were built before 1970 and 52% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Two-thirds (66%) of housing units are owner occupied, 32% are renter occupied, and 2% are vacant.

Transportation/Infrastructure

Canby is accessible by state highway 99E, running north to south on the city's west side. Congestion on 99E can result in the diversion of traffic onto City streets. Canby is also bisected by the Union Pacific Railroad main line, which separates the North side from the South; passenger service is provided by Amtrak.

Motor vehicles represent the dominant mode of travel through and within Molalla. Ten percent (10%) of renters and 2% of owners do not have a vehicle. Most workers drive alone to work (73%); 6% carpool, 2% use public transit, 4% either walk or use a bicycle, and 10% work at home.

The City's public transit is provided by the Canby Area Transit system, which provides shuttle transportation to scheduled route locations within Canby. The Canby Ferry, one of three ferries still in operation on the Willamette River, can transport nine vehicles per trip across the Willamette River. The availability and quality of pedestrian and bicycling facilities (sidewalks, bike lanes, and pathways) is inconsistent, generally newer neighborhoods have facilities.

Economy

Canby is a relatively self-sufficient city that operates its own electric and water service (uncommon in Oregon). The business district includes a thriving downtown core as well as flourishing businesses along Highway 99E. The Canby area has a multitude of attractions tied to the bountiful nursery industry, which attract thousands of visitors annually. In Clackamas County, 75% of the nursery acreage is in the vicinity of Canby.

To a certain extent, Canby has been a "bedroom" community for Portland and Salem, though the City hopes to moderate this trend by increasing industrial development. The City is accessible by rail and highway and is located outside of the Portland Air Quality Maintenance area (AQMA). About 49% of the resident population 16 and over is in the labor force (8,873 people) and are employed in a variety of occupations including management, business, and financial (19%), professional and related (16%), office and administrative (12%), construction, extraction, and maintenance (11%), and sales related (10%) occupations.

Most workers residing in the city (84%, 7,049 people) travel outside of the city for work primarily to Portland and surrounding areas.³ A significant population of people travel to the city for work, (82% of the workforce, 6,277 people) primarily from Portland and surrounding areas.⁴

³ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on December 19, 2023 at <https://onthemap.ces.census.gov>.

⁴ Ibid.

Table CA-3 Community Characteristics

Population Characteristics		Population	Household Characteristics	
		Growth		
2016 Population Estimate	16,420		Housing Units	
2022 Population Estimate	18,979	16%	Single-Family (includes duplexes)	4,882 72%
2045 Population Forecast*	23,104	22%	Multi-Family	1,567 23%
Race			Mobile Homes (includes RV, Van, etc.)	374 5%
American Indian and Alaska Native		< 1%	Household Type	
Asian		1%	Family Household	4,814 72%
Black/ African American		1%	Married couple (w/ children)	1,696 25%
Native Hawaiian and Other Pacific Islander		0%	Single (w/ children)	623 9%
White		76%	Living Alone 65+	737 11%
Some Other Race		0%	Year Structure Built	
Two or More Races		4%	Pre-1970	1,109 16%
Hispanic or Latino/a (of any race)		18%	1970-1989	2,188 32%
Limited or No English Spoken	1,430	8%	1990-2009	2,867 42%
Vulnerable Age Groups			2010 or later	659 10%
Less than 5 Years	745	4%	Housing Tenure and Vacancy	
Less than 15 Years	3,211	18%	Owner-occupied	4,478 66%
65 Years and Older	3,010	17%	Renter-occupied	2,183 32%
85 Years and Older	371	2%	Seasonal	0 0%
Age Dependency Ratio		0.52	Vacant	162 2%
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)	
Total Disabled Population	2,485	14%	No Vehicle (owner occupied)	73 2%
Children (Under 18)	136	3%	Two+ vehicles (owner occupied)	3,680 82%
Working Age (18 to 64)	1,346	12%	No Vehicle (renter occupied)	219 10%
Seniors (65 and older)	1,003	34%	Two+ vehicles (renter occupied)	976 45%
Income Characteristics			Employment Characteristics	
Households by Income Category			Labor Force (Population 16+)	
Less than \$15,000	485	7%	In labor Force (% Total Population)	8,873 49%
\$15,000-\$29,999	673	10%	Unemployed (% Labor Force)	259 3%
\$30,000-\$44,999	522	8%	Occupation (Top 5) (Employed 16+)	
\$45,000-\$59,999	818	12%	Management, Business, & Financial	1,637 19%
\$60,000-\$74,999	488	7%	Professional & Related	1,446 16%
\$75,000-\$99,999	1,295	19%	Office & Administrative	1,023 12%
\$100,000-\$199,999	1,831	28%	Construction, Extraction, & Maint.	941 11%
\$200,000 or more	549	8%	Sales & Related	917 10%
Median Household Income		\$83,948	Health Insurance	
Gini Index of Income Inequality		0.40	No Health Insurance	1,597 9%
Poverty Rates (Percent age cohort)			Public Health Insurance	6,472 36%
Total Population	1,647	9%	Private Health Insurance	12,364 69%
Children (Under 18)	348	8%	Transportation to Work (Workers 16+)	
Working Age (18 to 64)	1,088	10%	Drove Alone	6,388 73%
Seniors (65 and older)	211	7%	Carpooled	565 6%
Housing Cost Burden (Cost > 30% of household income)			Public Transit	158 2%
Owners with a Mortgage	1,101	35%	Motorcycle	0 0%
Owners without a Mortgage	263	20%	Bicycle/Walk	313 4%
Renters	1,105	51%	Work at Home	853 10%

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", 2016 & 2022; Portland State University, Population Research Center, "Population Forecast Tables", (2023, [Preliminary](#)).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Molalla. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

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 CA-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table CA-4 Critical Facilities in Canby

Critical Facilities by Community	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	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Ackerman Middle School	-	X	X	-	-
Baker Prairie Middle School	-	X	X	-	-
Canby Fire District 62	-	-	X	-	-
Canby Fire District Northside Station	-	X	X	-	-
Canby High School	-	X	X	-	-
Canby Police Department	-	-	-	X	-
Canby Public Works	-	X	X	-	-
Canby Sewage Treatment	-	X	X	-	-
Cecile Trost Elementary School	-	-	X	-	-
Howard Eccles Elementary School	-	X	X	-	-
Legacy Medical Group - Canby	-	X	X	-	-
Philander Lee Elementary School	-	X	X	-	-
Willamette Falls Health Center	-	-	X	-	-
William Knight Elementary School	-	-	X	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-14.

Highlighted cells are tentative to be confirmed by DOGAMI in their final Risk Report.

Additional Critical Facilities not included in the DOGAMI Risk Report

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include:

- 4 Power Substations
- Canby Area Transit (CAT)
- Canby Utility Business Offices
- City Hall Complex/Library
- Public Works Building (EOC #3)
- Telephone Central Station
- Wastewater Treatment Facilities
- Canby Police Department (EOC #2)
- Fire Station #362 (EOC #1)
- Fire Station #365 (south of Canby)

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. These facilities may include: community gathering places, churches, and other public facilities such as school fields.

- Ackerman Elementary School
- Baker Prairie School
- Canby High School
- Canby Adult Center
- Canby Christian Church
- Clackamas County Event Center
- Four Square Church
- Medical Clinics
- Old Canby Library Building
- St. Patricks Church
- United Methodist Church
- Student Transportation

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic, and functional ecosystem services for the community include:

- Canby City Parks
- Canby Utility Bottom Lands
- Emerald Park
- Molalla River State Park
- Willow Creek

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely.

Populations that have special needs or require special consideration include:

- Adult Foster Homes
- Canby Adult Center
- Countryside Living (assisted living)
- Hope Village (senior living and rehab)
- Providence Health Center
- Rackleff House (assisted living)
- Riverside RV Park
- Village on the Lochs

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered "critical." Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility.

Those sites that store, manufacture, or use potentially hazardous materials include:

- American Steel
- BBC Steel
- Johnson Controls Inc.
- JV Northwest
- Pacific Pride Fuel Storage Tanks
- Railroad

- SR Smith
- Wastewater Treatment Facility
- Water Treatment Facility
- Wilco

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Canby. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers and are a concern during evacuation/notification.

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

An example of the types of properties that should be considered before, during, and after an event include the following properties identified on the National Register of Historic Places within Canby:

- William Knight House, 525 SW 4th Avenue
- Kraft-Brades-Culbertson Farmstead, 2525 N Baker Drive
- Macksburg Lutheran Church, 10190 S Macksburg Road
- Herman Anthony Farm, 10205 S New Era Road

Other important historic resources:

- Canby Chapel
- Canby Depot Museum
- Canby Ferry
- Cemeteries
- Clackamas County Event Center

Hazard Characteristics

Drought

The HMAC determined that the City's probability for drought is **moderate** and that their vulnerability to drought 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 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.

The City of Canby currently obtains its potable water from the Molalla River with an intake pump station capacity of 7.9 million gallons a day (mgd). The primary groundwater source is the Springs Gallery with a seasonally varied capacity up to 1.4 mgd, though low pH and moderate nitrate concentrations limit the use of it as the primary source. The Canby Utility water system includes surface and groundwater sources, treatment facilities, 66 miles of piping, four storage reservoirs with total usable capacity of 5.5 million gallons, and three pump stations. The Water System Master Plan was last

updated in Summer 2023 to provide long-term guidance for the development of the City’s water system, which is a supporting document for the Comprehensive Plan.

Vulnerability Assessment

Due to insufficient data and resources, Canby 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 and Table CA-4.

Mitigation Activities

Canby Utility has a Water Supply Shortage Contingency Plan that details voluntary and non-voluntary actions to be taken in the event of a water shortage. Additional 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,”⁵ 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 City’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 Canby 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 Canby 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). Figure CA-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city 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.

Cascadia Subduction Zone

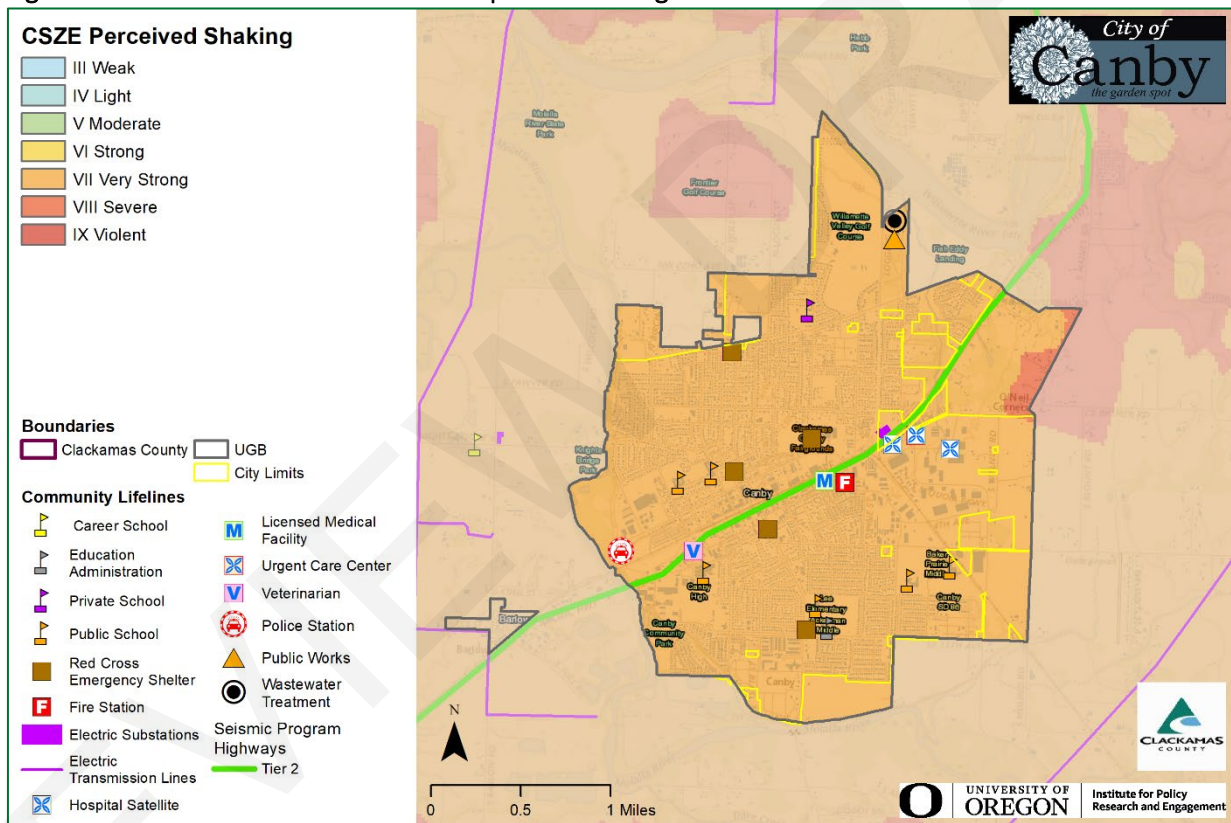
The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm

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

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.⁶

The city’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 city 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 city 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.

Figure CA-2 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

⁶ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

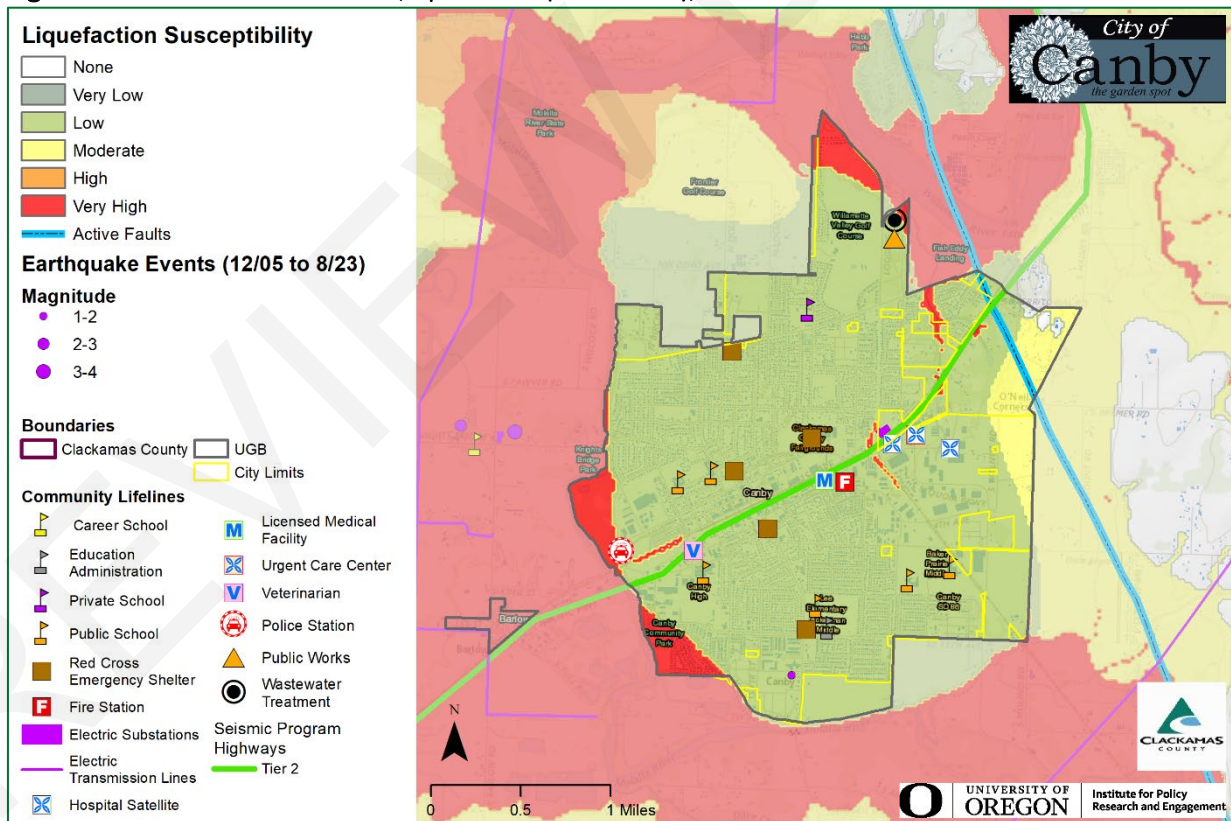
Earthquake (Crustal)

The HMAC determined that the City’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 Canby as well. Figure 3 shows a generalized geologic map of the Canby 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 City limits as red and orange.

There are two potential crustal faults and/or zones near the City that can generate high- magnitude earthquakes. These include the Gales Creek-Mt. Angel Structural Zone and Portland Hills Fault Zone (discussed in greater detail below). Other faults include the Canby- Molalla fault (running through the city’s east edge intersecting Highway 99E) and Oatfield fault (just to the east of the city on the eastern side of the Willamette River), and the Mt. Hood Fault in eastern Clackamas County. 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.

Figure CA-3 Active Crustal Faults, Epicenters (1971-2008), 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

Canby-Molalla Fault Zone

The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Molalla in northern Oregon.

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 lies about 11 miles northeast of Canby.

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 are provided at the end of the crustal earthquakes hazard section.

The city has overall moderate vulnerability to an earthquake, which includes the essential and critical facilities. Canby's infrastructure is particularly vulnerable to earthquake damage. All of the city's water facilities are all within the moderate hazard zone. Highway 99E crosses over the Molalla River and runs along the Willamette River, which are seismically vulnerable areas and might affect the ability of outside assistance in the case of an earthquake. During a major earthquake, emergency responders may have difficulty performing their duties because their buildings could be impacted by the event. The Canby Fire District 62 Station, and the Police Department's headquarters are in the moderate to high hazard zones. Areas near the Willamette and Molalla Rivers are likely comprised of softer soils prone to liquefaction. This can be very destructive to underground utilities such as water and sewer lines. Buildings and water lines can sink into the liquefied ground while sewer pipes, manholes and pump stations (assets partially filled with air) may float to the surface. After the earthquake, the liquefied soil will re-solidify, locking tilted buildings and broken pipe connections into place. In 2017, the Canby Fire District Station #62 was awarded a Seismic Rehabilitation Grant for \$233,256 and retrofitted their main fire station. For a list of facilities and infrastructure vulnerable to this hazard, see the Community Assets Section and Table CA-4.

Vulnerable populations such as children could be significantly impacted, as many schools lie in the moderate hazard zone. The data gathered from the statewide DOGAMI inventory should be used to prioritize school buildings in Canby for seismic hazard retrofitting.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 48% of residential buildings were built prior to 1990, which increases the City's 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 CA-5; each "X" represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), none have a very high (100% chance) or high (greater than 10% chance) collapse potential. *Note: one fire station has been rebuilt and the police department moved to a newly constructed location.*

Table CA-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Ackerman Center (350 SE 13 th Ave)	Clac_sch54	X			
Eccles Elementary (562 NW 5 th Ave)	Clac_sch55	X			
Knight Elementary (501 N Grant St)	Clac_sch53	X			
Lee Elementary (1110 S Ivy St)	-	Not assessed as part of the 2007 RVS			
Trost Elementary (800 S Redwood St)	Clac_sch76	X			
Baker Prairie Middle (1859 S Township Rd)	-	Not assessed as part of the 2007 RVS			
Canby High (721 SW 4 th Ave)	Clac_sch66	X			
Fire Facilities					
Canby Fire District Main Station 62 (221 S Pine St)	Clac_fir39	X			
See Mitigation Successes					
Canby Fire District Station 65 (26815 S Hwy 170) (Outside City)	Clac_fir48	X			
Law Enforcement Facilities					
Canby Policy Department (1175 NW 3 rd Ave)	-	Built at current site in 2012			

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](#)

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. Additionally, capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table CA-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Table CA-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	5,559	5,559	5,559	5,559
Building Value (\$ Million)	1,890	1,890	1,890	1,890
Building Repair Cost (\$ Million)	58	61	159	231
Building Loss Ratio	3%	3%	8%	12%
Debris (Thousands of Tons)	34	36	76	103
Long-Term Displaced Population	78	159	202	874
Total Casualties (Daytime)	38	40	109	172
Level 4 (Killed)	1	1	5	8
Total Casualties (Nighttime)	14	20	41	93
Level 4 (Killed)	0	0	1	2

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Cascadia Subduction Zone Scenario

The City of Canby is expected to have a 3% building loss ratio with a repair cost of \$58 million under the CSZ “dry” scenario, and a 3% building loss ratio with a repair cost of \$61 million under the CSZ “wet” scenario.⁷ The city is expected to have around 38 daytime or 14 nighttime casualties during the CSZ “dry” scenario and 40 daytime or 20 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 78 for the CSZ “dry” scenario and 159 for the CSZ “wet” scenario.⁸ (See Risk Report content for additional information.)

Portland Hills Fault Scenario

The City of Canby is expected to have a 8% building loss ratio with a repair cost of \$159 million under the CSZ “dry” scenario, and a 12% building loss ratio with a repair cost of \$231 million under the CSZ “wet” scenario. The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 109 daytime or 41 nighttime casualties during the Portland Hills Fault “dry” scenario and 172 daytime or 93 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 202 for the Portland Hills Fault “dry” scenario and 874 for the Portland Hills Fault “wet” scenario.

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 MO-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](#)).

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, O-24-XX)⁹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Reports the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone event (M9.0 Deterministic): 477 buildings, and (8 critical facilities), are expected to be damaged for a total potential loss of \$186 million (a loss ratio of 7%). About 516 residents may potentially be displaced.

Crustal event (Canby-Molalla fault M6.8 Deterministic): 2,210 building are expected to be damaged (12 critical facilities), for a total potential loss of \$811 million (a loss ratio of 31%). About 3,017 residents may be displaced (17% of population).

Future Projections

Future development (residential, commercial, or industrial) 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.

⁷ DOGAMI, *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, O-18-02), Tables 12-8 and 12-9.

⁸ Ibid, Tables 12-8 and 12-9.

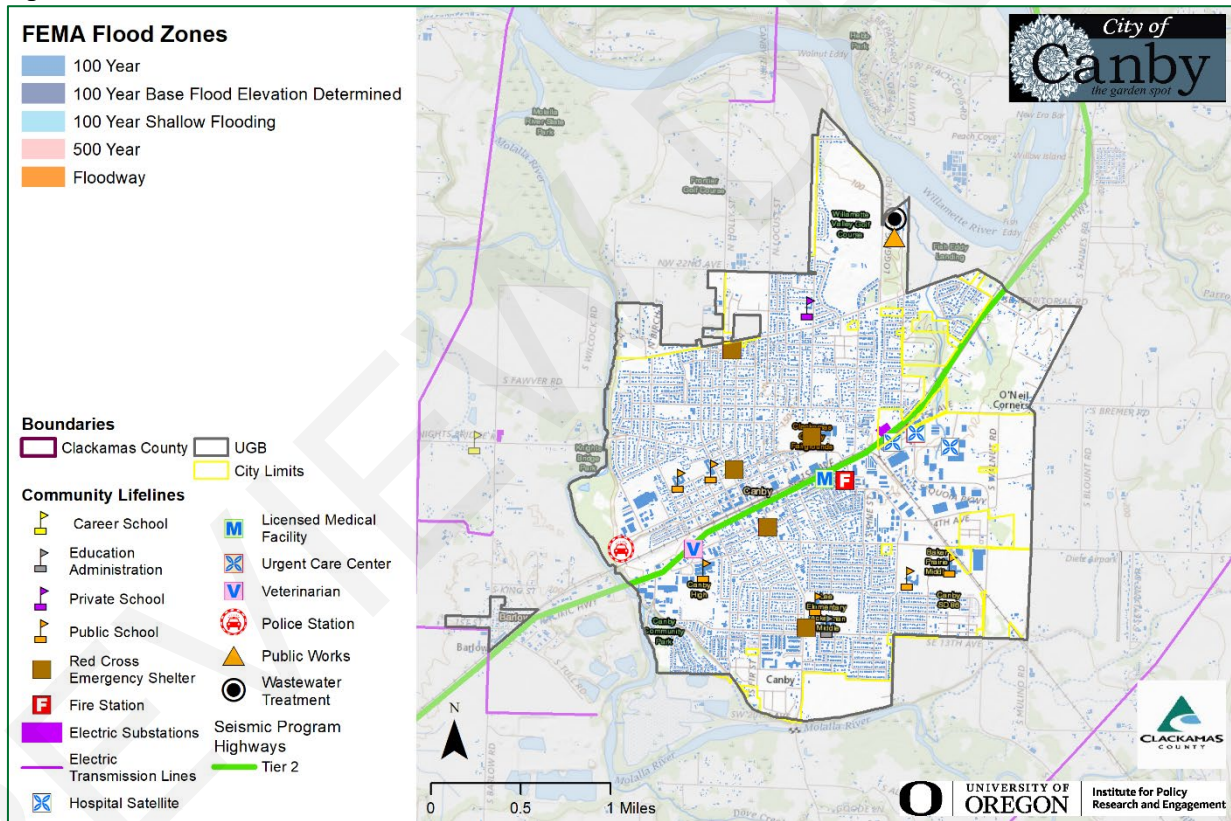
⁹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, [September 2023 Draft](#)), Table A-13.

Flood

The HMAC determined that the City’s probability for flood is **high** and that their vulnerability to flood is **moderate**. *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. Figure CA-4 illustrates the flood hazard area for Canby. Portions of Canby have areas of floodplain (located in the Hazard Overlay Zone). The Federal Emergency Management Agency (FEMA) regulatory floodplains for the Molalla and Willamette Rivers are depicted as relatively narrow areas on each side of the channels. On the Willamette River, the floodway is generally confined within high stream banks. On the Molalla River, the floodways cover a somewhat larger area that is usually located on the outside bank from Canby. 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 City to be aware of flooding impacts and assess its level of risk.

Figure CA-4 FEMA Flood Zones



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

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 Canby 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. City staff has identified sites where local drainage facilities are taxed during high flows, especially where open ditches enter culverts or go underground into storm sewers and works to mitigate the stormwater flood risks in these areas (see the City's Stormwater Master Plan for more information).

The largest flooding event to affect Canby was the February 1996 flood. The high-water level meant tributaries could not drain into the Molalla and Willamette River, which led to localized flooding on several backed-up creeks. Recently in December 2015, the Molalla River flooded low lying areas around Canby's South Pine Street.

The extent of flooding hazards in Canby primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow.

Vulnerability Assessment

The City completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2018. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

Approximately 4% percent of the total land area in Canby is exposed to the flooding hazard, and in some areas this hazard presents potential life safety hazards. Multi-family housing structures, including Redwood Terrace Apartment Complex and Canby Grove, may be affected by flooding. Critical facilities exposed to the flood hazard include the water treatment facility main river intake structure, the wastewater treatment facility, backwash ponds, and the city's public works facility. In flooding events these facilities may be exposed to high waters and services can be interrupted.

Bridges and culverts are also vulnerable to flooding because debris and sediment can choke culverts and undermine bridges, causing surface water drainage problems. Canby relies on bridges for transportation and connection to other main highways. Canby could potentially be isolated if the bridges were to fail. Knights Bridge and Goods Bridge are particularly exposed. Roadways exposed include S. Ivy (Hwy 170) and SW/SE 1st Ave (Hwy 99E). Disruption to this infrastructure could result in transportation issues, power outages, sewage back-up, and affect overall community and environmental health.

Many older buildings will have difficulty sustaining pressure from flooding events and should be targeted for floodplain retrofitting. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section and Table CA-4.

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, O-24-XX)**¹⁰ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled flood hazard.

¹⁰ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (O-24-XX, September 2023 Draft)*, Table A-13.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹¹ winter flood risk at mid- to low elevations in Clackamas County, where temperatures are near 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.

National Flood Insurance Program (NFIP)

FEMA’s [Flood Insurance Study](#) (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program. The last Community Assistance Visit (CAV) for the city was November 19, 1993. Canby does not participate in the Community Rating System (CRS). Canby has no Repetitive Loss or Severe Repetitive Loss Properties.

Landslide

The HMAC determined that the City’s probability for landslide is **high** and that their vulnerability to landslide is **moderate**. *The probability and vulnerability ratings increased 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. Although catastrophic landslides have not occurred in Canby, steep slopes do exist along the banks of the Molalla River and extends south from 6th Street up to the northern city limits. Highway 99E, north of Canby, is especially vulnerable to landslides with multiple incidents of rockslides shutting down lanes in 2007, 2010, and 2015. As an example, on January 7, 2009, two slides occurred in private yards after an intense winter storm. About three feet of earth fell 30 to 50 feet from the back yard of a home on North Baker Drive. Another home on Alder Creek Lane in Knights Bridge Estates lost approximately 10 feet of its back yard.

Landslide susceptibility exposure for Canby is shown in Figure CA-5. Most of Canby demonstrates a low to moderate landslide susceptibility exposure. Approximately 2% of Canby has very high or high, and approximately 9% moderate, landslide susceptibility exposure.¹² However, most of the areas that are identified to exhibit dangerous potential rapidly moving landslides are vacant and often preserved in wooded and dedicated open space.

Note that even if a jurisdiction 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.

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 CA-5. Additionally, the City completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2018. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community

¹¹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

¹² DOGAMI. [Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon](#) (2016)

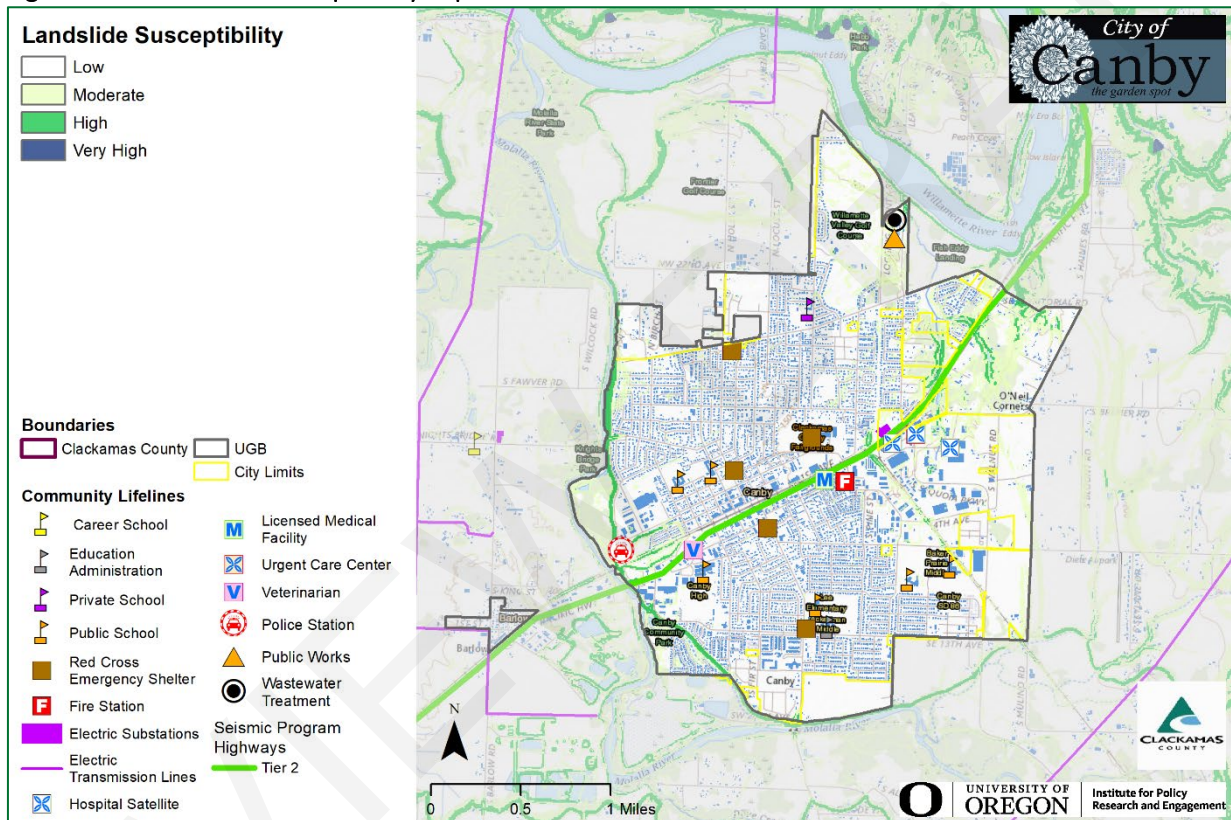
assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

Natural Hazard Risk Reports for Clackamas County

The Risk Report (DOGAMI, O-24-XX)¹³ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 11 buildings are exposed to the *high and very high landslide susceptibility* hazard (1 critical facilities) for a total exposure of \$19.5 million (a building exposure ratio of 0.7%). About 20 residents may be displaced by landslides (a population exposure ratio of 18.1%).

Figure CA-5 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

Two critical facilities are exposed to the landslide hazard — Canby Utility’s main river intake, Springs Gallery, and pump houses as well as the Police Department (EOC #2). The critical infrastructure is especially exposed to the landslide hazard. In addition, economic centers, cultural or historic assets, environmental assets, and hazardous material sites are exposed to the landslide hazard. Hazardous materials sites would also suffer damage, resulting in threats to environmental and human health, while disrupting the availability of gasoline for vehicle transport and furthering economic loss because such sites are also sources of employment. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section and Table CA-4.

¹³ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-13.

This exposure means that large scale and simultaneous landslides triggered by an earthquake could substantially disrupt City operations buildings, police, fire stations and key pieces of infrastructure (bridges, sewage pump stations, water reservoirs) that would hinder the ability of the City to respond to emergency situations created by such an event.

As a result, it will be important for the City to pursue opportunities for retrofitting and mitigating important structures and infrastructure, such that said facilities can withstand and survive landslides, particularly simultaneous landslides generated by an earthquake. Business continuity planning shall also be an important factor, given the number of economic centers and employment facilities that are threatened by the landslide hazard.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure 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, and thoroughfares beyond City limits are susceptible to obstruction as well.

The most common type of landslides are slides caused by erosion. 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.

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 can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **high** and that their vulnerability is **low**. *The probability rating increased and the vulnerability rating decreased since the previous 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 City 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 with temperatures greater than or equal to 90-degrees, or 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 City of Canby has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁴ 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 City’s probability for windstorm is **moderate** and that their vulnerability to windstorm is **low**. *The probability and vulnerability ratings decreased since the previous version of this 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 flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for Canby. In July 2016, two funnel clouds were spotted due to a low-pressure system and no damage was reported. While five miles east of Canby, a tornado touched down at Aurora State Airport in October of 2017.

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 may cause localized urban flooding.

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

¹⁴ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the City's probability for winter storm is **moderate** and that their vulnerability to winter storm is **moderate**. *The probability rating decreased and the vulnerability rating 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 City 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, they are frequent, and have the potential to impact economic activity. Road closures due to winter weather are an uncommon occurrence but can interrupt commuter and commercial traffic.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"¹⁵ 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 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.

Vulnerability Assessment

Due to insufficient data and resources, Canby is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards.

The areas of the City that are often most at risk to severe winter storms are residential areas on steeper slopes, where roads may be icy and, thus, difficult to climb and descend. Road corridors leading to residential areas with fuller tree canopies are susceptible to downed tree limbs, and those areas that are above 500 feet in elevation are particularly vulnerable. However, some weather systems are characterized by a temperature inversion, where the valley floor is colder than the nearby hills. Consequently, severe winter storms affect the entire city.

¹⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

The major risk to property results from exposed utilities, especially power lines and water pipes that are damaged by wind, broken tree limbs and cold temperatures. Businesses also suffer economic losses when they must close as the result of the inclement weather and/or the loss of power, which, in turn, disrupts the local supply chain of goods and services. Periods of extended ice coverage hinder emergency response services and limit the mobility of residents, which could result in serious life safety issues.

Telcom Central Station and City Hall Complex are critical facilities located adjacent to vulnerable power lines. Canby Utility, Public Works, and Canby Telephone would be strained during a severe storm event as they work to clear roads and repair or replace power distribution and/or transmission lines and maintain telephone lines for communication. Additionally, the area along 99E from South Elm to South Ivy St. is particularly vulnerable to damaged power lines from fallen tree limbs.

All schools and one adult community center that are considered essential facilities are also exposed to the severe weather hazards. In addition, critical infrastructure, economic centers, cultural or historic assets, environmental assets, and hazardous material sites are exposed to severe weather hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets section and Table CA-4.

The exposure of these facilities and infrastructure means that severe weather events could substantially disrupt the operations of City government buildings and fire stations, impairing key City functions, while hindering the ability of emergency response personnel to respond to emergency situations that are created by a severe storm event.

Volcanic Event

The HMAC determined that the City's probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **low**. *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 western portion of the County is likely to affect Canby as well. Several volcanoes are located near Canby, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Canby's relative distance from volcanoes, the city 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 city 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 city could experience a heavier coating of ash.

Natural Hazard Risk Reports for Clackamas County

The **Risk Report** [DOGAMI, O-24-XX](#)) provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

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

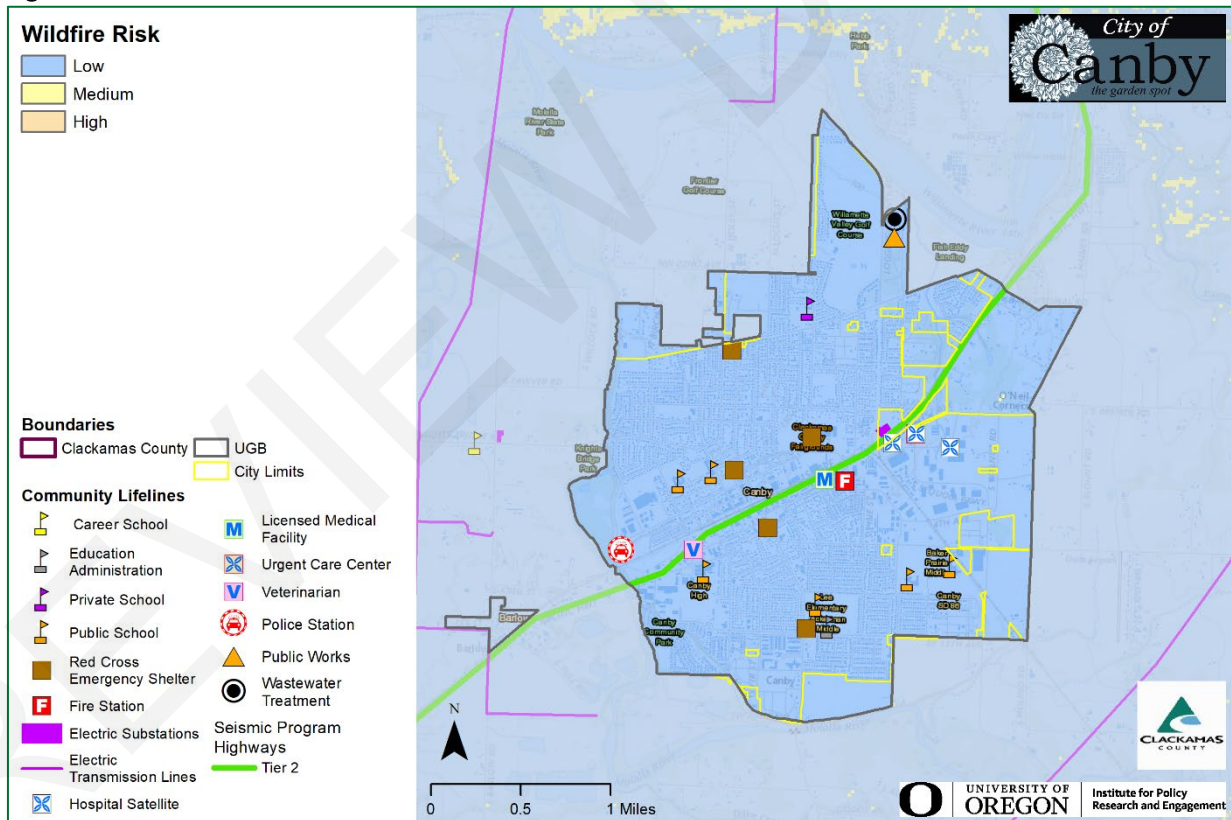
The HMAC determined that the City’s probability for wildfire is **low**, and that their vulnerability to wildfire is **moderate**. *These ratings did not change since the previous version of this NHMP.*

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 Canby is found in the following chapter: Chapter 9.2: Canby Rural Fire Protection District #62.

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.

Figure CA-6 shows overall wildfire risk in Canby. Weather, and urbanization conditions are primarily at cause for the hazard level. Canby has not experienced a catastrophic wildfire within City limits.

Figure CA-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished).

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

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 Canby, 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 Canby are interface areas including the following High Priority Communities at Risk (CARs): Adkins Circle, Dutch Vista/Madrona, Public Works Infrastructure, Sundowner, and the following Medium Priority CARs: N Side Molalla River Bluff, Molalla River State Park, and South End.¹⁶

The City is characterized by lush parks, neighborhoods surrounded by mature trees and under story vegetation and development intermingled with the natural landscape. One area of wildland-urban interface is the northeast portion of Canby. A heavily wooded area borders the north and south boundaries of the sewage treatment facility and Public Works Building (EOC #3). Most of the woodlands are surrounded by urban development that are a concern in the case of a wildfire event.

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four feet under normal weather conditions, except in a small, wooded area near the Willamette River on North Holly Street that has the probability of four to eight feet expected flame lengths. 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, Canby is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. However, the City completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2018. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

Residences and businesses that border wooded woodlands with slopes greater than 25% are at the greatest risk of loss or damage from wildfires. A great deal of infrastructure is exposed to the wildfire hazard, including Canby's primary water source, water treatment facilities, and Public Works Building (EOC#3). This could affect the efficiency of fire protection professionals during a large-scale wildfire. Vegetation along roadways is also highly dangerous, as negligent motorists provide ignition sources by tossing cigarette butts out car windows. A variety of historic landmarks are also included in the high wildfire zone.

Natural Hazard Risk Reports for Clackamas County

The **Risk Report (DOGAMI, O-24-XX)**¹⁷ provide hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 9 buildings are exposed to the *high and (or) moderate (medium) risk wildfire* hazard (no critical facilities) for a total exposure of \$2.9 million replacement value (a building

¹⁶ Clackamas County Community Wildfire Protection Plan, *Canby Rural Fire Protection District #62* (2018), Table 10.13-1.

¹⁷ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-13.

replacement value exposure ratio of 0.1%). About 8 residents may be displaced by wildfires (a population exposure ratio of 0.04%).

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁸ 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.

¹⁸ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

Table CA-7 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. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table CA-1).

Previous NHMP Actions that are Complete:

Severe Weather #1, *“Obtain funding to bury power lines subject to frequent failures to reduce power outages from the windstorm and severe winter storm hazard, where possible.”* Complete. This is part of normal operations.

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

None identified.

Table CA-7 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
Multi-Hazard #2	#2	Not Complete	Yes
Multi-Hazard #3	#3	Not Complete	Yes
Multi-Hazard #4	#4	Not Complete	Yes
Multi-Hazard #5	#5	Not Complete	Yes
Earthquake #1	#6	Not Complete, revised	Yes
Flood #1	#7	Not Complete, revised	Yes
Flood #2	#8	Not Complete	Yes
Landslide #1	#9	Not Complete	Yes
Severe Weather #1	-	Complete	No
Wildfire #1	#10	Not Complete	Yes

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 January XX through January XX on the City'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 added following posting

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 dates:

Meetings #1 and #2: March 20 and May 24, 2023 (via remote conference)

During these meetings, 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 city.
- 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 #3: December 14, 2023 (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 city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.