

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

---



Photo Credit: City of Gladstone

Effective:

April XX, 2024 – April XX, 2029

Prepared for  
The City of Gladstone

Updated:

**Date**, 2024, (Resolution # **xx**)  
November 12, 2019, (Resolution #1167)  
January 14, 2014 (Resolution #988)  
February 9, 2010, (Resolution #911)



This Natural Hazard Mitigation Plan was prepared by:



UNIVERSITY OF  
OREGON

School of Planning, Public  
Policy and Management

Institute for Policy  
Research and Engagement

Planning grant funding provided by:

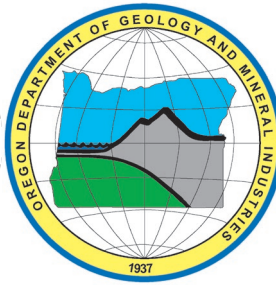


FEMA

Federal Emergency Management Agency (FEMA)

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

Additional Support Provided by:



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

# Table of Content

PURPOSE .....	1
NHMP PROCESS, PARTICIPATION AND ADOPTION .....	1
<i>Convener</i> .....	1
NHMP IMPLEMENTATION AND MAINTENANCE .....	2
<i>Implementation through Existing Programs</i> .....	3
CAPABILITY ASSESSMENT .....	3
<i>Existing Authorities</i> .....	3
<i>Policies and Programs</i> .....	5
<i>Personnel</i> .....	6
<i>Capital Projects</i> .....	6
<i>Capital Resources</i> .....	7
<i>Findings</i> .....	7
MITIGATION PLAN MISSION .....	8
MITIGATION PLAN GOALS .....	8
MITIGATION STRATEGY .....	9
<i>Mitigation Successes</i> .....	10
RISK ASSESSMENT .....	14
<i>Hazard Analysis</i> .....	14
<i>Community Characteristics</i> .....	15
<i>Community Lifelines</i> .....	18
<i>Critical Facilities</i> .....	18
<i>Critical Infrastructure</i> .....	18
<i>Essential Facilities</i> .....	19
<i>Environmental Facilities</i> .....	19
<i>Vulnerable Populations</i> .....	19
<i>Hazardous Materials</i> .....	19
<i>Economic Assets/Population Centers</i> .....	20
<i>Cultural and Historic Assets</i> .....	20
HAZARD CHARACTERISTICS .....	20
<i>Drought</i> .....	20
<i>Earthquake (Cascadia Subduction Zone)</i> .....	21
<i>Earthquake (Crustal)</i> .....	23
<i>Flood</i> .....	27
<i>Landslide</i> .....	29
<i>Severe Weather</i> .....	31
<i>Extreme Heat</i> .....	31
<i>Windstorm</i> .....	32
<i>Winter Storm (Snow/Ice)</i> .....	33
<i>Volcanic Event</i> .....	34
<i>Wildfire</i> .....	34
<b>ATTACHMENT A: ACTION ITEM CHANGES</b> .....	<b>37</b>
<b>ATTACHMENT B: PUBLIC INVOLVEMENT SUMMARY</b> .....	<b>38</b>
<i>Website Posting</i> .....	38
<i>HMAC</i> .....	39

## List of Tables

TABLE GA-1 ACTION ITEMS.....	11
TABLE GA-2 HAZARD ANALYSIS MATRIX.....	15
TABLE GA-3 COMMUNITY CHARACTERISTICS .....	17
TABLE GA-4 CRITICAL FACILITIES.....	18
TABLE GA-5 RAPID VISUAL SURVEY SCORES .....	24
TABLE GA-6 EXPECTED DAMAGES AND CASUALTIES FOR THE CSZ FAULT AND PORTLAND HILLS FAULT: EARTHQUAKE, SOIL MOISTURE, AND EVENT TIME SCENARIOS.....	26
TABLE GA-8 STATUS OF ALL HAZARD MITIGATION ACTIONS IN THE PREVIOUS PLAN .....	37

## List of Figures

FIGURE GA-1: UNDERSTANDING RISK .....	14
FIGURE GA-2 CASCADIA SUBDUCTION ZONE EXPECTED SHAKING .....	22
FIGURE GA-3 ACTIVE CRUSTAL FAULTS, EPICENTERS (1971-2008), AND SOFT SOILS.....	23
FIGURE GA-4 SPECIAL FLOOD HAZARD AREA.....	28
FIGURE GA-5 LANDSLIDE SUSCEPTIBILITY EXPOSURE .....	31
FIGURE GA-6 WILDFIRE RISK.....	35

# Purpose

This is an update of the Gladstone 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 Gladstone’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.

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

## NHMP Process, Participation and Adoption

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

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

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

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

### Convener

The Gladstone City Administrator 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 Gladstone 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 Gladstone HMAC was comprised of the following representatives:

- Convener, Jacque Betz, City Administrator
- Justin Poyser, City of Gladstone Utility Manager
- Darren Caniparoli, Public Works Director
- John Schmerber, Police Chief
- Haley Kratz, Executive Assistant
- Tami Bannick, City Recorder

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 Gladstone 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 Gladstone NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

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

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

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

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

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

## Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, Gladstone 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 Gladstone 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.

Gladstone addresses Statewide Planning Goal 7 Natural Hazards as part of their Comprehensive Plan Element, Natural Resources. This element was written in 1979 and contains policies *to protect life and property from natural disasters and hazards such as floods, landslides, weak foundation soils and earthquakes.*

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.

The Gladstone Municipal Code, last updated in 2022 with housing code amendments to comply with HB 2001, includes Chapter 17 Zoning Code. The Zoning Code identifies uses and restrictions for all properties

within the city limits of Gladstone, and includes overlay district standards for Flood Management Areas (17.29), habitat conservation, open space, water quality resource areas, etc., as well as development standards related to siting, design, drainage, grading and fill, and land divisions. Chapter 17.29 Flood Management Area District includes all flood management areas and is an overlay district that also includes areas of inundation from February 1996 flood, FIS June 16, 2008 (last amended in 2008). Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage.

Gladstone's planning services are provided by 3J Consulting, which is responsible for the administration of state, county, and local land use policies and regulations as they relate to the preservation and quality development of property lying within the city limits and urban growth boundary (UGB). The consultants work closely with Building, Public Works, and Fire in the review of development applications and building permits.

Recent planning activity that integrates natural hazards and resilience findings and actions include:

- Gladstone Nature Park Site Plan (2020) – retains and restores the tree canopy that covers 90% of site
- Meldrum Bar Park Site Plan (2022) – includes plan for flood management area, wetlands, greenway and habitat conservation areas
- 2021 Gladstone Housing Needs Analysis -- included analysis of lands within floodplains and floodways, and land with slopes over 25% (as unsuitable for residential development)

### **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 Clackamas County Building Department administers and enforces the 2022 Oregon Fire Code and the 2022 Oregon Structural Specialty Code. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

### **Public Works**

The City of Gladstone Public Works Department is responsible for drinking water, sanitary sewer, stormwater, roads and streets, parks, and public facilities. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

Gladstone maintains a local system of three water tanks, two pump stations, and almost 40 miles of pipelines. Gladstone is an owner in a regional water treatment provider, the North Clackamas County Water Commission. This Commission provides safe, treated water from the Clackamas River. Gladstone is also part of the [Clackamas River Water Providers, Our Regional Water Source](#), a coalition of all the municipal water providers that receive their drinking water from the Clackamas River.

Gladstone Public Works partners with Oregon City to provide residents with a comprehensive GIS mapping system.

### **City Administration**

The City Council of Gladstone has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and



departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

## **Policies and Programs**

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

### **Infiltration & Inflow (I/I) Project**

The City of Gladstone has a longstanding history of Oregon Department Environmental Quality (DEQ) violations pertaining to raw sewage overflowing into the Clackamas River. Violations that have been a result of stormwater Infiltration and Inflow (I&I) into the city's sewer collection system.

As part of a Mutual Agreement Order (No. WQ/M-NWR-2019-038) between DEQ and the City of Gladstone, DEQ granted the city time to correct the system's deficiencies. In May 2019 the City contracted with Leeway Engineering to complete field work, which included smoke testing and CCTV investigations. The findings from the fieldwork were used to prepare the final I&I report for DEQ.

In April 2022 the City Council approved a contract with Leeway Engineering to design the I&I Reduction Project. Leeway Engineering is in the final design stages of the work that needs to be completed in 2024. The City issue a second Request for Proposal in November 2023 and will bring a contract before City Council in early 2024 for approval.

### **MS4 Permit**

Gladstone's Phase II Municipal Separate Storm Sewer System (MS4) permit was reissued by the Oregon Department of Environmental Quality (DEQ) in 2021. The permit program has six areas of focus that are consistent with EPA's Federal Clean Water Act: public education, public involvement, illicit discharge detection and elimination, construction, post-construction, and municipal operations.

The City revised its Stormwater Management Program document in 2022 to meet the requirements of the new MS4 Permit.

### **TMDL Plan**

The City also maintains a Total Maximum Daily Load (TMDL) Plan (updated in 2020). The Total Maximum Daily Load (TMDL) program includes many of the same requirements as the MS4 program, focusing on measures that impact the parameters of concern – temperature, bacteria, and mercury – with the Willamette River and the Clackamas and Lower Willamette Subbasins. The NHMP actions are incorporated into this document as appropriate. Example projects include participation in regional stormwater outreach projects, staff training on pollution control, and street cleaning after major storm events.

### **Gladstone Emergency Management Support**

The City of Gladstone administers a Volunteer Emergency Management Program, Gladstone Emergency Management Support (GEMS). The program realizes that Gladstone has limited personnel and equipment resources for a sustained medium to large scale natural or human caused emergency. During an emergency, the Gladstone Community Center becomes an Emergency Resource Center for volunteer assembly and management.

### 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

Gladstone participates in the National Flood Insurance Program. The Planning consultants are responsible for administering the day-to-day activities of the city's floodplain program. They are assisted by the Building Department, the Public Works Department, and by the City Administrator.

Specifically, the floodplain manager:

- maintains and administers Gladstone'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.

### Personnel

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

Emergency Management: Police Department

Public Information Officer: Police Department

Floodplain Manager: Planning

Grant writing (for Public Works or emergency management): Administration

Capital improvement planning: Public Works Department

Capital improvement execution: Public Works Department

Gladstone 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

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

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

- New Public Works facility (underway, 2024 completion)
- Barclay Stormwater Project
- Gladstone Civic Center Project
- Dunniway and Watts Stormwater upgrades in conjunction with Gladstone Civic Center Project
- West Clackamas Sewer Project
- New library (underway 2024 completion)
- Gladstone Fire Station 22 remodeled

The following projects are in development and proposed for completion by 2025:

- Trolley Trail Bridge Replacement Engineering/Environmental Phase
- 82<sup>nd</sup> Drive Pump Station replacement
- Evergreen Storm Line Replacement
- Capital improvements in Oak Lodge Service Area

## Capital Resources

Gladstone 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:

- Gladstone Community Center
- Gladstone Public Works
- Gladstone Civic Center

Warming or cooling shelters include:

- Gladstone Community Center
- Gladstone Library
- New Life Church

## 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

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

### Reliance upon outside funding streams and local match requirements

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

## 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](#)<sup>1</sup>.

### FEMA Funded Mitigation Successes

- 2007: City of Gladstone Fire/EMS Seismic Upgrade (PDM 2007), completed 2010

### Seismic Rehabilitation Grant Program Mitigation Successes

- 2013/14: Gladstone Police Department seismic retrofit (\$360,729)  
NOTE: police department is no longer located at this location.

### Other Mitigation Successes

- Gladstone High School new building (2009)
- Gladstone Library (owned and operated by Clackamas County)
- Civic Center developed at 18505 Portland Ave to house City Hall and Police Station (2020)
- Public Works Facility (under construction, completion Spring 2024)
- Gladstone Library (owned and operated by Clackamas County)
- Barkley Stormwater Project
- Duniway and Watts
- Evergreen Lane Stormwater Project scheduled for 2024
- 82<sup>nd</sup> Drive Pump station 2024
- Inflow and infiltration Project Phase 1 & 2 (Fall 2024)
- Oaklodge Infrastructure Improvements (complete 2027)

### Action Items

Table GA-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.

---

<sup>1</sup> 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.

Table GA-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
1	Integrate the goals and mitigation actions from the Gladstone Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	Planning	Ongoing	Local Resources. DLCDC TA, FEMA HMA-C&CB	Low
2	Develop, enhance, and implement education programs designed to reduce the losses from natural hazards.	X	X	X	X	X	X	X	X	X	Gladstone EMS	Ongoing	Local Resources. DLCDC TA, FEMA HMA-C&CB	Low
3	Improve vegetation management throughout the city.				X	X		X	X	X	Public Works	Ongoing	Local Resources	Low
4	Enhance strategies for debris management for all hazards.		X		X	X	X	X	X	X	Public Works	Ongoing	Local Resources. DLCDC TA, FEMA HMA	Low
5	Maintain the Gladstone Emergency Operations Plan.	X	X	X	X	X	X	X	X	X	Police	Ongoing	Local, State, Federal Grants and BRIC	Low
6	Evaluate and upgrade stormwater management infrastructure and identify appropriate mitigation strategies.				X						Public Works	Long	Local, State and Federal Grants; FEMA HMA	High
7	Update water distribution system.		X			X					Public Works	Ongoing	Local and State	Medium to High

		Impacted Hazard										Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost	
8	Conduct seismic evaluations on identified critical/essential facilities and infrastructure for implementing appropriate structural and non-structural mitigation strategies.		X								City Administration	Long	Local Resources, SRGP, FEMA HMA	Medium to High	
9	Ensure continued compliance in the National Flood Insurance Program through enforcement of local floodplain management ordinances.				X						City Administration	Ongoing	Local Resources, FEMA HMA (FMA)	Low	
10	Coordinate with Clackamas County to address the flooding issues on Glen Echo that stem from the two-way diversion on Hull Avenue put in by Clackamas County.				X						Public Works	Medium	Local, State, Federal Grants and BRIC	Medium to High	
11	Maintain and implement the Gladstone Stormwater Master Plan.				X						Public Works	Ongoing	Local Resources, FEMA HMA (FMA)	Medium to High	
12	Update Water System Telemetry System.				X					X	Public Works	Short (2024-2025)	Local Resources, FEMA HMA (FMA)	High	
13	Replace failed storm line and outfall on Evergreen Lane.		X		X					X	Public Works	Short (2024)	Local Resources, FEMA HMA (FMA)	High	
14	Construct repairs to sanitary sewer and storm system extensions to reduce I/I and SSOs				X					X	Public Works	Short (2024)	Local Resources, FEMA HMA (FMA)	High	



		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
15	Construct repairs identified in the 2021 TV survey of the sanitary sewer system draining to Oak Lodge.				X					X	Public Works	Short (2024-2027)	Local Resources, FEMA HMA (FMA)	Medium to High
16	Replace aging Sherwood Forest water distribution system piping.		X		X					X	Public Works	Medium (2025-2030)	Local Resources, FEMA HMA (FMA)	High
17	Reduce the vulnerability of property owners in landslide-prone areas.					X					City Administration	Long	Local Resources, FEMA TA, FEMA HMA	Medium to High
18	Reduce negative effects from severe windstorm and severe winter storm events.								X	X	Public Works	Ongoing	Local Resources, FEMA HMA	Low to High
19	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.							X			Clackamas Fire District	Ongoing	Local Resources, FEMA HMA	Low to High

Source: Gladstone NHMP HMA, 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

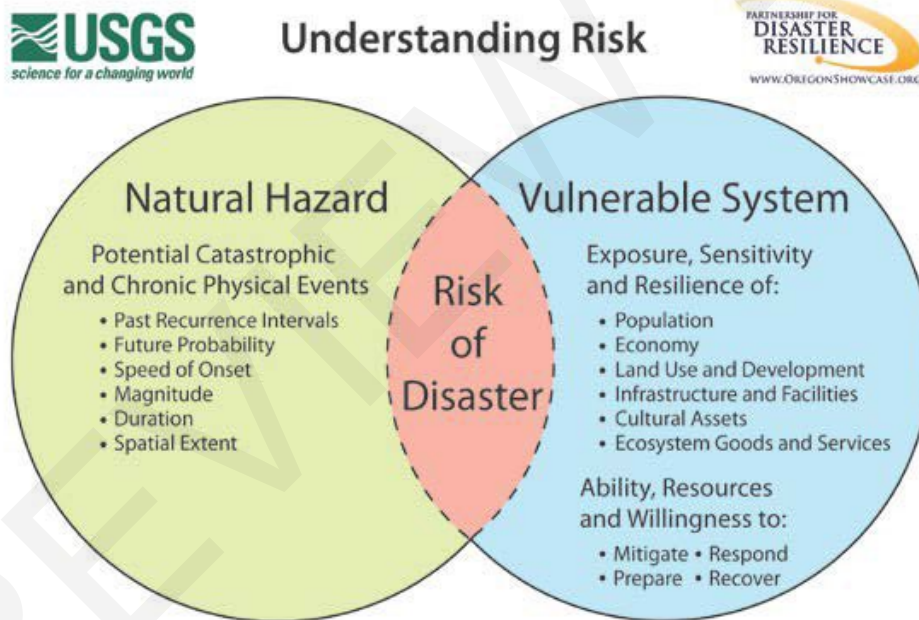
# Risk Assessment

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

**Figure GA-1: Understanding Risk**



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

## Hazard Analysis

The Gladstone 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 Gladstone, which are discussed throughout this addendum. Table GA-2 shows the HVA matrix for Gladstone listing each hazard in order of rank from high to low. For local governments, conducting the

hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. Two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) and one chronic hazard (winter storm) rank as the top hazard threats to the City (Top Tier). Extreme heat event, flood, windstorm, and wildfire comprise the next highest ranked hazards (Middle Tier), while drought, landslide, and volcanic event comprise the lowest ranked hazards (Bottom Tier).

**Table GA-2 Hazard Analysis Matrix**

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Earthquake - Cascadia	2	45	100	35	182	1	Top Tier
Earthquake - Crustal	6	50	100	21	177	2	
Winter Storm	14	35	70	49	168	3	
Extreme Heat Event	10	40	70	35	155	4	Middle Tier
Flood	6	25	70	49	150	5	
Windstorm	10	35	50	42	137	6	
Wildfire	6	25	50	42	123	7	
Drought	10	15	30	56	111	8	Bottom Tier
Landslide	2	25	40	35	102	9	
Volcanic Event	2	20	40	7	69	10	

Source: Gladstone HMAC, 2023.

## Community Characteristics

Table GA-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.

### Population, Housing, and Income

Gladstone has grown substantially since its incorporation in 1911 and has an area today of 2.4 square miles. It is in the south-central region of Clackamas County, located approximately 12 miles south of the City of Portland. Gladstone is part of the Clackamas River Water Providers, which is a coalition that gets its water from the Clackamas River.

Located at 57 feet above sea level, Gladstone’s climate is consistent with a Mediterranean climate zone, with warm summers and cool, wet winters. Gladstone receives most of its rainfall between October and May, and averages 46 inches of rain, and less than a couple inches of snow, per year.

Between 2016 and 2021 the City grew by 510 people (4%; as of 2022 the population is 12,170). Between 2022 and 2040 the population is forecast by Metro to decrease slightly to 12,021 (due to two years of negative growth following the COVID pandemic). As the region rebounds from pandemic-related economic challenges, this population projection is expected to change.

Most of the population is White/Caucasian (76%) and about 18% of the population is Hispanic or Latino. The poverty rate is 16% (25% of children under 18, 11% for people 65 and older), 5% do not have health insurance, and 52% of renters pay more than 30% of their household income on rent (39% for owners). About 26% of the population has a bachelor’s degree or higher (8% do not have a high school degree). Approximately 16% of the population lives with a disability (39% of population 65 and older), and 39% are

either below 15 (19%) or over 65 (20%) years of age. About 11% of the population are 65 or older and living alone and 15% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 71% of housing units are single-family, 23% are multifamily, and 6% are mobile homes. One third of homes (32%) were built before 1970 and 27% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (62%) of housing units are owner occupied, 36% are renter occupied, 0% are seasonal homes, and 2% are vacant.

### **Transportation and Infrastructure**

Gladstone is roughly 12 miles south from Portland and adjacent to Milwaukie, Oregon City, and West Linn. It is located within the Portland Metro with Highway 99E, otherwise known as McLoughlin Blvd, running north to south through the southwestern corner of Gladstone. The majority of Gladstone lies west of Interstate 205 and Highway 212/224 is located just north of the city boundary. The Union Pacific Railroad main line, which carries both passengers and freight, crosses through Gladstone east of Interstate 205 and west of the Clackamas River.

Motor vehicles represent the dominant mode of travel through and within Gladstone. Fifteen percent (15%) of renters and 3% of owners do not have a vehicle. Most workers drive alone to work (75%); 6% carpool, 4% use public transit, 2% either walk or use a bicycle, and 13% work at home. Portland Tri-Met has a light-rail line in Milwaukie and is the bus service that provides public transit to the City. There are no port services available on the Willamette and Clackamas Rivers near Gladstone, but there are recreational areas along the river.

### **Economy**

Gladstone's proximity to major transportation routes and access to rail has made it a desirable place for commercial and industrial development. Historically Gladstone's economy focused on forestry and farming, which still has a major presence in the workforce. About 50% of the resident population 16 and over is in the labor force (6,015 people) and are employed in a variety of occupations including professional (16%), office and administrative (15%), management, business, and financial (14%), production (11%), and construction, extraction, and maintenance (11%) occupations.

Gladstone has an economic advantage due to its location at the north end of the Willamette Valley and its proximity to Portland. A significant portion of the land available for industrial development in Clackamas County is in the Gladstone area. There are currently new expansions in existing industries currently underway with available industrial land in the Industrial Parks.<sup>2</sup>

Most workers residing in the city (96%, 5,464 people) travel outside of the city for work primarily to Portland and surrounding areas.<sup>3</sup> A significant population of people travel to the city for work, (93% of the workforce, 2,971 people) primarily from Portland and surrounding areas.<sup>4</sup>

---

<sup>2</sup> Economic Development (2019). City of Gladstone. <https://www.cityofGladstone.com/ed>

<sup>3</sup> U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on December 21, 2023 at <https://onthemap.ces.census.gov>.

<sup>4</sup> Ibid.

Table GA-3 Community Characteristics

Population Characteristics		Population	Household Characteristics		
		Growth			
<b>2016 Population Estimate</b>	11,660		<b>Housing Units</b>		
<b>2022 Population Estimate</b>	12,170	4%	Single-Family (includes duplexes)	3,410 71%	
<b>2045 Population Forecast*</b>	12,021	-1%	Multi-Family	1,127 23%	
<b>Race</b>			Mobile Homes (includes RV, Van, etc.)	293 6%	
American Indian and Alaska Native		1%	<b>Household Type</b>		
Asian		2%	Family Household	3,123 66%	
Black/ African American		2%	Married couple (w/ children)	624 13%	
Native Hawaiian and Other Pacific Islander		< 1%	Single (w/ children)	699 15%	
White		76%	Living Alone 65+	523 11%	
Some Other Race		< 1%	<b>Year Structure Built</b>		
Two or More Races		6%	Pre-1970	1,546 32%	
<b>Hispanic or Latino/a (of any race)</b>			1970-1989	1,961 41%	
		18%	1990-2009	984 20%	
<b>Limited or No English Spoken</b>	379	3%	2010 or later	339 7%	
<b>Vulnerable Age Groups</b>			<b>Housing Tenure and Vacancy</b>		
Less than 5 Years	369	3%	Owner-occupied	2,978 62%	
Less than 15 Years	1,946	16%	Renter-occupied	1,742 36%	
65 Years and Older	1,994	17%	Seasonal	0 0%	
85 Years and Older	302	3%	Vacant	110 2%	
Age Dependency Ratio		0.49	<b>Vehicles Available (Occupied Units)</b>		
<b>Disability Status (Percent age cohort)</b>			No Vehicle (owner occupied)	75 3%	
Total Disabled Population	1,901	16%	Two+ vehicles (owner occupied)	2,280 77%	
Children (Under 18)	163	7%	No Vehicle (renter occupied)	258 15%	
Working Age (18 to 64)	988	13%	Two+ vehicles (renter occupied)	581 33%	
Seniors (65 and older)	750	39%	<b>Employment Characteristics</b>		
<b>Income Characteristics</b>			<b>Labor Force (Population 16+)</b>		
<b>Households by Income Category</b>			In labor Force (% Total Population)	6,015 50%	
Less than \$15,000	439	9%	Unemployed (% Labor Force)	378 6%	
\$15,000-\$29,999	427	9%	<b>Occupation (Top 5) (Employed 16+)</b>		
\$30,000-\$44,999	475	10%	Professional & Related	961 16%	
\$45,000-\$59,999	309	7%	Office & Administrative	885 15%	
\$60,000-\$74,999	498	11%	Management, Business, & Financial	856 14%	
\$75,000-\$99,999	671	14%	Production	678 11%	
\$100,000-\$199,999	1,467	31%	Construction, Extraction, & Maint.	660 11%	
\$200,000 or more	434	9%	<b>Health Insurance</b>		
<b>Median Household Income</b>			\$83,214	No Health Insurance	641 5%
<b>Gini Index of Income Inequality</b>			0.43	Public Health Insurance	5,057 42%
<b>Poverty Rates (Percent age cohort)</b>				Private Health Insurance	7,833 66%
Total Population	1,932	16%	<b>Transportation to Work (Workers 16+)</b>		
Children (Under 18)	591	25%	Drove Alone	4,465 75%	
Working Age (18 to 64)	1,136	15%	Carpooled	336 6%	
Seniors (65 and older)	205	11%	Public Transit	225 4%	
<b>Housing Cost Burden (Cost &gt; 30% of household income)</b>			Motorcycle	0 0%	
Owners with a Mortgage	877	39%	Bicycle/Walk	91 2%	
Owners without a Mortgage	289	40%	Work at Home	791 13%	
Renters	911	52%			

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", 2016 & 2022; Portland State University. 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 Gladstone. 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 GA-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

**Table GA-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
Gladstone Emergency Operations Center	-	X	-	-	-
Gladstone Fire Department	-	-	-	-	-
Gladstone High School	-	X	X	-	-
Gladstone Police Department	-	X	X	-	-
Gladstone Public Works	-	X	X	-	-
John Wetten Elementary School	-	X	X	-	-
Rivergate SDA School	-	X	X	-	-
Walter L Kraxberger Middle School	-	X	-	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-18

Additional Critical Facilities not included in the DOGAMI Risk Report:

- Gladstone Civic Center (City Hall and Police Station)
- Gladstone Community Center
- Public Works
- Gladstone Fire Station #22
- Gladstone area churches

## Critical Infrastructure

Infrastructure that provides necessary services for emergency response include: Oregon City Bridge, communication towers, Highway 205, McLoughlin Blvd Corridor (Highway 99E), NW Natural pipelines off McLoughlin Blvd, power substation on Jennings, railroad, Clackamas River Water, Oak Lodge Water,

pump stations, sanitary sewer collection system and pump station, stormwater infrastructure, and water lines.

## 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.

- Gladstone High School
- John Wetten Elementary
- Kraxburger Middle School
- Gladstone Center for Children and Families
- Hillside Christian Fellowship Gladstone
- Church of Christ
- Church of Jesus Christ of Latter-Day Saints
- Gladstone Christian Church
- First Baptist Church
- Seventh Day Adventist
- St. Stephen Lutheran Church
- The Source Church
- Safeway
- Avamere Rehabilitation of Clackamas
- Somerset Assisted Living
- Tukwila Springs (Affordable Housing)

## Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include: Billy Goat Island, McLoughlin/Risley Wetland, Olsen Wetland, Willamette and Clackamas Rivers and riparian corridors, and City Parks (including Abernathy Lane Trail, Cross Park, Dahl Beach, Diericks Field, Gladstone Nature Park, Glen Echo Wetland, High Rock Park, Max Patterson Memorial City Park, Meldrum Bar Park, Nick Shannon Park, Ridgeway Tracts, Robin Hood Park, Salty Acres Wetlands, and Stocker Park).

## 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:

### Assisted Living Facilities

- Avamere Rehabilitation of Clackamas
- Gladstone Senior Center
- Somerset Assisted Living
- Somerset Lodge

### Child Care Centers

- Gladstone Center for Children and Families

### Mobile Home Parks

- Tri-City Mobile Home Park
- Two Rivers Coop Home Park
- Hollyview Court

### Other Vulnerable Populations

- 7<sup>th</sup> Day Adventist Annual Conference (Gladstone Park)
- Schools
- Tukwilla Springs (Affordable Housing)

## 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: Cal Spas Chemical Storage, Classic Pool and Spa, First Student Bus Barn, Gas Stations, and Gladstone Public Works.

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

## Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Happy Valley. 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 include:

### Economic Centers

- 82<sup>nd</sup>/Arlington Corridor
- Budget Inn
- Holiday Inn
- McLoughlin Blvd Corridor
- Walgreens
- Safeway

### Apartment Centers

- Alder Creek Apartments
- Arlington West Apartments
- Autumn Oak Apartments
- Bridgland's Properties LLC
- Fairway Village
- Gladstone Forest Apartments
- Los Verdes Townhomes
- Lynisa Apartments
- Monte Verde Apartments
- Oak Hill Apartments
- PDX Pads LLC
- Rask Properties LLC
- Rivergreens Associates LLC
- Riverplace Apartments
- Rocky Bluff Townhomes
- T & K Properties
- Webster A to Z LLC
- Webster Ridge Apartments

## 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.

## Hazard Characteristics

### Drought

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



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

The City of Gladstone Public Works Department manages Gladstone’s water supply. Gladstone maintains a local system of three water tanks, two pump stations, and almost 40 miles of pipelines. These pipelines and other water infrastructure has not been updated or repaired properly, so the City Council approved water and sewer rate increases since 2018 to help with maintenance costs. The City is also part of a regional water treatment provider, the North Clackamas County Water Commission. The City draws its water supply from the Clackamas River. There is potential contamination sources within the Clackamas Watershed area from agriculture, managed forest land, wastewater treatment plans, and other sources.<sup>5</sup>

### **Vulnerability Assessment**

Due to insufficient data and resources, Gladstone is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table GA-4.

### **Future Projections**

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”<sup>6</sup> drought, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation, is projected to become more frequent in Clackamas County by the 2050s.

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

## **Earthquake (Cascadia Subduction Zone)**

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

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Gladstone 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 Gladstone 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-Gladstone Fault Zone (discussed in the crustal earthquake section).

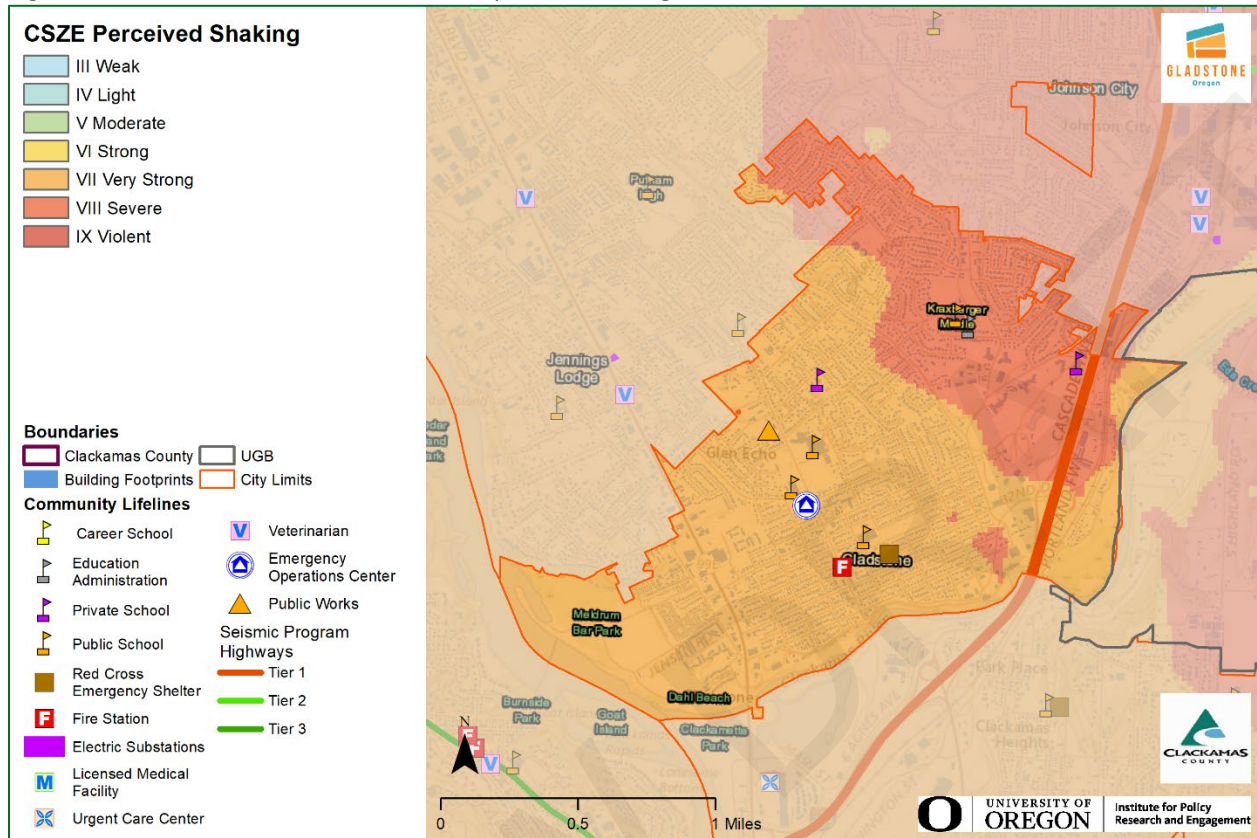
Figure GA-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange).

---

<sup>5</sup> Profita, C. *Clackamas Watershed Collects Pollutants and Drinking Water* (2013). OPB.org.

<sup>6</sup> Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Figure GA-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.<sup>7</sup>

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.

The City is not within the severe shaking area, though there is significant area around the City that have severe and very severe shaking if a large earthquake were to occur. These areas include Highway 205 and

<sup>7</sup> The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

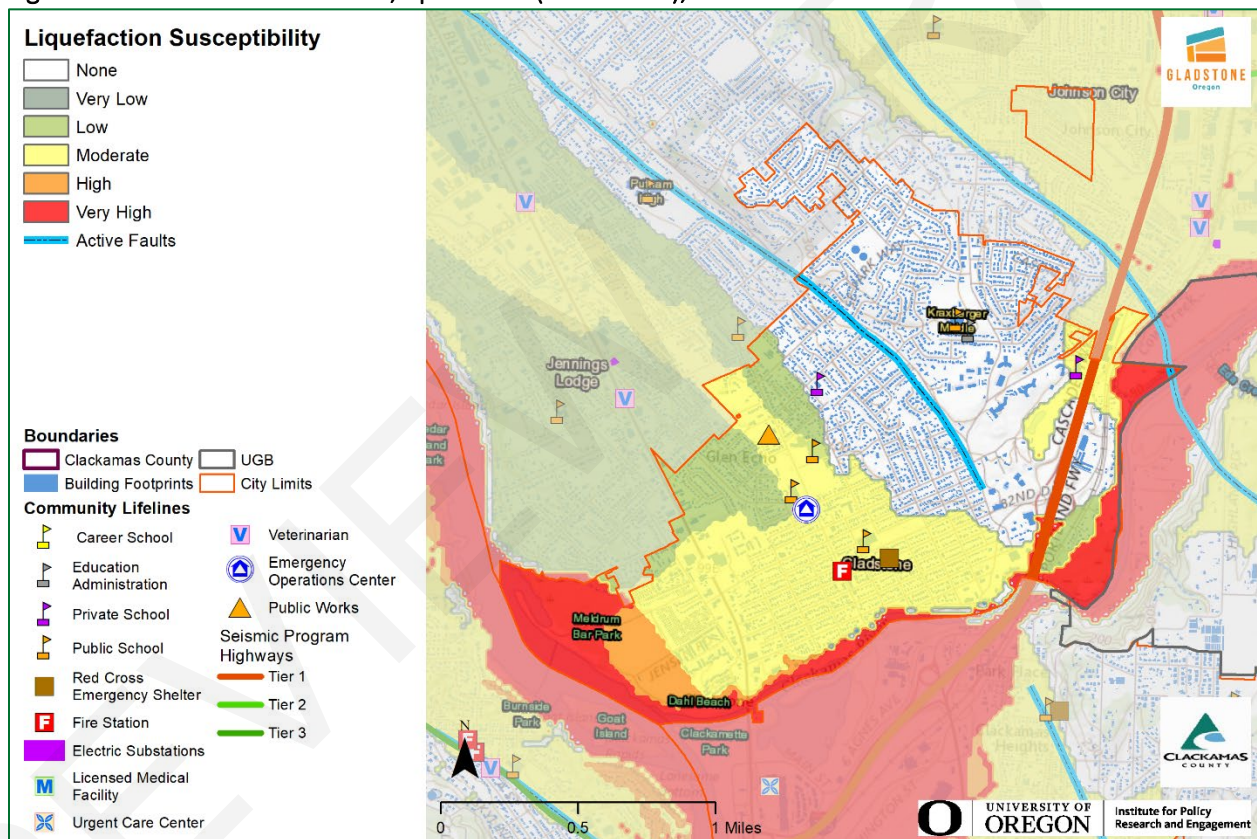
Highway 99E, which could result in Gladstone having access issues from emergency vehicles and other response efforts.

## Earthquake (Crustal)

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

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Gladstone as well. Figure GA-3 shows a generalized geologic map of the Gladstone 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.

Figure GA-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

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

Gladstone has the Canby-Molalla and Portland Hills Faults running through the city, which can generate high-magnitude earthquakes. 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-Gladstone 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 Gladstone in northern Oregon.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 15 miles northeast of Gladstone.

**Vulnerability Assessment**

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

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 GA-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.

**Table GA-5 Rapid Visual Survey Scores**

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
<b>Schools</b>					
Gladstone High (18800 Portland Ave)	Clac_sch64	X	X,X		
John Wetten Elementary (250 E Exeter St)	Clac_sch63	X	X	X	
Walter L Kraxberger Middle (17777 Webster Rd)	Clac_sch90	X	X,X	X	
<b>Fire Facilities</b>					
Gladstone Fire Main Station (operated by CFD #1) (555 Portland Ave) <b>see mitigation successes</b>	Clac_fir19	X			

## Police Facilities

Police Station (EOC) (18505 Portland Ave)	n/a	This building was built after 2007 and not included in the RVS.
--	-----	---

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

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

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

### Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and 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 GA-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 GA-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	4,022	4,022	4,022	4,022
Building Value (\$ Million)	1,129	1,129	1,129	1,129
Building Repair Cost (\$ Million)	51	69	437	504
Building Loss Ratio	5%	6%	39%	45%
Debris (Thousands of Tons)	27	32	139	157
Long-Term Displaced Population	63	235	1,816	2,656
Total Casualties (Daytime)	48	61	351	394
Level 4 (Killed)	3	3	11	24
Total Casualties (Nighttime)	13	26	197	258
Level 4 (Killed)	0	1	5	7

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 Gladstone is expected to have a 2% building loss ratio with a repair cost of \$21 million under the CSZ “dry” scenario, and under the CSZ “wet” scenario.<sup>8</sup> The city is expected to have around 12 daytime or 3 nighttime casualties during the CSZ “dry” scenario and 12 daytime or 3 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 8 for the CSZ “dry” scenario and 8 for the CSZ “wet” scenario.<sup>9</sup> (See Risk Report content for additional information.)

#### Portland Hills Fault Scenario

The City of Gladstone is expected to have a 4% building loss ratio with a repair cost of \$37 million under the CSZ “dry” scenario, and under the CSZ “wet” scenario.<sup>10</sup> The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 17 daytime or 7 nighttime casualties during the Portland Hills Fault “dry” scenario and 17 daytime or 7 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 17 for the Portland Hills Fault “dry” scenario and 17 for the Portland Hills Fault “wet” scenario.<sup>11</sup>

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 GA-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](#)).

<sup>8</sup> DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, [Oregon \(2018, O-18-02\)](#), [Tables 12-8 and 12-9](#).

<sup>9</sup> Ibid, Tables 12-8 and 12-9.

<sup>10</sup> Ibid, Tables 12-10 and 12-11.

<sup>11</sup> Ibid, Tables 12-10 and 12-11.

## Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-XX)<sup>12</sup> 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 Scenario

In Gladstone, 369 buildings and 7 critical facilities are expected to be damaged for a total potential loss of \$121 million (a loss ratio of over 8%). About 263 residents may be displaced.

### Canby-Molalla Fault Scenario

In the city, 348 buildings are expected to be damaged, 5 critical facilities, for a total potential loss of \$91 million (a loss ratio of 6%). About 240 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.

## Flood

The HMAC determined that the City's probability of flooding is **moderate** and that their vulnerability to flooding is **moderate**. *These ratings decreased since the previous version of this NHMP.*

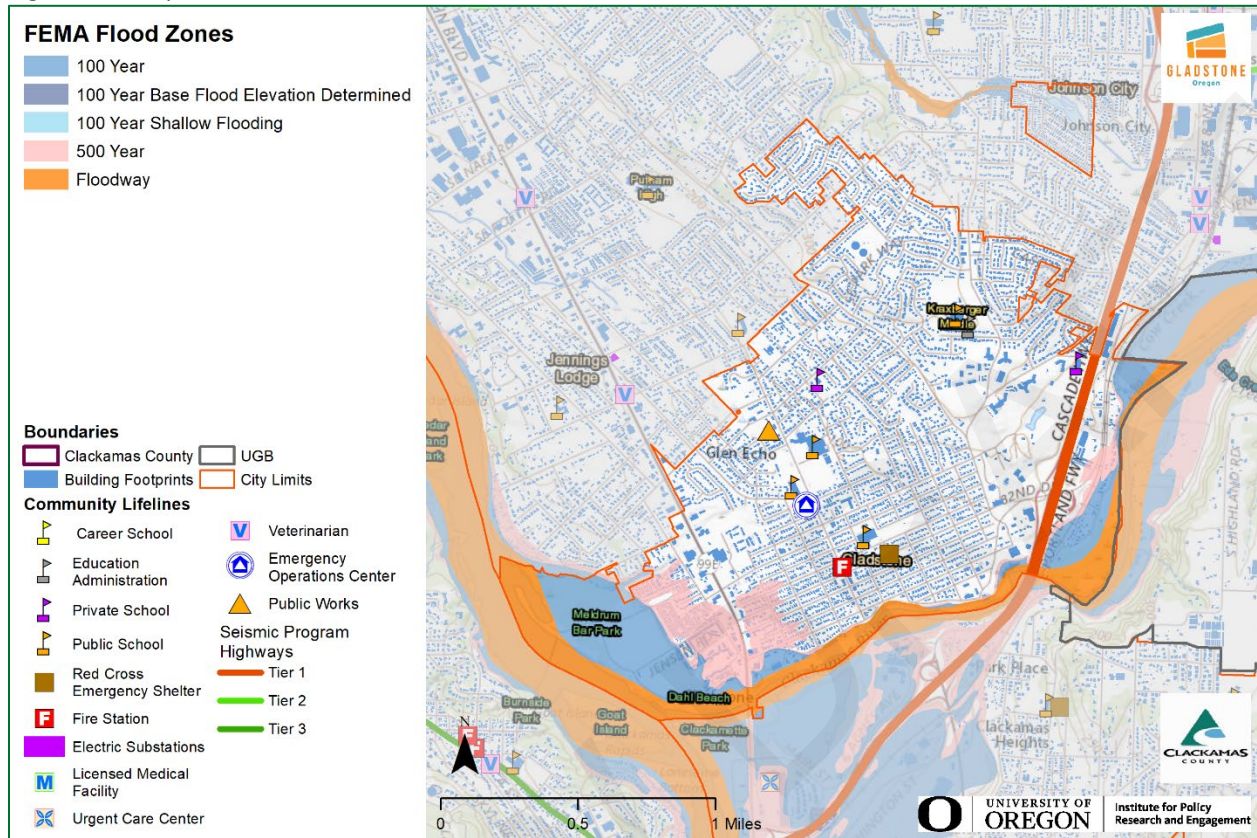
Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure GA-4 illustrates the flood hazard area for Gladstone.

While Gladstone does not show many areas within the FEMA mapped special flood hazard areas (100-year flood vulnerability), with roughly 274 acres (21% of the total land within the city) is located within the 100-year floodplain. A larger flooding event, such as the 500-year flood, could cause serious damage. The city can experience urban flooding which is primarily due to inadequate storm drain pipes, and culverts that are too small. Additionally, the extent of flooding will vary depending on climatic conditions and precipitation levels. Typically, roads are covered with water in urban flooding events, and water will occasionally overflow manholes in some parts of the city. Newer homes are built on higher ground to avoid flooding issues, and many older homes have pumps within their crawlspaces to avoid flood events.

---

<sup>12</sup> DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-17.

Figure GA-4 Special Flood Hazard Area



Source: Map created by Oregon Partnership for Disaster Resilience.

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

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

### Vulnerability Assessment

There are no critical facilities in the 100-year floodplain. The only essential facility exposed to flooding is the river View Care Center as well as sewer, water lines, and roads. These roads include Clackamas Blvd, Edgewater Rd, Glen Echo Ave, Risley Ave, River Ln, Evergreen Ln, south end of Rinearson Rd, and the south end of Rivergreens Rd.

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. Other portions of Gladstone outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The extent of flooding hazards in Gladstone 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. In the past flooding has occurred along Edgewater Rd, Risley Ave, Glen Echo Ave, Ipswich St, Evergreen Ln, and Portland Ave. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table GA-4.

### Natural Hazard Risk Report for Clackamas County

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

According to the Risk Report 29 buildings could be damaged for a total potential loss of \$2.8 million (a building loss ratio of less than 1%). About 110 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 Community Repetitive Loss record does not identify any Repetitive Loss Properties<sup>14</sup> or Severe Repetitive Loss Properties<sup>15</sup>.

### Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"<sup>16</sup> 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 **moderate** and that their vulnerability to landslide is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Gladstone does not have a history of landslides. This is due to the relatively flat topography within the UGB as well as the City's requirements of geological analysis on slopes of 20% or greater, usually located along stream embankments, before extensive tree removal, excavation, or construction occurs.

The biggest landslide threat is in the residential Oatfield/Oakridge corridor. This area has several steep slopes and slow ground movement. A home on Oakridge Drive slowly slid over the years and was

---

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

<sup>14</sup> 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.

<sup>15</sup> 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.

<sup>16</sup> Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

eventually removed from the property. Ground movement is also common on Parkway and Caldwell, as several homeowners on these streets have put pilings under their homes.

Landslide susceptibility exposure for Gladstone is shown in Figure GA-5. Most of Gladstone demonstrates a low landslide susceptibility exposure. Steep slopes are primarily located along the Willamette and Clackamas Rivers, some of these locations are in High Rocks Park, Cross Park, Dahl Park, and Meldrum Park. The McLoughlin/Risley Wetland, a tributary to the Willamette River, has small areas of steep slopes as well. There is approximately 7% within Gladstone that have very high or high landslide susceptibility exposure, while approximately 22% show moderate landslide susceptibility exposure.<sup>17</sup>

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

### **Vulnerability Assessment**

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided above and within Figure GA-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. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table GA-4.

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](#))<sup>18</sup> provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report, 244 buildings are exposed to the *high and very high landslide susceptibility* hazard for a total exposure of \$103 million (a building exposure ratio of 7%). About 974 residents may be displaced by landslides (a population exposure ratio of 8%).

### **Future Projections**

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

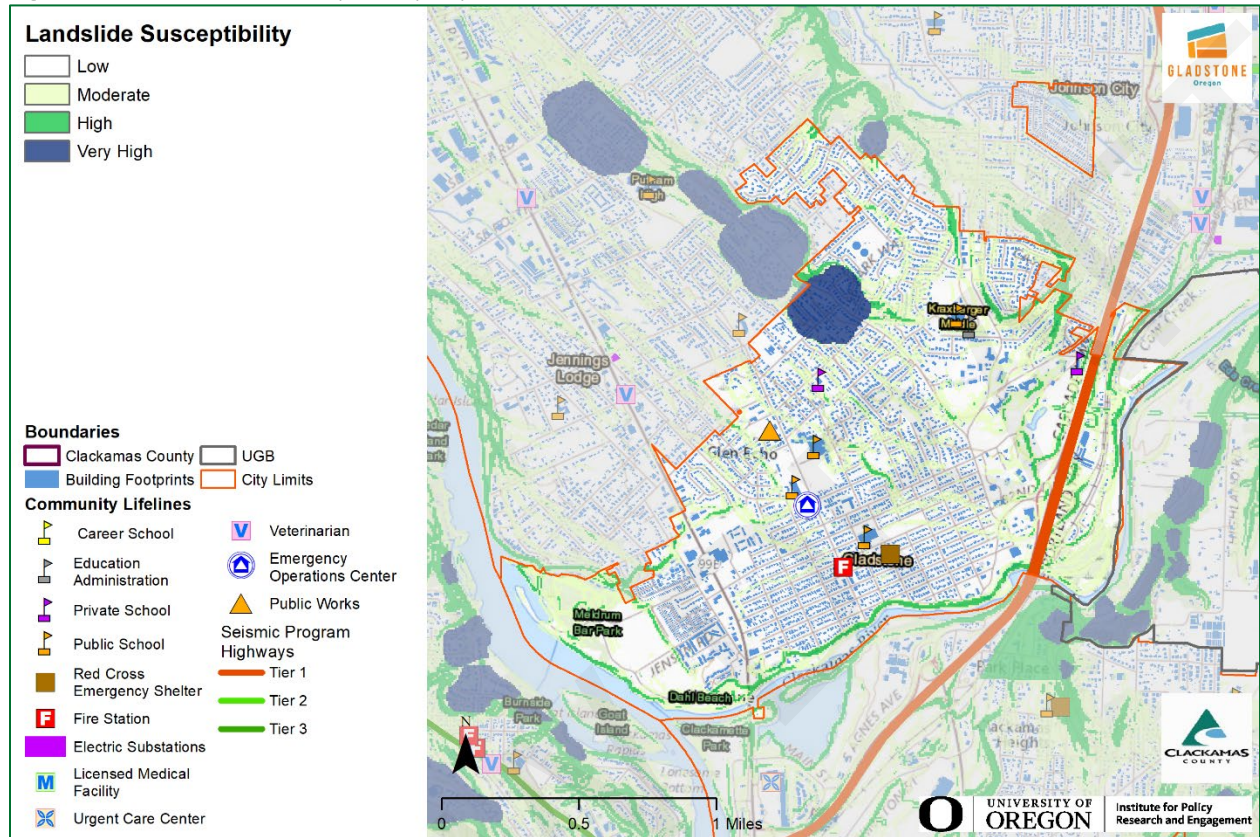
---

<sup>17</sup> DOGAMI. [Open-File Report, O-16-02](#), *Landslide Susceptibility Overview Map of Oregon* (2016)

<sup>18</sup> DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, [September 2023 Draft](#)), Table A-17.

landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Figure GA-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 **moderate** and that their vulnerability is **high**. *The probability rating did not change and the vulnerability rating increased 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.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees

Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The City of Gladstone has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events. resulting from hazards.

#### Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”<sup>19</sup> the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the hottest day of the year is projected to increase by an average of about 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

## Windstorm

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

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

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris.

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. Power outages can affect sewer and water pump stations. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

#### Future Projections

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

---

<sup>19</sup> Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

## Winter Storm (Snow/Ice)

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

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

Winter storms cause problems on roadways as well as power outages that affect sewer and water pump stations. In 2016 and 2017 the Governor declared a state of emergency for the county, though no major damage was reported in city limits.

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

### Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"<sup>20</sup> 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, Gladstone is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets Section and Table GA-4.

---

<sup>20</sup> Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

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

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

### Vulnerability Assessment

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

### Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, O-24-xx)**<sup>21</sup> provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

### Future Projections

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

## Wildfire

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

The [Clackamas County Community Wildfire Protection Plan \(CWPP\)](#) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Gladstone is found in the following chapter: Chapter 9.6: Gladstone Fire Department (note Clackamas Fire District #1 provides services for the fire district).

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

Weather and urbanization conditions are primarily at cause for the hazard level. Gladstone 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. Figure GA-6 shows overall wildfire risk in Gladstone.

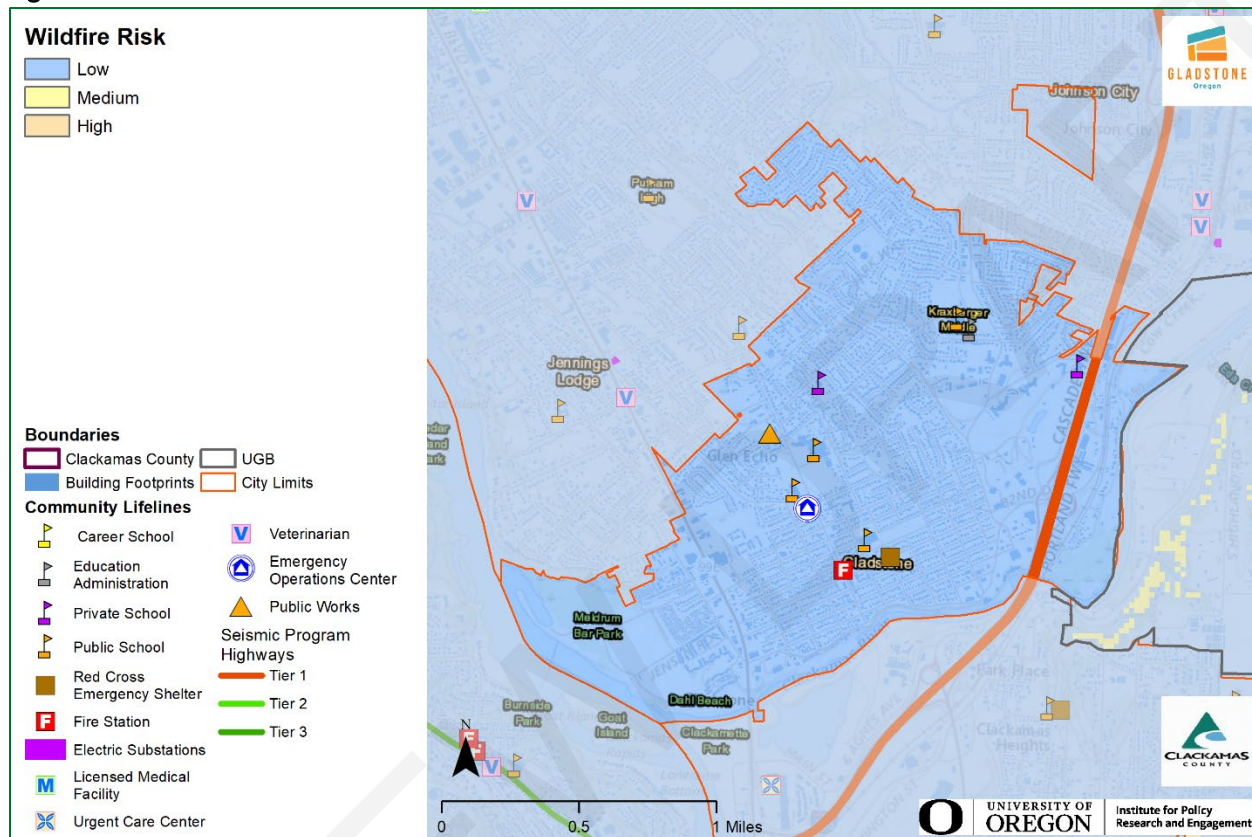
Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Gladstone, is the most heavily populated portion of the county and is

---

<sup>21</sup> DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (O-24-XX, September 2023 Draft)*, Table A-17.

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. In Gladstone, most fires have been small enough to contain quickly and easily.

Figure GA-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

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

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

Gladstone is surrounded mostly by urban areas which creates a buffer from the forested areas. There are some areas of heavy tree coverage and other fuel supplies include the open field along Webster Rd, Billy Goat Island, Meldrum Bar, and Nick Shannon Park. Additionally, these areas are located adjacent to potential wildfire hazard zones: the business corridor along Highway 99E, area between Ridgeway Dr and Parkway Dr, area near Bird Song Way, Rinearson Creek wetlands, and the Oatfield/Oakridge corridor. Identified High and Medium Priority Communities at Risk (CARs) located within the City are: (High) Billy Goat Island, Dahl Beach, Parkway Woods, and (Medium) Risley Wetlands.<sup>22</sup> Wildfires are not a frequent occurrence within the city, but regional wildfires occasionally introduce pollutants within the city. Gladstone sits in the bottom of a valley, and pollution from regional fires settles in the area, causing health concerns for residents.

Most of the city has low wildfire burn probability that includes expected flame lengths less than four-feet under normal weather conditions.<sup>23</sup> However, conditions vary widely and with local topography, fuels,

<sup>22</sup> Clackamas County Community Wildfire Protection Plan, *Molalla Fire Department* (2018), Table 10.13-1.

<sup>23</sup> [Oregon Wildfire Risk Explorer](#), date accessed November 9, 2018.

and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

### **Vulnerability Assessment**

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the City as well. Gladstone’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 the City’s 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).

### **Natural Hazard Risk Report for Clackamas County**

The **Risk Report (DOGAMI, O-24-xx)**<sup>24</sup> provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard. There are no moderate (medium) or high wildfire hazard zones in the City. As such, the Risk Report does not identify any exposed buildings or displaced residents.

### **Future Projections**

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”<sup>25</sup> 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.

---

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

<sup>25</sup> Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.



# Attachment A: Action Item Changes

Table GA-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 GA-1).

Previous NHMP Actions that are Complete:

None identified.

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

None identified.

**Table GA-7 Status of All Hazard Mitigation Actions in the Previous Plan**

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete, Ongoing	Yes
Multi-Hazard #2	#2	Not Complete, Ongoing	Yes
Multi-Hazard #3	#3	Not Complete, Ongoing	Yes
Multi-Hazard #4	#4	Not Complete, Ongoing	Yes
Multi-Hazard #5	#5	Not Complete, Ongoing	Yes
Multi-Hazard #6	#6	Not Complete, Ongoing	Yes
Multi-Hazard #7	#7	Not Complete, Ongoing	Yes
Earthquake #1	#8	Not Complete, Ongoing	Yes
Flood #1	#9	Not Complete, Ongoing	Yes
Flood #2	#10	Not Complete, Ongoing	Yes
Flood #3	#11	Not Complete, Ongoing	Yes
-	#12	New	-
-	#13	New	-
-	#14	New	-
-	#15	New	-
-	#16	New	-
Landslide #1	#17	Not Complete, Ongoing	Yes
Severe Weather #1	#18	Not Complete, Ongoing	Yes
Wildfire #1	#19	Not Complete, Ongoing	Yes

# Attachment B: Public Involvement Summary

---

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

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from January XX through February 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. The steering committee met formally on the following date:

Meeting #1 and #2: March 8 and May 30, 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 community lifelines.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: November 14, 2023 (via remote conference)

During this meeting, the HMAC:

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