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

Photo Credit: City of Milwaukie

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Prepared for
The City of Milwaukie

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This Natural Hazard Mitigation Plan was prepared by:

CLACKAMAS COUNTY

UNIVERSITY OF OREGON | School of Planning, Public Policy and Management | Institute for Policy Research and Engagement

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Table of Content

List of Tables

List of Figures

Purpose

This is an update of the Milwaukie 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 Milwaukie'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.

Milwaukie 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.*

Milwaukie first developed an addendum to Clackamas County's Natural Hazard Mitigation Plan in 2003. This plan was updated in 2009, 2012/2013, and in 2018/2019.

In addition to establishing a comprehensive community-level mitigation strategy, the Disaster Mitigation Act of 2000 (DMA2K), and the regulations contained in 44 CFR 201, require that jurisdictions maintain an approved NHMP to receive federal funds for mitigation projects. Local adoption, and federal approval of this NHMP ensures that the 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 Milwaukie to update their NHMP.

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

Convener

The Milwaukie Events & Emergency Management Coordinator 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 Milwaukie 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 Milwaukie HMAC was composed of the following representatives:

- Convener, Dan Harris, Events and Emergency Management Coordinator
- Luke Strait, Police Chief
- Robbie Graves, Police Captain
- Damien Farwell, Fleet and Facilities Supervisor
- Mike Harman, Acting Fleet and Facilities Supervisor
- Nick Lindekugel, GIS Coordinator
- Natalie Rogers, Climate and Natural Resources Manager
- Peter Passarelli, Public Works Director
- Steve Adams, City Engineer
- Jennifer Garbely, City Engineer
- Patrick McLeod, Building Official
- Joseph Briglio, Community Development Director
- Brett Kelver, Senior Planner

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 Milwaukie 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 Milwaukie 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 city's Events & Emergency Management Coordinator will serve as the convener and will be responsible for assembling the HMAC. The HMAC will be responsible for:

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

The 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, Milwaukie 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 implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Milwaukie 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.

Milwaukie adopted a new Comprehensive Plan document in August 2020. The Community Vision in the Comprehensive Plan includes the statement: "Milwaukie is a resilient community, adaptive to the realities of a changing climate, and prepared for emergencies, such as the Cascadia Event." The Environmental

Stewardship and Community Resiliency chapter addresses Statewide Planning Goal 7 Natural Hazards. It includes "important issues that have gained prominence more recently, such as climate change adoption and mitigation" in Subsection 5, Natural Hazards. This chapter reflects the findings and recommendations of the Milwaukie Climate Action Plan (2018), Milwaukie Hazard Mitigation Plan (2020), and Clackamas County Multi-Jurisdictional Hazard Mitigation Plan (2019).

Hazards specifically called out include flooding, landslides, weak foundation soils, earthquakes, high winds, and wildfires. Key issues include climate change, Cascadia Subduction Zone Earthquake, and vulnerable populations. Goals identify areas with high natural hazard potential and develop policies and programs to avoid or reduce potential negative impact, expand partnerships and education, ensure that the City's build environment and infrastructure are adequately prepared, and develop programs for adaptation and mitigation. This includes a prohibition against building essential facilities that serve vulnerable populations in areas at risk from flooding, landslides, liquefaction, and fire.

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.

Title 3 of the Metro Urban Growth Management Functional Plan

This policy requires the city to balance any fill in the floodplain with a corresponding cut that excavates an equal amount of material. In addition, Title 3 requires the city to regulate the area of inundation from the 1996 flood in addition to the area with a 1% chance of flooding as identified on National Flood Insurance Program (NFIP) maps.

Municipal Development Codes

The Planning Department maintains and implements the Comprehensive Plan and other planning documents, and implements the community's development standards through the Zoning, Land Division, and Sign Ordinances. They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

Examples of Municipal Code sections that directly relate to resilience and mitigation efforts include:

- Title 16 Environment
  - Includes Chapter 16.12 Seismic Conditions, Chapter 16.16 Weak Foundation Soils, and Chapter 16.28 Erosion Control.
- Title 18 Flood Hazard Regulations
  - Adopted 2021 by Ordinance 2199, this section enforces the National Flood Insurance Program requirements within the city limits. Special flood hazard areas are those identified in the Flood Insurance Study for Clackamas County, Oregon and Incorporated Areas," dated January 18, 2019, with accompanying FIRMs 4100C0009D, 4100C0017D, 4100C0028D, and 4100C0036D. The February 1996 flood inundation area identified by the Metro Water Quality and Flood Management Area is also incorporated by reference. Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage.

- Title 19 Zoning
    - Title 19 includes land use standards for all zones and uses within the city.
- Title 12 Public Services
    - Includes development standards to meet provisions of the City's NPDES permit, including design standards for water quality facilities.

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.

The Milwaukie **Community Development Department** oversees the following departments and services:

The **Planning Division** regulates growth and development in the city of Milwaukie by administering the city's Comprehensive Plan and Municipal Code related to zoning and land division. Tasks range from implementing existing zoning regulations to assisting city Council with land use and growth planning policy development. Planning is also responsible for regulating development impacts in natural resource areas.

The **Building Division** is responsible for plan review and inspections on commercial, industrial, and residential developments, as well as fire life and safety plan review. The Division administers and enforces the 2022 Oregon Fire Code, the 2022 Oregon Structural Specialty Code, Mechanical Specialty Code, Plumbing Specialty Code, Electrical Specialty Code, and Residential Specialty Code.

The **Engineering Department** provides quality engineering services to ensure that all city utilities, including wastewater collection, water, streets, and storm water infrastructure, meet all municipal code requirements, are efficiently managed at the lowest cost to ratepayers, and serve the long-term needs of the community. In addition, the Engineering Department provides floodplain management and regulation for the city.

Public Works

The City of Milwaukie Public Works Department is composed of the divisions responsible for stormwater, wastewater, water, streets, facilities, natural resources, and the city's fleet. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

The **Public Works Department** provides many of the basic urban services to the citizens of Milwaukie including the following:

The **Stormwater Division** conducts regular sewer line cleaning and inspection. The Stormwater Division maintains all the components that comprise the city's stormwater infrastructure, valued at over $6,094,886. The various components of the system include: 1190 catch basins, 548 manholes, 62 sedimentation-manholes, 197 drywells, 37 miles of pipe and open ditches, and 5 detention ponds. It uses information from inspections for ongoing analysis of the sewer system components and capital needs assessment, and on the spot pipe rehabilitation to minimize sewer back-ups.

The **Wastewater Division** is responsible for the maintenance of the city's wastewater (sanitary sewer) system. The Wastewater Division maintains all the components that comprise the city's wastewater

infrastructure, valued at over $7,029,552. The various components of the system include: 75 miles of sanitary sewer, 5 lift stations, and 1,607 manholes.

The **Water Division** is responsible for the supply and distribution of drinking water. The Water division maintains all the components that comprise the city's infrastructure, valued at over $16,516,356. The various components of the system include: 100 miles of water main, 964 fire hydrants, 6,911 water services, 7 well houses, 3 storage reservoirs and 4 pump stations. The division ensures that the city's water storage and distribution systems comply with all state and federal regulations.

The **Streets Division** maintains all the components that comprise the city's infrastructure, valued at over $ 38,785,042. The various components of the system include: 75 miles of road surface, signage, and street pavement markings.

The **Fleet Division** maintains all the city's vehicles and equipment including police cars, sweepers, excavators, dump trucks and 150 pieces of small equipment and generators. And, the **Facilities Division** is responsible for maintaining all city facilities.

The **Natural Resources Division** is responsible for the maintenance of green infrastructure in the city, including management of the urban forest. It also ensures that the city complies with the National Discharge Elimination System (NPDES) to protect surface water quality. The Natural Resources division also leads the city's climate work and environmental outreach and education.

City Administration

The City Council of Milwaukie 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.

The **Office of the City Manager** is responsible for taking charge of the daily supervision of city affairs. The Events & Emergency Management Coordinator is assigned to this department.

Policies and Programs

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

Transportation System Plan 2025

The City has begun a comprehensive Transportation System Plan update (updating the original 2008 document, which was partially updated in 2013). One of the broad goals for the update is to "improve Milwaukie's ability to recover from severe storms or an earthquake."

Water System Master Plan 2021

This 2021 Water Master Plan (2021 WMP) updates the City of Milwaukie's 2010 Water Master Plan. The 2021 WMP describes current conditions of the City's water system and addresses projected future needs. Information in the 2021 WMP enables City staff to respond effectively to new water system demand for future development. It includes a capital improvement program (CIP) designed to meet current and future demand and to replace aging and seismically non-resilient assets. The 2021 WMP includes an assessment of seismic resiliency of public water system assets in compliance with Oregon Health

Authority requirements and identifies water system risks associated with natural hazards and malevolent act based on the U.S. Environmental Protection Agency's comprehensive list of water system threats.

Stormwater Management

Under the Clean Water Act, the City of Milwaukie is permitted to manage storm water in a manner that reduces pollution from entering local streams and groundwater to the maximum extent practicable. The division develops and oversees the Capital Improvement Program (CIP) for replacing or upgrading Stormwater infrastructure found in the 2014 Stormwater Management Plan.

The Stormwater division must ensure that the work is done in compliance with the National Pollutant Discharge Elimination System (NPDES) Permit. This Division has an aggressive sweeping cycle of every eight days to meet NPDES MS4 Permit requirements and it is committed to an ongoing education program for its employees to keep up with the evolving changing technology, rules, and regulations.

TMDL Plan

The City maintains a Total Maximum Daily Load (TMDL) Plan (updated in 2022). The Total Maximum Daily Load (TMDL) program is intended to comply with the Willamette Basin TMDL order and to address the Revised Willamette Basin Mercury TMDL (effective February 2021). The goal of this Implementation Plan is to minimize and reduce temperature, bacteria, mercury, and DDT/dieldrin (Johnson Creek only) contributions to surface waters within Milwaukie. The NHMP actions are incorporated into this document as appropriate. Example projects include erosion control education and enforcement, stormwater conveyance system cleaning and maintenance, and consistent street cleaning.

Community Wildfire Protection Plan

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.

National Flood Insurance Program

Milwaukie participates in the National Flood Insurance Program. The Engineering and Planning Divisions and Public Works share responsibility for administering the day-to-day activities of the city's floodplain program.

Specifically, the floodplain manager is responsible for:

- maintains and administers Milwaukie's floodplain regulations;
- reviews and issues floodplain development permits;
- maintains elevation certificates for all new and substantially improved structures (and maintains an extensive database of historic elevation certificates);
- ensures that encroachments do not occur within the regulated floodway;
- implements measures to ensure that new and substantially improved structures are protected from flood losses;
- maintains floodplain studies and maps and makes this information available to the public;
- maintains a flood information website with digital flood insurance rate map (DFIRM) data;
- conducts site visits to assess conditions and provide technical assistance to the public;
- maintains a library of historical flood related information;
- informs the public of flood insurance requirements; and
- conducts outreach and training about flood hazards and development within the floodplain.

Community Emergency Response Teams (CERT)

The Milwaukie CERT program was founded in 2010 and includes active and reserve members who meet periodically for training and to conduct drills that prepare them to help in responding to natural hazards – such as flooding, earthquakes, and snow/ice – that impact Milwaukie.

Personnel

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

Emergency Management: Dan Harris, Events & Emergency Management Coordinator

Public Information Officer: Jordan Imlah, Communication Program Manager

Floodplain Manager: Brett Kelver, Senior Planner

Grant writing (for Public Works or emergency management): Dan Harris, Events & Emergency Management Coordinator

Capital improvement planning: Jennifer Garbely, City Engineer

Capital improvement execution: Jennifer Garbely, City Engineer

Milwaukie 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

Milwaukie 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 are a sample of those completed prior to 2018:

- Ardenwald Elementary reconstruction (2010)

The following mitigation-related or resilience projects have been completed since 2019:

- Milwaukie High School reconstruction

Ongoing projects that enhance the City's resilience include:

- Public Safety Building seismic upgrade

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

- Seismic evaluation of Stanley Reservoir and performance of required retrofit
- Seismic evaluation of wells, pumphouses, and 3rd Pressure Zone building.
- Removal of Kellogg Dam in 2027-2028. The project will include habitat restoration on lower Kellogg Creek.

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

- 2016: FMA-PJ-10-OR-2016-002, *Rusk Road Acquisition/demolition* ($395,485) In City
- 2016: FMA-PJ-10-OR-2016-003, *Acquisition/demolition* ($474,078) In City

Seismic Rehabilitation Grant Program Mitigation Successes

- 2022: Public Safety Building ($1,233,817) -*in process*

Capital Resources

Milwaukie 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 include: City Hall, the Public Safety Building, and several Public Works facilities around the city.

Warming or cooling shelters include: The City's Ledding Library acts as a de facto warming/cooling center during operating hours. Discussions are underway with Clackamas Countyj to expand its capacity as a colling center and to identify private providers for a warming shelter within the city.

Food pantries include: The city does not maintain any food pantries. Pantries are maintained by Providence Milwaukie Hospital, the North Clackamas School District, the LoveOne community organization, and other non-city organizations.

Fueling storage: The city does not maintain fueling services following the decommissioning of its fueling center at its Johnson Creek Boulevard facility. The city relies on commercial fueling centers for gasoline and diesel fuel.

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

Milwaukie staff are assigned hazard mitigation responsibilities as a 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.

[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.

Reliance upon outside funding streams and local match requirements

Milwaukie operates on a limited budget with many conflicting priorities. The city incorporates hazard mitigation as part of infrastructure and other projects, even where hazard mitigation is not the primary purpose of those projects. The city relies upon state and 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 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of 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 HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

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) was first developed during the 2009 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 if the action is complete, not complete and whether the

actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table MI-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 MI-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
1	Coordinate with Clackamas County, OEM, the American Red Cross, and other relevant agencies to identify shelter facilities within Milwaukie to ensure there are adequate shelter facilities in hazard-free zones to serve Milwaukie residents.		X	X	X	X	X	X	X	X	Emergency Management/ CERT Volunteer, CFD#1	Ongoing	General Fund, BRIC	Low
2	Increase outreach and education for hazard awareness and natural disaster preparedness, especially for low-income, elderly, non-English speaking, and other vulnerable populations.	X	X	X	X	X	X	X	X	X	Emergency Management/ Public Works, Community Services, CFD#1, CERT	Ongoing	General Fund, HMGP, BRIC	Medium
3	Maintain and enhance strategies for debris management for all hazards.		X		X	X	X	X	X	X	Public Works/ METRO	Ongoing	General Fund	Medium
4	Improve and obtain resources and equipment essential for responding to and recovering from disasters.	X	X	X	X	X	X	X	X	X	Public Works/ Emergency Management	Ongoing	General Fund, HMGP, BRIC, Seismic Rehabilitation Grant Program	High
5	Coordinate natural hazard related climate change action items through the Milwaukie Community Climate Action Plan (CAP).	X		X	X			X	X	X	Public Works/ Planning, CFD#1, EM, Community Services	Ongoing	General Fund	High
6	Evaluate alternatives for reducing the flooding hazard for properties along Kellogg Creek, Johnson Creek, Mount Scott Creek area, and the Willamette River.				X						Engineering/ Planning, Public Works	Long	General Fund, HMGP, FMA, PDM	High

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
7	Bury vulnerable critical infrastructure, such as power lines, to lessen potential failures during severe weather.								X	X	Public Works / Engineering	Long	General Fund, HMGP, BRIC	High
8	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.									X	Emergency Management/ Clackamas FD1, Public Works, Building, Planning	Ongoing	General Fund, HMGP, BRIC	Low

Source: Milwaukie 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

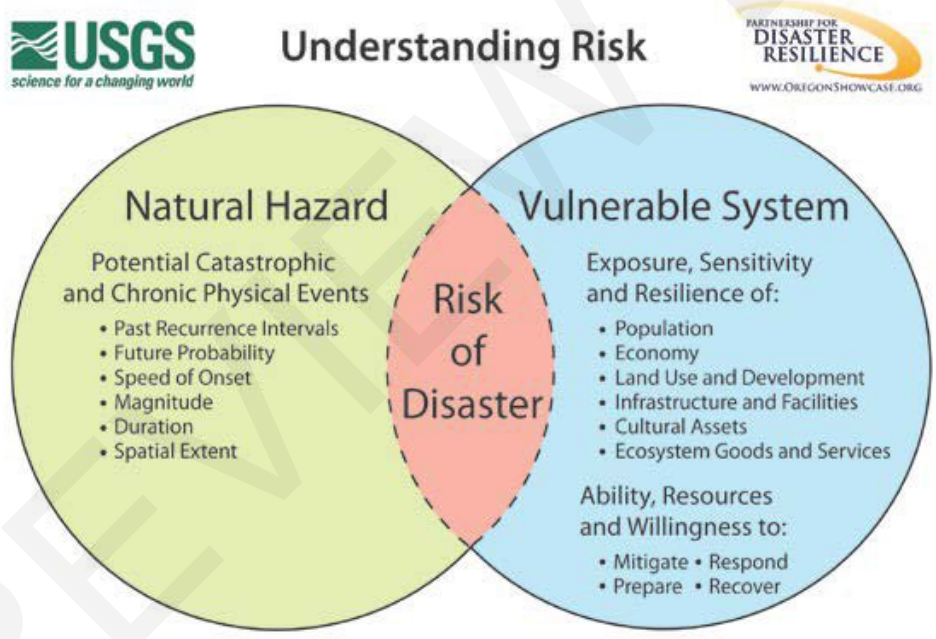
Risk Assessment

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 MI-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure MI-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The Milwaukie 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 Milwaukie, which are discussed throughout this addendum. Table MI-2 shows the HVA matrix for

Milwaukie 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. Three chronic hazards (extreme heat, wildfire, and flood) rank as the top hazard threats to the City (Top Tier). Cascadia earthquake, crustal earthquake, winter storm, drought, and windstorm comprise the next highest ranked hazards (Middle Tier), while landslide and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table MI-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Extreme Heat Event	16	50	90	70	226	1	*Top Tier*
Wildfire	16	45	90	70	221	2	
Flood	10	30	80	70	190	3	
Earthquake - Cascadia	2	50	100	35	187	4	*Middle Tier*
Earthquake - Crustal	2	40	100	42	184	5	
Winter Storm	16	20	90	56	182	6	
Drought	16	20	70	70	176	7	
Windstorm	8	25	70	56	159	8	
Landslide	12	15	60	56	143	9	*Bottom Tier*
Volcanic Event	2	15	50	7	74	10	

Source: Milwaukie HMAC, 2023.

Future Climate Variability

Human-caused climate change is impacting the natural systems and environmental health of regional and local communities. The city of Milwaukie recognizes the effects that climate change will have on the city and its residents, including changes to the frequency, severity, and impacts of natural hazards from historical norms. According to the Intergovernmental Panel on Climate Change Fourth National Climate Assessment, the Pacific Northwest region will see impacts to drought risk, water quality, wildfires and air quality, human health and more due to climate change. Even with these challenges, the Pacific Northwest and the city of Milwaukie will shelter a growing population seeking livability and refuge from more extreme climates in the nation.

Climate models for Oregon suggest, future regional climate changes include increases in temperature around 0.2-1°F per decade in the 21st Century, along with warmer and drier summers, and some evidence that extreme precipitation will increase in the future.[2] Increased droughts may occur in the Willamette Valley under various climate change scenarios because of factors, including reduced snowpack, rising temperatures, and reductions in summer precipitation. Climate models suggest that as the region warms, winter snow precipitation will likely shift to higher elevations and snowpack will be diminished as more precipitation falls as rain altering surface flows.

Acknowledging the city's responsibility to be a leader in the climate crisis, Milwaukie adopted a Climate Action Plan detailing 53 city-led actions to mitigate and adapt to climate change. Along with reducing the city's greenhouse gas emissions and contribution to climate change, the Climate Action Plan calls for

[2] Oregon Climate Change Research Institute (OCCRI), Fourth Oregon Climate Assessment Report (2019) and Fourth National Climate Assessment, Chapter 23: Northwest (2019). http://www.occri.net/publications-and-reports/publications/

increasing the community's resiliency and preparedness for natural hazards through policy, advocacy, outreach, and education.

Milwaukie is committed to planning and preparing for the immediate and future threats that climate change will have on the community. By addressing the climate crisis through the actionable goals of the Climate Action Plan, Milwaukie hopes to reduce the risk and impact of climate change related natural hazards on residents of Milwaukie and the region while encouraging others to take climate action.

Community Characteristics

Table MI-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.

The city is located within the southern bounds of the Portland metropolitan area approximately six miles from downtown Portland. The city is within the Willamette River basin and has two major creeks flowing through it, Johnson Creek in the northern part of the city and Kellogg Creek in the south.

Milwaukie's climate is consistent with the Marine West Coast Climate Zone, with warm summers and cool, wet winters. Milwaukie receives most of its rainfall between October and May, and averages 43 inches of rain, and less than one (1) inch of snow, per year. Elevations in the city range from 205 feet near 59th Avenue and Monroe Street to a low of 43 feet on the shores of the Willamette River. Milwaukie is characterized by flat or gently hilly topography.

Population, Housing, and Income

Milwaukie has grown substantially since its incorporation in 1903 and has an area today of about 5 square miles. Between 2016 and 2021 the City grew by 795 people (4%; as of 2022 the population is 21,305). Between 2022 and 2040 the population is forecast to grow by 9% to 23,268.

Most of the population is White/Caucasian (81%) and about 18% of the population is Hispanic or Latino. The poverty rate is 8% (7% of children under 18, 11% for people 65 and older), 6% do not have health insurance, and 53% of renters pay more than 30% of their household income on rent (34% for owners). About 38% of the population has a bachelor's degree or higher (5% do not have a high school degree). Approximately 12% of the population lives with a disability (30% of population 65 and older), and 38% are either below 15 (21%) or over 65 (17%) years of age. About 12% of the population are 65 or older and living alone and 10% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 73% of housing units are single-family, 26% are multifamily, and 1% are mobile homes. Over half of homes (55%) were built before 1970 and only 22% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (57%) of housing units are owner occupied, 40% are renter occupied, less than 1% are seasonal homes, and 3% are vacant.

Transportation and Infrastructure

Milwaukie is accessible by two state highways, 99E (or McLoughlin Blvd.), running north to south in the western part of the city, and Highway 224, running west to east through the central part of the city. Milwaukie is also bisected by the Union Pacific Railroad main line, which travels northwest to southeast carrying both passengers and freight.

As shown in Table MI-3 Motor vehicles represent the dominant mode of travel through and within Milwaukie. Nine percent (9%) of renters and 39% of owners do not have a vehicle. Most workers drive alone to work (69%); 7% carpool, 6% use public transit, 4% either walk or use a bicycle, and 14% work at home.

The responsibility and authority, as well as the financial capability, to maintain an adequate level or service for the highways rests with Metro and Oregon Department of Transportation (ODOT) authorities. Congestion can result in the diversion of traffic onto City streets.

The City's public transit is provided by the TriMet transit system. Nine bus routes go through the downtown Milwaukie transit center daily. The MAX Orange Line provides service to Milwaukie. The availability and quality of pedestrian and bicycling facilities (sidewalks, bike lanes, and pathways) is inconsistent but has improved substantially since the 2019 NHMP update due to an increased investment in the Safe Routes to School and Safe Access for Everyone Programs. Base Maps are found on the city's website.

Economy

Milwaukie is a major industrial center in the Portland metropolitan area containing one of the largest concentrations of warehousing and distribution facilities in the region. The Milwaukie Industrial Park, Omark Industrial Park, and the Johnson Creek industrial area comprise over 300 acres of industrial land within the city. These areas are nearing capacity and very little land within the city is currently available for new industrial development.

Milwaukie's commercial lands are largely built up. New commercial development along Highway 224, McLoughlin Boulevard, and 82nd Avenue has lured many people away from downtown Milwaukie for purchasing comparison goods such as clothes, furniture, and appliances. Downtown Milwaukie, however, has continued to attract commercial investment in the form of commercial service uses including banks, insurance, professional offices, and several residential mixed-use developments. The city has identified areas for commercial, office, or mixed use development: map.

The City, school district, and smaller employers (retail, offices and other professional services) provide for most of Milwaukie's employment.

About 56% of the resident population 16 and over is in the labor force (11,892 people) and are employed in a variety of occupations including professional (25%), management, business, and financial (19%), office and administrative (13%), sales (10%), and construction, extraction, and maintenance (9%) occupations.

Most workers residing in the city (93%, 9,523 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, (95% of the workforce, 12,992 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 18, 2023 at https://onthemap.ces.census.gov.

[4] Ibid.

Table MI-3 Community Characteristics

Population Characteristics		Population Growth
2016 Population Estimate	20,510	
2022 Population Estimate	21,305	4%
2045 Population Forecast*	23,268	9%
Race		
American Indian and Alaska Native		< 1%
Asian		3%
Black/ African American		1%
Native Hawaiian and Other Pacific Islander		< 1%
White		81%
Some Other Race		< 1%
Two or More Races		6%
Hispanic or Latino/a (of any race)		18%
Limited or No English Spoken	309	2%
Vulnerable Age Groups		
Less than 5 Years	1,108	5%
Less than 15 Years	3,264	16%
65 Years and Older	3,217	15%
85 Years and Older	369	2%
Age Dependency Ratio		0.44
Disability Status (Percent age cohort)		
Total Disabled Population	2,618	12%
Children (Under 18)	124	3%
Working Age (18 to 64)	1,546	11%
Seniors (65 and older)	948	30%

Household Characteristics		
Housing Units		
Single-Family (includes duplexes)	6,935	73%
Multi-Family	2,507	26%
Mobile Homes (includes RV, Van, etc.)	116	1%
Household Type		
Family Household	5,176	56%
Married couple (w/ children)	1,482	16%
Single (w/ children)	892	10%
Living Alone 65+	1,090	12%
Year Structure Built		
Pre-1970	5,212	55%
1970-1989	3,129	33%
1990-2009	1,151	12%
2010 or later	66	1%
Housing Tenure and Vacancy		
Owner-occupied	5,441	57%
Renter-occupied	3,779	40%
Seasonal	32	< 1%
Vacant	306	3%
Vehicles Available (Occupied Units)		
No Vehicle (owner occupied)	171	3%
Two+ vehicles (owner occupied)	3,824	70%
No Vehicle (renter occupied)	352	9%
Two+ vehicles (renter occupied)	1,268	34%

Income Characteristics		
Households by Income Category		
Less than $15,000	504	5%
$15,000-$29,999	754	8%
$30,000-$44,999	1,363	15%
$45,000-$59,999	994	11%
$60,000-$74,999	1,090	12%
$75,000-$99,999	1,167	13%
$100,000-$199,999	2,891	31%
$200,000 or more	457	5%
Median Household Income		$73,351
Gini Index of Income Inequality		0.40
Poverty Rates (Percent age cohort)		
Total Population	1,902	9%
Children (Under 18)	403	10%
Working Age (18 to 64)	1,159	8%
Seniors (65 and older)	340	11%
Housing Cost Burden (Cost > 30% of household income)		
Owners with a Mortgage	1,406	34%
Owners without a Mortgage	226	17%
Renters	1,986	53%

Employment Characteristics		
Labor Force (Population 16+)		
In labor Force (% Total Population)	11,892	56%
Unemployed (% Labor Force)	632	5%
Occupation (Top 5) (Employed 16+)		
Professional & Related	2,978	25%
Management, Business, & Financial	2,223	19%
Office & Administrative	1,585	13%
Sales & Related	1,152	10%
Construction, Extraction, & Maint.	1,027	9%
Health Insurance		
No Health Insurance	1,329	6%
Public Health Insurance	7,194	34%
Private Health Insurance	15,210	72%
Transportation to Work (Workers 16+)		
Drove Alone	8,126	69%
Carpooled	841	7%
Public Transit	678	6%
Motorcycle	0	0%
Bicycle/Walk	416	4%
Work at Home	1,662	14%

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", METRO 2040 Population Distributed Forecast (2021, Exhibit A to Ordinance 21-1457).
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 Milwaukie. 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 and essential 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 MI-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table MI-4 Critical Facilities

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
Ardenwald Elementary School	-	X	X	-	-
Campbell Elementary School	-	X	X	-	-
Public Safety Building (CFD #1 - Station 2)	-	X	-	-	-
Kellogg Creek WWTP	-	X	X	-	-
Lewelling Elementary School	-	X	-	-	-
Milwaukie Elementary School	-	X	X	-	-
Milwaukie High School	-	X	X	-	-
Milwaukie Public Works Campus	-	X	X	-	-
Portland Waldorf School	-	X	X	-	-
Providence Milwaukie Hospital	-	X	X	-	-
Rowe Middle School	-	X	X	-	-

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

Additional Critical Facilities not included in the DOGAMI Risk Report:

Facilities not in the City:

- Town Center Station (11300 SE Fuller Rd)
- Oak Grove Station (2930 SE Oak Grove Blvd)
- Lake Road Station (6600 SE Lake Rd)
- Clackamas County Sheriff's Office (9101 SE Sunnybrook Blvd)
- Oregon State Police (8805 SE Deer Creek Ln)

Hospitals:

- Kaiser Permanente Sunnyside Hospital (10180 SE Sunnyside Rd; not in city)
- Providence Willamette Falls Medical Center (1500 Division St; not in city)

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, commercial centers, and other public facilities such as school fields.

City Buildings:

- City Hall
- Ledding Library
- Milwaukie Community Center
- Johnson Creek Blvd Campus
- Public Safety Building

County Buildings:

- Kellogg Treatment Plant

Schools:

- Ardenwald Elementary
- Clackamas Community College (Harmony Road Campus)
- Linwood Elementary
- Milwaukie Elementary/ El Puente
- Milwaukie High School
- Portland Waldorf School (private)
- Rowe Middle School
- Seth Lewelling Elementary
- St. John the Baptist School (private)
- School Transportation Center (not in city)
- Wichita Center (not in city)

Potential Red Cross Shelter Sites:

- Milwaukie Community Center (5440 SE Kellogg Creek Dr)
- Milwaukie Presbyterian Church (2416 SE Lake Rd)
- Clackamas Park Friends Church (8120 SE Thiessen Rd, Oak Grove)
- King of Kings Lutheran Church (5501 SE Thiessen Rd, Oak Grove)
- New Hope Church (5197 SE King Rd, Milwaukie)
- Grace Pointe Church (10750 SE 42nd Ave)
- Oddfellows Hall (10282 SE Main St)
- Schools throughout Milwaukie

Essential Infrastructure

Infrastructure that provides necessary services for emergency response include:

Bridges:

Clackamas County:

- 55th Ave across Johnson Creek
- 60th Ave across Johnson Creek
- Linwood Ave across Johnson Creek
- Milport Rd across Johnson Creek
- Oatfield Rd across Kellogg Creek
- Rusk Rd across Mount Scott Creek

Portland:

- Johnson Creek Blvd. across Johnson Creek
- Ochoco St across Johnson Creek

TriMet (rail):

- Rail across Highway 99E
- Rail across Kellogg Creek
- Rail crossing north of Mailwell Dr

State of Oregon:

- 17th Ave across Johnson Creek
- McLoughlin Blvd. across Johnson Creek N. of city
- McLoughlin Blvd. across Kellogg Creek
- McLoughlin off-ramp to Hwy 224 across Johnson Creek
- Hwy 224 across Johnson Creek, McLoughlin Blvd. & Main
- Hwy 224 across railroad tracks and 26th Ave
- Hwy 224 across Mount Scott Creek
- Hwy 224 across MAX Light Rail Orange Line tracks

City of Milwaukie:

- Kellogg Creek near Milwaukie Bay Park
- Wichita Ave across Johnson Creek
- Stanley Ave across Johnson Creek
- 55th Ave across Johnson Creek

Transportation Corridors:

- 17th Ave
- 32nd Ave
- 55th Ave
- Harrison St/42nd Ave/King Rd.
- Highway 224
- Johnson Creek Blvd
- King Rd
- Lake Rd
- Linwood Ave
- Max Orange Line
- McLoughlin Blvd/Highway 99E
- Oatfield Rd
- River Rd

Water Treatment Facilities:

- 8 City Wells
- Aeration Packed Towers – 5 total at two locations
- Concrete Storage Tank – 40th Ave & Harvey St
- Elevated Water Storage Tank – 40th Ave & Harvey St
- Ground Level Metal Tank – Stanley Ave & Harlow St
- Sewerage Pump Stations – 5

Other Utilities:

- NW Natural pipelines
- PGE Substations (One is at edge of Lake Rd / Harmony Rd; a second is on the East end of Johnson Creek; a third is on the border between Milwaukie and Oak Grove)

Environmental Assets

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

City-owned Parks:

- Ball-Michel Park
- Dogwood Park
- Homewood Park
- North Clackamas Park
- Milwaukie Bay Park
- Stanley Park
- Water Tower Park
- Spring Park
- Wichita Park
- Scott Park
- Balfour Park
- Bowman Brae Park

City-managed greenspaces and green infrastructure:

- Stormwater detention facilities
- Public bioswales and raingardens
- Elk Rock Island
- Minthorn Wetlands (partial ownership)
- Willow Place Natural Area
- Public street trees

Waterways and Willamette Tributaries

- Johnson Creek
- Kellogg creek
- Spring 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:

- Behavioral Health Facility (9200 SE McBrod Ave)
- Hillside Manor (2889 SE Hillside Ct)
- Johnson Creek Treatment Facility (2808 SE Balfour St)
- Prestige Post-Acute and Rehab Center (12045 SE Stanley Ave)
- Royal Marc Retirement Residence (5555 SE King Rd)
- Annie Ross House (transitional family housing; 2316 SE Willard St)
- Milwaukie Community Center (daytime programs; 5440 SE Kellogg Creek Dr)
- ElderPlace Providence (daytime programs, Providence Milwaukie; 10330 SE 32nd Ave)
- Retirement Community near North Clackamas Park (5801 SE Kellogg Creek Dr)
- Deerfield Village (5770 SE Kellogg Creek Dr, not in city)

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:

- Johnson Creek Blvd (numerous businesses along the road)
- North Milwaukie Industrial Area

- Milwaukie Business Industrial Area
- Kellogg Treatment Plant
- Precision Cast Parks

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the City of Milwaukie. 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 during a hazard event. These assets include: Downtown, McLoughlin Commercial Areas, and North Milwaukie Industrial Area.

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.

Historic Inventory: (see State Historic Preservation Office for more information)

- Over 500 houses
- 5 commercial buildings
- 3 schools
- 1 cemetery
- 1 church
- 1 city hall
- 1 waterworks

Community Attractions:

- 17th Avenue Bike/Pedestrian Path
- Bob's Red Mill
- Carefree Sunday
- Dark Horse Comics Corporate Headquarters
- First Friday (June-October)
- Milwaukie Art and Artisan Market
- Milwaukie Bay Park
- Milwaukie Farmers Market
- Milwaukie Museum
- Sara Hite Memorial Rose Garden
- Spring Park and Elk Rock Island
- Springwater Trail
- Trolley Trail
- Umbrella Parade
- Winter Solstice Event

Hazard Characteristics

Drought

The HMAC determined that the City's probability for drought is **high** and that their vulnerability to drought is **moderate**. *These ratings both increased from the previous NHMP addendum due to a combination of a different understanding of the most severe possible effects of drought and an increasingly unstable climate.*

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 Milwaukie currently obtains its potable water from the Troutdale Aquifer through eight operating wells located throughout the city. Interties to the City of Portland and Clackamas River Water systems are maintained for emergency water supplies. The network of three water reservoirs provides a storage volume of six million gallons. The Water System Master Plan was last updated in 2021 to provide long-term guidance for the development of the city's water system. It is a supporting document for the Comprehensive Plan. The document also includes recommended capital improvement projects and a map documenting the water infrastructure placement within the city.

Vulnerability Assessment

Due to insufficient data and resources, Milwaukie is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard.

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.

Mitigation Activities

Milwaukie has a public awareness action item that can be used to address drought education. The existing drought hazard mitigation activities are conducted at the county, regional, state, and federal levels and are described in the Clackamas County NHMP.

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

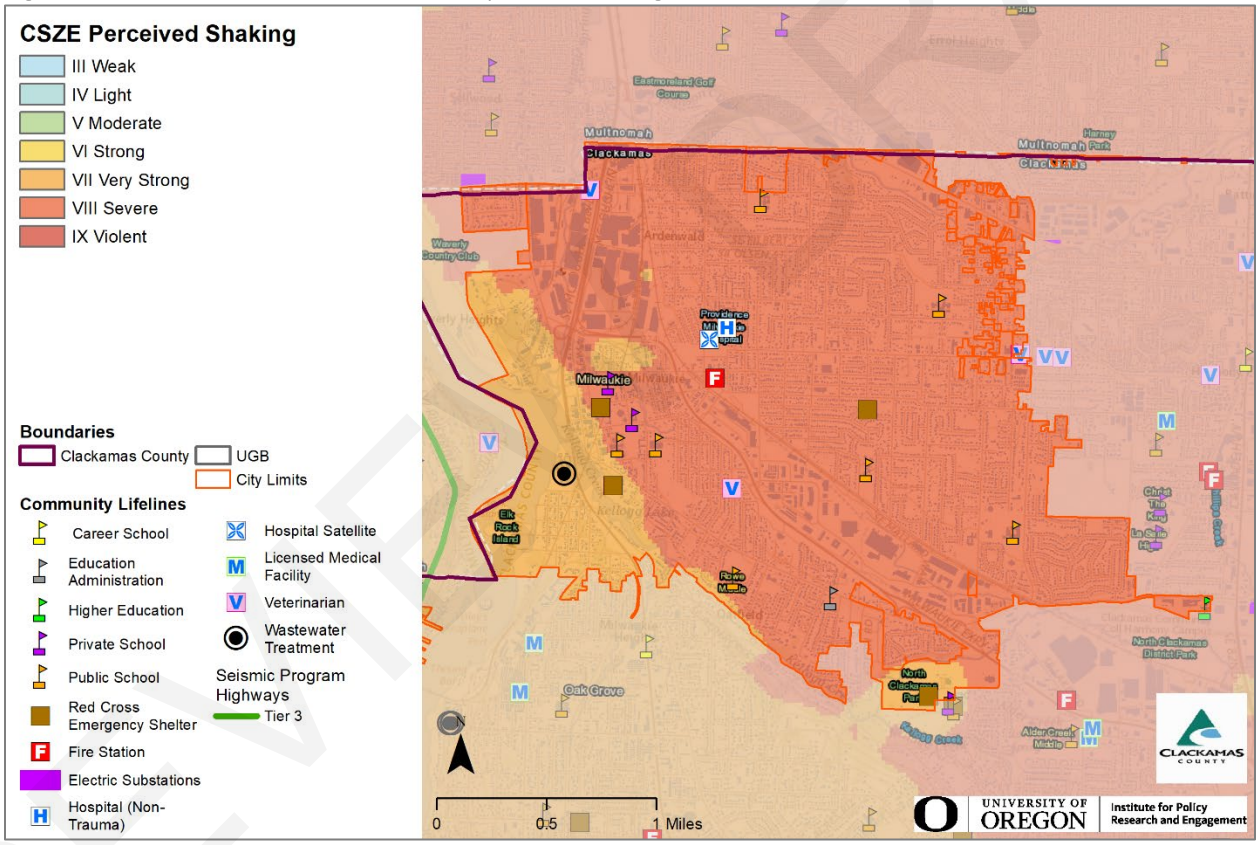
[5] Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Milwaukie as well. The causes and characteristics of an earthquake event are appropriately described within 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 Milwaukie 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, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Milwaukie Fault Zone (discussed in the crustal earthquake section).

Figure MI-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 around the city will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Figure MI-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

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and

5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.[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.

Earthquake (Crustal)

The HMAC determined that the City's probability for a crustal earthquake is **moderate** and that their vulnerability to crustal earthquake is **high**. *The probability rating increased while the vulnerability rating did not change since the previous version of this NHMP addendum due to an improved understanding of the likelihood of a crustal earthquake.*

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 Milwaukie as well. Figure MI-3 shows a generalized geologic map of the Milwaukie 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 are the Gales Creek-Mt. Angel Structural Zone and Portland Hills Fault Zone (discussed in greater detail below). Other faults include the Oatfield fault (just to the east of the city on the eastern side of the Willamette River), the Damascus-Tickle Creek fault, also to the east of the city, 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.

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 Milwaukie in northern Oregon.

Portland Hills Fault Zone

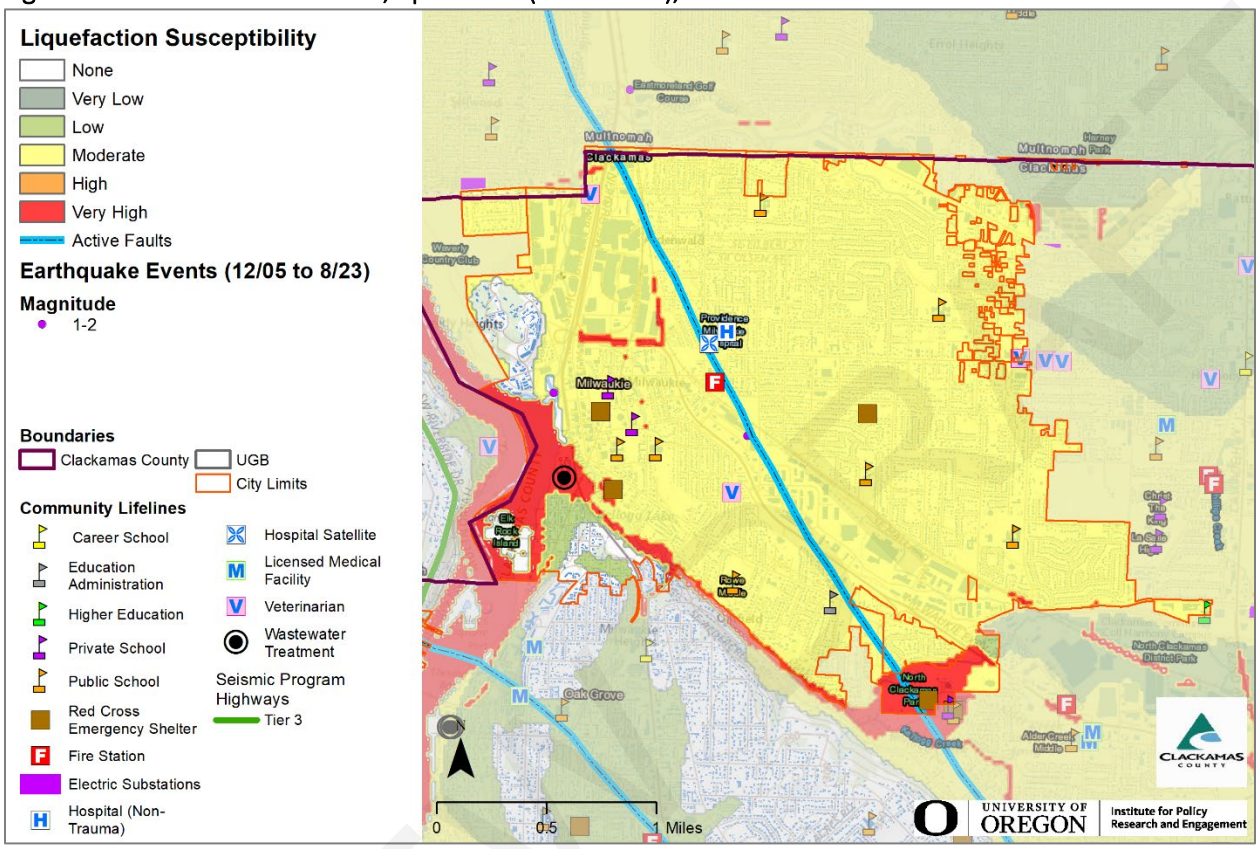
The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and runs through the western side of Milwaukie.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to

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

accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

Figure MI-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

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 and 2023. 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. Additionally, 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.

Community assets located in the highest hazard zone for earthquakes include the Public Safety Building (Milwaukie Police Department and Clackamas Fire District Station 2), Providence Milwaukie Hospital, and the Milwaukie Business Industrial Area. Milwaukie's infrastructure is particularly vulnerable to earthquake damage, especially Highway 224, Highway 99E, and the crossings of Johnson Creek. Of the city's eight wells, two of them are along the fault line, with others in the moderate to high hazard zones for earthquakes. During a major earthquake, emergency responders may have difficulty performing their duties because their buildings could be impacted by the event. The Public Safety Building is in the moderate to high hazard zones. Areas near the Willamette River and various creeks around Milwaukie are

likely composed 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.

Vulnerable populations, including children, could be significantly impacted, as many schools lie in the highest two hazard zones. The data gathered from the statewide DOGAMI inventory should be used to prioritize school buildings in Milwaukie 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 36% 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 MI-5; each "X" represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), zero (0) have a very high (100% chance) collapse potential and zero (0) have a high (greater than 10% chance) collapse potential. *Note: two schools, Ardenwald Elementary and Milwaukie High School, have been rebuilt since the 2007 DOGAMI study.*

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.

Mitigation Activities

Milwaukie has taken mitigation steps to reduce the city's vulnerably in earthquake events. Additional mitigation activities completed by the City of Milwaukie include:

- Compliance with SB 13, enacted in 2001, requiring local governments to develop seismic preparation procedures, inform their employees about the procedures, and conduct earthquake drills.
- Conformance with seismic-related construction requirements in the Oregon Structural Specialty Code and Oregon One- and Two-Family Dwelling Specialty Code.
- Adoption of a policy to require undergrounding of power lines in new subdivisions.
- Development Code restrictions regarding construction on steep slopes.
- The following buildings have been constructed to be earthquake safe:
    - Water tower at 40th Ave and Harvey St, Milwaukie High School Fine Arts Center, and Linwood Elementary Media Center and Gym.
    - Ardenwald Elementary rebuilt per 2008 bond passed by voters (former building demolished in 2009).
    - Milwaukie High School Main building rebuilt in 2021.

Table MI-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Alder Creek Middle (13801 SE Webster Rd)	Clac_sch83	X			
Ardenwald Elementary (8950 SE 36th Ave)	Clac_sch14	**Retrofitted ca. 2010 per a 2008 bond.**			
Hector Campbell Elementary (11326 SE 47th Ave) - CLOSED	Clac_sch87		X	X	
Linwood Elementary (11909 SE Linwood Ave)	Clac_sch19	X			X
Milwaukie Elementary School (11250 SE 27th Ave)	Clac_sch20			X	X
Milwaukie High School (2301 SE Willard St)	-	**Rebuilt ca. 2021 per a 2016 bond.**			
Portland Waldorf School (2300 SE Harrison St)	-	2007 RVS report did not include structural appendix for this facility.			
Seth Lewelling Elementary (5325 SE Logus Rd)	Clac_sch88	X			
St. John Catholic School (10956 SE 25th Ave)	-	2007 RVS report did not include structural appendix for this facility.			
Fire Facilities					
CFD Fire Station 1 (ca. 1983) (11300 SE Fuller Rd)	Clac_fir09	X			
CFD Fire Station 2 (ca. 1993) (Public Safety Building) (3200 SE Harrison)	Clac_fir26	X			
CFD Fire Station 3 (ca. 1997) (2930 SE Oak Grove Blvd)	Clac_fir27	X			
CFD Fire Station 4 (ca. 1999) (6600 SE Lake Rd)	Clac_fir08	X			
Hospital					
Providence Milwaukie (10150 SE 32nd Ave)	Clac_hos02	X			

Source: DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.
"*" – Site ID is referenced on the RVS Clackamas County Map

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 on 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 nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table MI-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 MI-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	7,891	7,891	7,891	7,891
Building Value ($ Million)	2,890	2,890	2,890	2,890
Building Repair Cost ($ Million)	295	394	1,341	1,598
Building Loss Ratio	10%	14%	46%	55%
Debris (Thousands of Tons)	162	193	542	615
Long-Term Displaced Populatior	93	83	2,459	5,456
Total Casualties (Daytime)	294	380	1,427	1,595
Level 4 (Killed)	14	19	82	89
Total Casualties (NIghttime)	34	92	326	546
Level 4 (Killed)	1	3	10	16

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 Milwaukie is expected to have a 10% building loss ratio with a repair cost of $295 million under the CSZ "dry" scenario, and a 14% building loss ratio with a repair cost of $394 million under the

CSZ "wet" scenario.[7] The city is expected to have around 294 daytime or 34 nighttime casualties during the CSZ "dry" scenario and 380 daytime or 92 nighttime casualties during the CSZ "wet" scenario. It is expected that there will be a long-term displaced population of around 93 for the CSZ "dry" scenario and 83 for the CSZ "wet" scenario.[8]

Portland Hills Fault Scenario

The City of Milwaukie is expected to have a 46% building loss ratio with a repair cost of $1.341 billion under the CSZ "dry" scenario, and a 55% building loss ratio with a repair cost of $1.598 billion under the CSZ "wet" scenario.[9] The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 1,427 daytime or 326 nighttime casualties during the Portland Hills Fault "dry" scenario and 1,595 daytime or 546 nighttime casualties during the Portland Hills Fault "wet" scenario. It is expected that there will be a long-term displaced population of around 2,459 for the Portland Hills Fault "dry" scenario and 5,456 for the Portland Hills Fault "wet" scenario.[10]

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 MA-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)[11] provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Report the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone event (M9.0 Deterministic): 1,045 buildings, and (16 critical facilities), are expected to be damaged for a total potential loss of $1.09 billion (a loss ratio of 30%). About 1,115 residents may potentially be displaced.

Crustal event (Canby-Molalla fault M6.8 Deterministic): 745 building are expected to be damaged (13 critical facilities), for a total potential loss of $471 million (a loss ratio of 13%). About 558 residents may be displaced.

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] Ibid, Tables 12-10 and 12-11

[10] Ibid, Tables 12-10 and 12-11.

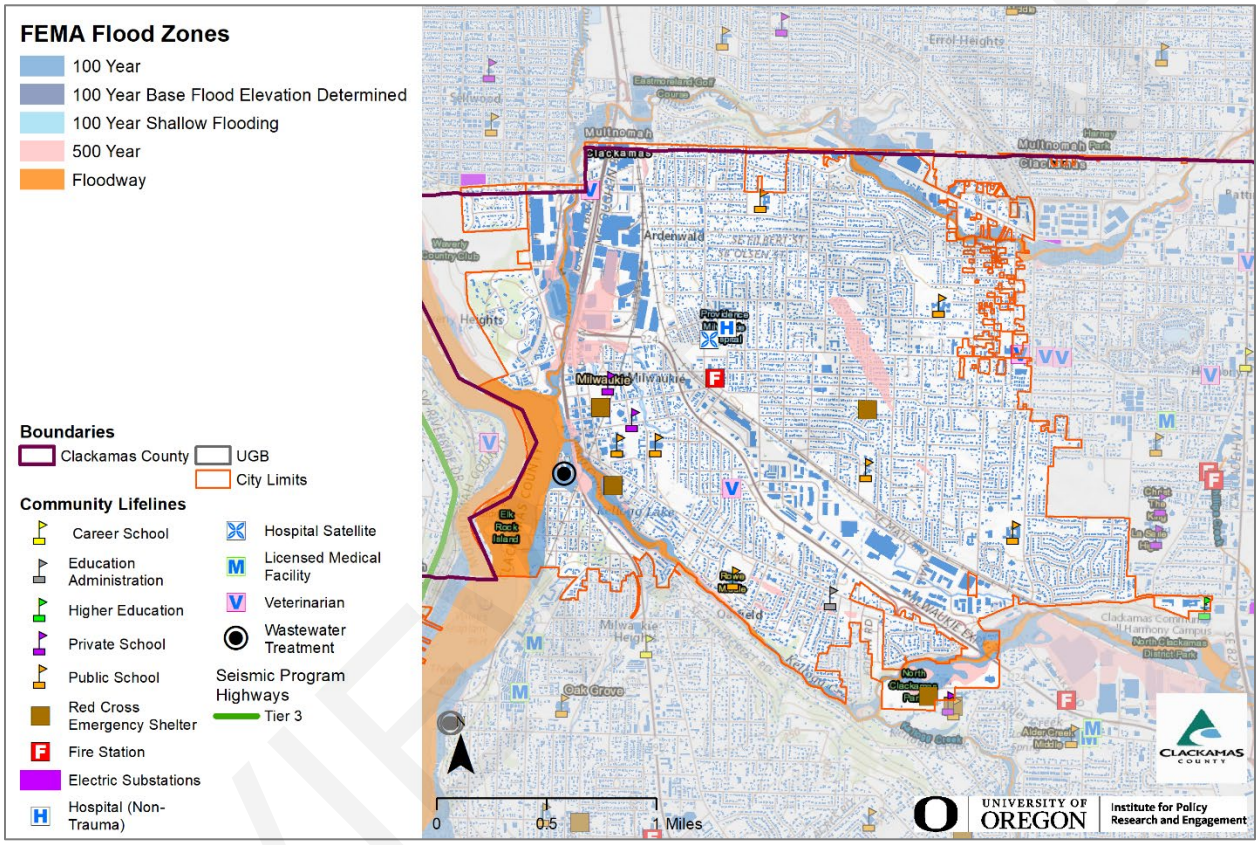
[11] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-23.

Flood

The HMAC determined that the City's probability of flooding is **high** and that their vulnerability to flooding is **moderate**. *The probability rating did not change, while the vulnerability rating decreased since the previous version of this NHMP addendum due to progress made in infrastructure retrofitting and other mitigation actions.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure MI-4 illustrates the flood hazard area for Milwaukie.

Figure MI-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

Portions of Milwaukie have areas of floodplain (special flood hazard areas, SFHA). These include Johnson Creek, Kellogg Creek, Mount Scott Creek, Minthorn Creek, Spring Creek, and the Willamette River. The Federal Emergency Management Agency (FEMA) regulatory floodplains for each of these 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. The FEMA 100-year map shows that approximately 1.3 miles of the transportation network could be affected in a flood.

More information on stormwater infrastructure and floodplain and runoff capacity planning can be found in the Milwaukie Stormwater System Plan.

The largest flooding event to affect Milwaukie was the February 1996 flood. The high-water level meant tributaries could not drain into the Tualatin and Willamette River, which led to localized flooding on several backed-up creeks.

The extent of flooding hazards in Milwaukie 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 and 2023. 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.

The areas around Johnson Creek (impacts industrial area), Kellogg Creek, Mount Scott Creek (impacts North Clackamas Park, Senior Center, and multiple residences north of Highway 224 and south of Lake Road), and Willamette River are particularly vulnerable to flooding. Additionally, proposed lots on 19th Avenue may be vulnerable to Willamette River flooding. Johnson Creek runs through the Downtown Mixed Use and North Milwaukie Employment zones. Kellogg Creek mostly affects residential areas in the chance of flooding. The downtown area is located near the Willamette River due to the historic use of the river for economic reasons.

Additionally, a great deal of infrastructure (bridges, water lines, sewage pump stations, etc.) is in the floodplain. Infrastructure exposed to flooding includes, but is not limited to, Highway 224, SE Lake Rd, SE McLoughlin Blvd, and the north industrial park. Highway 99 is adjacent to the river, but approximately 50-70 feet above flood stage. Disruption to this infrastructure could result in transportation issues, power outages, sewage back-up, and affect overall community and environmental health.

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.

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. As an urban city, Milwaukie is predominantly covered in impermeable surfaces like roads and buildings, impacting historical watershed hydrology and altering the amount and speed of stormwater runoff as sheet flow. With more frequent and intense storms caused by climate change, flash flooding events can produce volumes of surface water which can quickly exceed the capacity of the city's stormwater infrastructure. These events lead to an overflowing of piped stormwater facilities during high flow, as well as scouring, erosion, overflow flooding, and vegetation decline and/or death at facilities like detention ponds and rain gardens, along with the numerous small creeks, streams, ponds, and other waterbodies crossing Milwaukie's landscape. Resulting damage from these events can be extremely costly in both labor and materials, and can compromise both gray and green infrastructure. This in turn reduces the functionality of these systems for protecting water quality, jeopardizing the city's ability to meet state and federal water quality mitigation requirements.

The speed of onset, lack of warning, and depth of flooding make dam failures a potentially deadly, albeit unlikely, occurrence. There are four major dams upstream of Milwaukie on the Clackamas River: North Fork, Faraday, River Mill and Timothy. These are operated by Portland General Electric and are subject to the dam safety and warning requirements of the Federal Energy Regulatory Commission. According to the

Clackamas County Emergency Operations Plan, areas of Milwaukie bordering on the Willamette in the vicinity of its confluence with the Clackamas would be inundated by a wall of water 60 - 80 feet high in approximately an hour and a half should the North Fork dam fail under a "probable maximum flood" (a worst-case scenario where all four dams fail). In December 2015 Milwaukie had to evacuate approximately 50 people from their homes as Mount Scott and Johnson Creek overflowed.

The largest flooding event to affect Milwaukie was the February 1996 flood. The high-water level meant tributaries could not drain into the Tualatin and Willamette River, which led to localized flooding on several backed-up creeks.

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-xx)[12] provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report 20 buildings (0 critical facilities) could be damaged for a total potential loss of $6.1 million (a building loss ratio of 0.2%). About 130 residents may be displaced by flood (a population displacement ratio of less than 1%).

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 city development code includes policies and regulations for flood prone areas including, Natural Resources Overlay Zone (Chapter 19.402, Natural Resources Administrative Map), Flood Hazard Regulations (Title 18 – Flood Hazard Areas (includes the SFHA and the 1996 flood inundation area; Flood Hazard Map Viewer), and Willamette Greenway Zone (Chapter 19.401). The City's flood hazard regulations include substantial damage/substantial improvement provisions which are enforced by the Floodplain Administrator. The last Community Assistance Visit (CAV) for the City was in July 2019. The City does not participate in the Community Rating System (CRS).

Risk Analysis - Repetitive Loss Properties

Milwaukie works to mitigate problems regarding flood issues when they arise. Some areas in the city are more susceptible to flooding issues and have incurred repetitive losses. The Community Repetitive Loss record for Milwaukie identifies ten (10) Repetitive Loss (RL) properties[13], and one (1) Severe Repetitive Loss (SRL) property[14]. RL and SRL properties are troublesome because they continue to expose lives and valuable property to the flooding hazard. Local governments as well as federal agencies such as FEMA attempt to address losses through floodplain insurance and attempts to remove the risk from repetitive loss of properties through projects such as acquiring land and improvements, relocating homes or elevating structures. Continued repetitive loss claims from flood events lead to an increased amount of damage caused by floods, higher insurance rates, and contribute to the rising cost of taxpayer funded disaster relief for flood victims.

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[12] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-23.

[13] A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

[14] A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP, and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000, and with cumulative amount of such claims payments exceeding $20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

Table MA-8 provides information on the identified RL and SRL properties. There have been 31 paid RL claims totaling $1,550,590. Seven (7) of the RL and SRL properties are not insured as of May 2023. For additional detail and a map of their general location see Volume I, Section 2, and Figure 14.

Table MA-7 Repetitive Loss and Severe Repetitive Loss Properties Detail

RL #	RL or SRL Property	Occupancy	Mitigated?	Currently NFIP Insured	Rated Flood Zone	Post FIRM	Paid Claims	Total Paid Amount
38925	SRL	Single Family	NO	NO	B	N	6	$100,814
75554	RL	2-4 Family	NO	NO	C	N	3	$28,463
82010	RL	Single Family	NO	NO	X	N	2	$5,058
83292	RL	2-4 Family	NO	NO	C	N	2	$17,351
84896	RL	Non-Residential	NO	NO	A19	N	2	$396,804
245015	RL	Single Family	NO	YES	X	Y	2	$65,060
245137	RL	Single Family	NO	NO	AE	N	2	$141,105
246398	RL	2-4 Family	NO	YES	AE	N	3	$138,450
246399	RL	2-4 Family	NO	YES	AE	N	3	$226,756
246400	RL	2-4 Family	NO	YES	AE	N	3	$240,033
288900	RL	Single Family	NO	NO	AE	N	3	$190,696
						Total	31	$1,550,590

Source: FEMA Region X, Regional Flood Insurance Liaison, email February 23, 2023.

Mitigation Activities

The City maintains a Stormwater Master Plan and has been planning various projects to restore Kellogg Creek. These projects would include building a bridge over the creek and downtown revitalization.

In 2022 and 2023, the city and project partners secured grant funding through the National Oceanic and Atmospheric Administration to pay for the planning, design, and permitting of the Kellogg Creek Restoration and Community Enhancement Project. Although Kellogg Creek has historically been less prone to flooding than Johnson Creek, the removal of the dam and restoration of the lower creek, as well as 14 acres of buried floodplain, is expected to further mitigate the existing flood hazard by draining Kellogg Lake and removing substantial amounts of contaminated sediment impounded by the dam. City engineers are working with project partners to undertake project planning, including risk assessment, design, and permitting for project implementation.

To improve stormwater management the city of Milwaukie continues to line the interiors of pipes in conjunction with Clackamas County Water Environment Services. This mitigation project minimizes the amount of groundwater that infiltrates into sewer lines and helps reduce the overall amount of water going into the wastewater treatment plant, thus reducing the chance of overflow of the sewer system. Additionally, a severe repetitive loss property on Rusk Road was purchased and demolished using FEMA Flood Mitigation Assistance funding in 2018 (grant covered approximately $315,000 for the purchase of the property, additional funds were allocated for staff hours, title report, due diligence reports, and demolition contract).

In 2006 Clackamas County Water Environment Services partnered with eight community groups to restore the Three Creeks area – including Mount Scott Creek, a tributary to Kellogg Creek and the Willamette River. The group reshaped the stream channel to make it more natural; removed invasive species; planted thousands of native plants to stabilize banks; and put in wood and boulders to stabilize the channel and provide habitat for fish. The groups also removed trash and transient camps that polluted the streams during floods.

Projects completed by the Johnson Creek Watershed Council:

- Tree Plantings along Johnson Creek in various places.
- Storm water detention near Milport.

The North Clackamas Watersheds Council has published a 10-year plan for further restoration and enhancement actions. Although many of these actions are currently unfunded, the city will continue to seek new opportunities to partner with the council.

In 2018 the city completed its Urban Forest Management Plan which includes information on tree planting and maintenance strategies. Increasing the extent of the urban canopy can help to divert, capture, and infiltrate precipitation and surface water that would otherwise contribute directly to flooding.

Future Projections

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

Landslide

The HMAC determined that the City's probability for landslide is high and that their vulnerability to landslide is low. *The probability rating increased, and the vulnerability rating did not change since the previous version of this NHMP addendum due to the inclusion of smaller scale landslides and landslides occurring upstream of Milwaukie in the current update.*

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 Milwaukie, steep slopes do exist along the banks of the Willamette River and Kellogg Creek. Additionally, upstream landslides affecting waters that flow into or through Milwaukie pose secondary hazards to the city due to debris and flood risks.

Landslide susceptibility exposure for Milwaukie is shown in Figure MI-5. Most of Milwaukie demonstrates a low to moderate landslide susceptibility exposure. Approximately 4% of Milwaukie has very high or high, and approximately 31% moderate, landslide susceptibility exposure.[16] 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.

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

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

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 MI-5.

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.

Across the Willamette River in Riverdale area, there is a large area of land that is at a very high risk of landslide. This could result in flooding along Milwaukie's banks in the event of a landslide that disrupts the flow of the Willamette River. Within the City, parts of Highway 224, SE Lake Rd, and SE Johnson Creek Blvd are located within the areas of high landslide susceptibility. These important arterials help connect Milwaukie. The Milwaukie Heights area, which includes mostly low density residential and open space areas, is also vulnerable. This exposure means that large scale and simultaneous landslides triggered by an earthquake could substantially disrupt City operations buildings, 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.

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.

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-xx)[17] provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 102 buildings are exposed to the *high and very high landslide susceptibility* hazard for a total exposure of $73.8 million (a building exposure ratio of 2%). About 568 residents may be displaced by landslides (a population exposure ratio of 2.8%).

Mitigation Activities

Milwaukie works to mitigate future landslide hazards. The city development code includes several policies and regulations to protect slopes including Erosion Control (Chapter 16.28), Willamette Greenway Zone Overlay (Chapter 19.401), and limitations of permitted development within slopes greater than 25%.

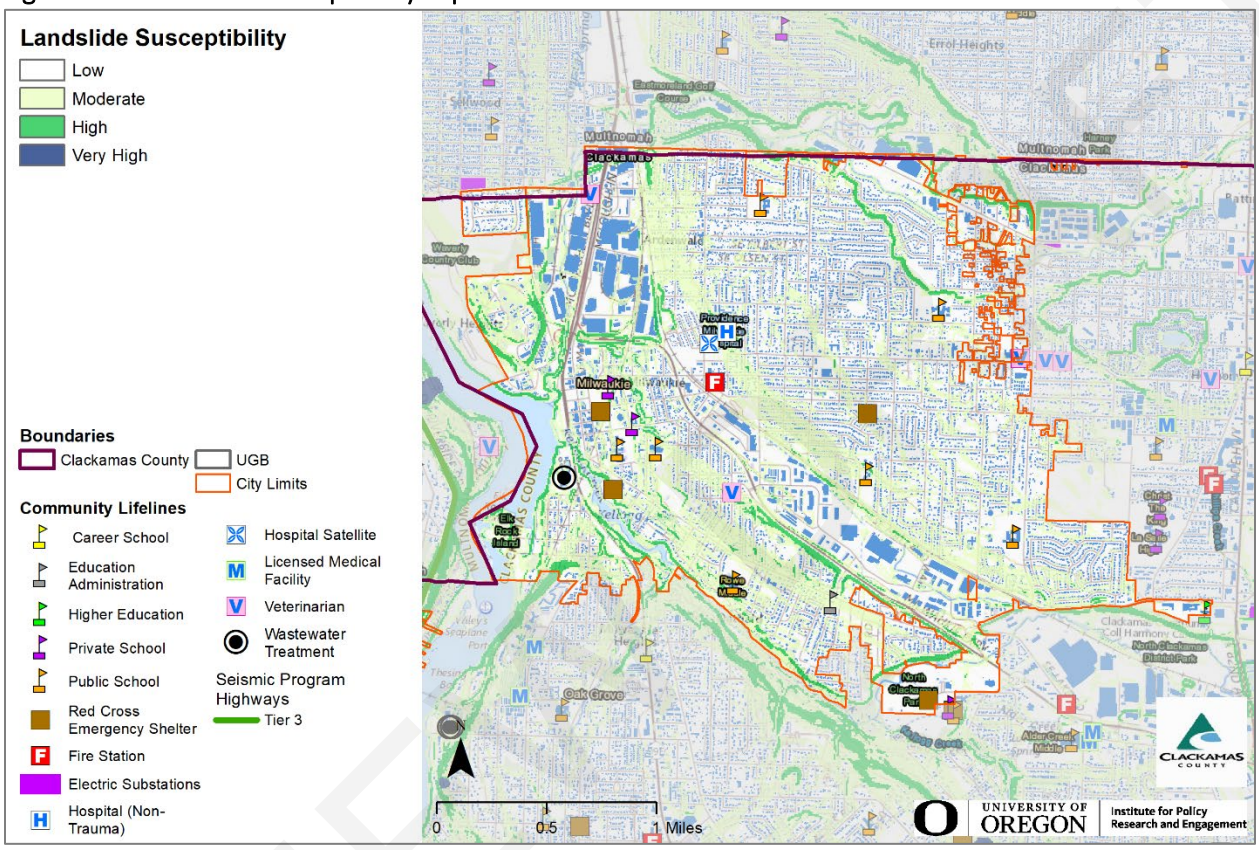
Future Projections

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

[17] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-23.

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.

Figure MI-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

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 **high**. *The probability rating increased and vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well, but Milwaukie is more vulnerable to the so "heat island effect" than more rural portions of the county. Heat islands occur where extremely localized ambient air temperatures in urban areas are an average of 1-7 degrees higher than those found in surrounding areas. They occur as

structures and pavement absorb, radiate, and reflect heat energy rather than engaging in evapotranspiration as trees and other plants do. Milwaukie's efforts to preserve and expand its urban forest canopy will continue to play a role in mitigating the formation of heat islands, but the threat remains a significant one.

A severe heat episode or "heat wave" occurs about every two to three years. These heat episodes typically last two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of temperatures 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 14.6 days with temperatures above 90-degrees Fahrenheit, and 1.2 days above 100-degrees Fahrenheit annually, based on new 30-year climate averages (1991-2020) from the National Weather Service – Portland Weather Forecast Office. The 30-year average is used to account for short-term variation in temperatures. The frequency of high temperature days is expected to increase with the growing climactic instability of anthropogenic climate change. For example, the six hottest summers on record for Portland occurred between 2015 and the present.

Future Projections

Increasing frequency and duration of extreme heat events pose threats to human and animal life, as well as a danger to agricultural production in the Willamette Valley.

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[18] 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 **high** and that their vulnerability to windstorm is **moderate**. *These ratings increased since the previous version of this NHMP addendum due to the increased frequency and intensity of windstorms in recent years.*

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 may clog drainage-ways, which in turn may cause localized pluvial flooding.

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

Future Projections

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

Winter Storm (Snow/Ice)

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

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the 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 do not cause significant damage, but they are semi-frequent, and have the potential to impact economic activity. Road closures due to winter weather can interrupt commuter and commercial traffic, and roads that are not closed may present vehicle operators and pedestrians with dangerous conditions.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[19] 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, Milwaukie is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. 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 and 2023. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the

[19] Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

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.

The areas of the city that are often most at risk of severe 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 storms affect the entire city. In 2016, 2017, 2019, and 2021 the State of Oregon declared a state of emergency for severe storms. The city's Plowing, Sanding, and De-Icing Removal Plan is maintained by the Public Works Department and includes provisions to place equipment on designated principal routes throughout the city (Plowing and Sanding Routes Map). Private property owners are also required to clear the sidewalks abutting their property of snow or ice within 24 hours after the snow has stopped falling. For more information see the city's Winter Weather Response Plan information webpage.

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.

Residents and businesses that are in areas that exhibit the severe storm hazard face some risk of damage from severe storms. Severe weather events are expected to impact nearly all city residents. In addition, critical infrastructure, economic centers, cultural or historic assets, environmental assets, and hazardous material sites are exposed to the severe weather hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets section.

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.

All these facilities depend upon utility lines, roads and bridges to operate and perform their respective important functions within the city. Exposed utility and power lines are particularly vulnerable to damage from severe winter storms by wind, ice and snow.

Hardened infrastructure, like bridges and roads, can sustain a severe winter storm, but during the event, they are often hazardous to traverse because of icy, windy and snowy conditions.

Consequently, severe weather (wind or winter storm) could substantially disrupt numerous key resources and facilities within the city through impediments to the transportation system and damage to the power grid. Among other things, these transportation problems and power failures disrupt business operations and educational facilities, resulting in economic losses and halting educational opportunities.

Power to hazardous material sites, including gas stations, rail yards, and some industrial facilities in the city, could also be disrupted. The sites themselves could be damaged or rendered inaccessible in an especially severe storm. These conditions could pose threats to the natural environment of the city and the health of its population, while disrupting the availability of gasoline for vehicle transport.

As a result, it will be important for the city to pursue opportunities for undergrounding utilities and retrofitting utility lines so that they may withstand cold weather conditions without freezing and bursting. Adhering to current building codes for weatherization of structures, as well as current engineering and fire codes that pertain to the steepness of new roads, are also key factors for the city to consider.

Business continuity planning shall also be an important factor, given the number of economic centers and employment facilities that are threatened by the severe storm hazard

Mitigation Activities

Mitigating severe weather can be difficult because storms affect all areas of the city, but Milwaukie has made progress to reduce the effects of storms. Milwaukie has a tree board to maintain a plan for the care of the trees as well as codes governing where trees can be planted (Chapter 16.32). Most utilities are underground, and all new utilities are required to be undergrounded. In case of power outages the city's critical facilities have back up power generation. Milwaukie also has a designated snow plow and sanding routes to help expedite snow removal (Plowing and Sanding Routes Map). The city is also partnering with Clackamas County to develop the Ledding Library as a cooling center and is exploring options for the potential establishment of an overnight warming shelter in the downtown area.

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 addendum.*

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 Milwaukie as well. Volcanoes are located near Milwaukie, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Given Milwaukie's relatively long distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions may 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. In the event of an eruption on Mount Hood, the city could experience a heavier coating of ash due to its closer proximity to that volcano.

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-xx)[20] 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.

Mitigation Activities

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

Future Projections

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

[20] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-23.

Wildfire

The HMAC determined that the City's probability for wildfire is **high**, and that their vulnerability to wildfire is **high**. *The probability and vulnerability ratings increased since the previous version of this NHMP due in part to the increased hazard posed by wildfire smoke.*

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 Milwaukie is found in the following chapter: Chapter 9.3: Clackamas Fire District #1.

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

Weather and urbanization conditions are primarily at cause for the hazard level. Milwaukie has not experienced a wildfire within City limits, but the city has abundant wooded areas that are a concern in the case of a wildfire event. Clackamas Fire District #1 provides services to other cities besides Milwaukie, including: Oregon City, Happy Valley, Johnson City, and many unincorporated areas within Clackamas County. Figure MI-6 shows overall wildfire risk in Milwaukie.

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 Milwaukie, 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.

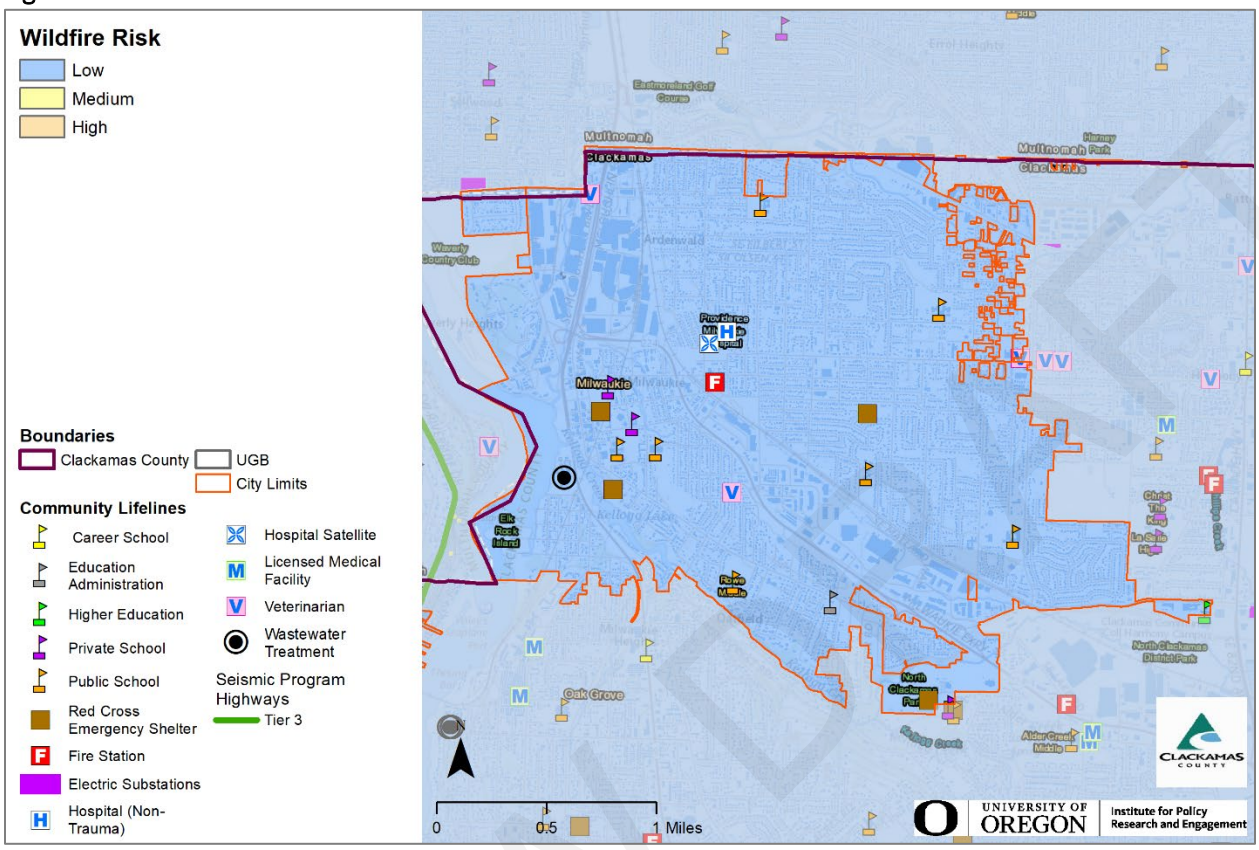
Milwaukie is highly urbanized and as such does not have as much danger of wildfire within its boundaries as more rural locations in Clackamas County. The City does have parks and neighborhoods surrounded by mature trees, as well as several natural areas. Located on the edge of its southeastern boundary is the Three Creeks Natural Area, which has heavy fuels adjacent to homes and infrastructure. Three Creeks Natural Area is a designated Medium Priority Community at Risk (CARs).[21] Elk Rock Island, though listed as low risk for wildfire by the Oregon Wildfire Risk Explorer, is a publicly owned greenspace near a built-up residential area. The island contains dense vegetation which dries out in the summer, and has no roads, which makes firefighting operations on the island more difficult, as demonstrated by the large fire there in 2020.

Most of the city has less severe (moderate or less) wildfire burn probability. This indicates expected flame lengths less than four feet under normal weather conditions.[22] However, conditions vary widely and with local topography, fuels, and local weather conditions, especially wind. Under warm, dry, windy, and drought conditions, the City expects 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.

[21] Clackamas County Community Wildfire Protection Plan, *Clackamas Fire District #1* (2018), Table 10.13-1.

[22] Oregon Wildfire Risk Explorer, date accessed February 14, 2023.

Figure MI-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.
Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).
Note: To view additional wildfire risk information click this link to access Oregon Explorer's CWPP Planning Tool

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 and 2023. 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.

Milwaukie does not have much vulnerability to wildfire flames, though there is always the risk of fire destroying residential and commercial areas. Vegetation along roadways can be highly dangerous, as negligent motorists provide ignition sources by tossing cigarette butts out car windows. Because schools are generally located near parks and scenic areas, they can be threatened by wildfires.

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the city as well. Milwaukie's fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City will update its wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively

respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Although the direct threat of wildfire burning Milwaukie is low, the city is vulnerable to smoke and aerial particulate matter generated by fires in the region. The 2020 wildfire season was especially bad, with the air quality index in the Portland metropolitan area being recorded as over 500, the upper limit of that scale. The region's air quality was rated as the worst in the world during that period. Air quality is not listed as standalone hazard by FEMA or the State of Oregon for the purposes of natural hazard mitigation planning. It was, nonetheless, discussed by the Milwaukie HMAC and factored into the vulnerability rating calculation for wildfires.

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-xx)[23] provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

According to the Risk Report 10 buildings are exposed to the *high and (or) moderate (medium) risk wildfire* hazard for a total exposure of $5.6 million (a building exposure ratio of 0.2%). About 59 residents may be displaced by wildfires (a population exposure ratio of 0.3%).

Mitigation Activities

Milwaukie and Clackamas Fire District #1 (CFD#1) use several mitigation tools to reduce the city's risk to wildfires. CFD #1 provides emergency fire suppression, medical response, and rescue services to the City of Milwaukie. Mutual aid agreements with neighboring jurisdictions are also in place. Water supply and storage capacity in Milwaukie conforms with recommended fire flow requirements.

The city does not allow backyard burning due to requirements of DEQ. The CFD #1 provides outreach and education to the community on wildfire mitigation via news releases, posters, signage, website messages, safety exhibits at community events, and visits to schools, civic organizations, and neighborhood associations.

Partially in response to the fire hazard they create, the city banned the sale and use of fireworks in 2023. Additionally, the city partners with the North Clackamas Parks and Recreation District to manage and reduce the amount of potential fuel for wildfires in natural areas.

Clackamas Fire District #1 (CFD #1) serves the city of Milwaukie. For more information on the fire district see their addendum.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[24] 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.

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[23] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-23.

[24] Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

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

Previous NHMP Actions that are Complete:
Multi-Hazard #2, "Improve network of communications during a disaster." Complete. Although there are always opportunities for improvement, the combination of satellite, radio, and cellular communication technology provides layers of redundancy in the event of a major disaster.

Multi-Hazard #4, "Maintain and promote CERT program activity in the area and recruit new members for training." Complete. The City regularly coordinates with CERT and Clackamas FD1.

Multi-Hazard #7, "Integrate the goals and mitigation actions from the Milwaukie Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate." Comprehensive plan last updated in 2021.

Earthquake #1, "Conduct seismic evaluations on identified critical and essential facilities and infrastructure and implement appropriate structural and non-structural mitigation strategies." Complete. The city has evaluated its existing infrastructure and will continue to evaluate newly acquired infrastructure for seismic resiliency.

Flood #2, "Ensure continued compliance with the National Flood Insurance Program through enforcement of local floodplain management ordinances." Complete. The city is continuing to comply with participation requirements for the National Flood Insurance Program

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

Drought #1, "Develop public brochures to raise awareness about drought hazards and mitigation actions residents can take to reduce the impact of drought." No longer relevant. Pamphlets are an inefficient and largely outmoded form of communication. This has been rolled into Action Item 2.

Table MI-8 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	-	Complete	No
Multi-Hazard #3	#2	Not Complete, revised	Yes
Multi-Hazard #4	-	Complete	No
Multi-Hazard #5	#3	Not Complete	Yes
Multi-Hazard #6	#4	Not Complete	Yes
Multi-Hazard #7	-	Complete	No
Multi-Hazard #8	#5	Not Complete, revised	Yes
Drought #1	-	Complete	No
Earthquake #1	-	Complete	No
Flood #1	#8	Not Complete	Yes
Flood #2	-	Complete	No
Severe Weather #1	#10	Not Complete	Yes
Wildfire #1	#11	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.

This document was completed with the assistance of a substantial community engagement effort. During August 2023, members of the public had the opportunity to ask questions and offer suggestions about the composition of the NHMP through the Engage Milwaukie platform. More than 450 community members visited the page during these months. The suggestions made through the platform resulted in several additions to the list of essential facilities and environmental assets. This opportunity was advertised through the city website, the Pilot newsletter, Facebook, and various other media.

Drafts of the plan were submitted to the Milwaukie City Council for discussion at the council's August 1 and August 15, 2023 regular meetings. Suggestions and comments from members of the council were incorporated throughout the document.

Also in August, a draft of this document was sent to 23 community groups with focus areas ranging from housing and medical care to education and environmental protection. Substantive changes, particularly concerning the flood hazard, were made based on feedback from these partners.

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 provided

HMAC

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

Meeting #1 and #2: March 9 and May 22, 2023

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 #2: December 6, 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.