Eugene-Springfield Area Multi-Jurisdictional
NATURAL HAZARDS MITIGATION PLAN

City of Eugene
940 Willamette #200
Eugene, Oregon 97401

City of Springfield
225 Fifth Street
Springfield, Oregon 97477

January 2020

Eugene Water & Electric Board
500 East Fourth Ave.
Eugene, Oregon 97401

Rainbow Water District
1550 N. 42nd St.
Springfield, OR 97477

Springfield Utility Board
250 A Street
Springfield, Oregon 97477

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COUNCIL RESOLUTION NO. 5303

A RESOLUTION ADOPTING THE EUGENE-SPRINGFIELD AREA MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN 2020 AND REPLACING THE PLAN ADOPTED BY RESOLUTION NO. 5126.

PASSED: 7:0

REJECTED:

OPPOSED:

ABSENT: Evans

CONSIDERED: June 24, 2020

RESOLUTION NO. 5303

A RESOLUTION ADOPTING THE EUGENE-SPRINGFIELD AREA MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN 2020 AND REPLACING THE PLAN ADOPTED BY RESOLUTION NO. 5126.

The City Council of the City of Eugene finds that:

A. On February 9, 2015, Resolution No. 5126 was adopted approving the December 2014 "Eugene-Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan." The Federal Emergency Management Agency ("FEMA") requires that Natural Hazards Mitigation Plans be updated every five years.

B. The City of Eugene recognizes the threat that natural hazards pose to people and property within our community.

C. Undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences.

D. An adopted Multi-Jurisdictional Natural Hazards Mitigation Plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs.

E. The City of Eugene fully participated in the FEMA-prescribed mitigation planning process to prepare the Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan 2020 attached as Exhibit A.

F. The Oregon Office of Emergency Management and Federal Emergency Management Agency, Region 10 (X) officials have reviewed the "Eugene-Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan 2020," dated January 2020, and have pre-approved it contingent upon this official adoption of the participating governments and entities.

NOW, THEREFORE,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF EUGENE, a Municipal Corporation of the State of Oregon, as follows:

Section 1. The "Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan 2020" attached as Exhibit A is adopted and replaces the Plan adopted by Resolution No. 5126.

Section 2. The City Manager, or the Manager's designee, is requested to submit a copy of this Resolution, including Exhibit A, to the Oregon Office of Emergency Management and Federal Emergency Management Agency, Region 10 (X) officials to obtain formal approval of the Plan.

__Section 3.__ This Resolution is effective immediately upon its passage by the City Council.

The foregoing Resolution adopted the 24th day of June, 2020.

City Recorder – Deputy

CITY OF SPRINGFIELD, OREGON
RESOLUTION NO. 2020-04

A RESOLUTION OF THE CITY OF SPRINGFIELD COMMON COUNCIL ADOPTING THE JANUARY 2020 EUGENE-SPRINGFIELD AREA MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN AND REPLACING THE PLAN ADOPTED BY RESOLUTION NO. 2015-04

WHEREAS, on February 17, 2015, the Common Council of the City of Springfield adopted its Resolution No. 2015-04 thereby approving the December 2014 "Eugene/Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan"; and

WHEREAS, Springfield recognizes the threat that natural hazards pose to people and property within our community; and

WHEREAS, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

WHEREAS, the Federal Emergency Management Agency (FEMA) requires jurisdictions to update and formally adopt their Natural Hazards Mitigation Plan every five years to maintain their eligibility to receive funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, Springfield actively participated in the FEMA-prescribed mitigation planning process to prepare this January 2020 "*Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan*"; and

WHEREAS, the Oregon Office of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the January 2020 "*Eugene-Springfield Area Multi-Jurisdictional Natural Hazard Mitigation Plan*" and approved it as of January 13, 2020, contingent upon its official adoption by the participating governments and entities;

NOW, THEREFORE, BE IT RESOLVED, BY THE COMMON COUNCIL OF THE CITY OF SPRINGFIELD:

Section 1. The January 2020 "*Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan*" is adopted as an official plan and replaces the Plan adopted by Council Resolution 2015-04.

Section 2. The Springfield City Manager will submit this Adoption Resolution to the Oregon Office of Emergency Management and Federal Emergency Management Agency, Region X officials to enable the Plan's final approval.

Section 3. This Resolution will take effect upon adoption by the Council and approval by the Mayor.

ADOPTED by the Common Council of the City of Springfield, this 18 day of February, 2020 by a vote of 5 for and 0 against. (1 absent - Woodrow)

Mayor

ATTEST:

City Recorder

REVIEWED & APPROVED
AS TO FORM
Kristina Kraaz

DATE: 2/13/2020
SPRINGFIELD CITY ATTORNEY'S OFFICE

Eugene Water & Electric Board
PO Box 10148
Eugene, OR 97440-2148
541-685-7000
www.eweb.org

July 17, 2020

Kevin Holman, Emergency Management Program Manager
City of Eugene
Emergency Management
Employee Resource Center
940 Willamette St., Suite 200
Eugene OR 97401

Re: EWEB Board Approval of 2020 Eugene/Springfield Natural Hazard Mitigation Plan

Mr. Holman:

The EWEB Board of Commissioners approved the 2020 Eugene-Springfield Area Multi-Jurisdictional Natural Hazard Mitigation Plan via the consent calendar at its February 4, 2020 regular meeting.

By adopting the plan, the Eugene Water & Electric Board commits to work on the mitigation actions described in the EWEB Annex.

Anne Kah

Anne Kah
Executive Assistant/Assistant Board Secretary
Eugene Water & Electric Board

SPRINGFIELD UTILITY BOARD

RESOLUTION 20-02

WHEREAS, the Springfield Utility Board, organized under the laws of the State of Oregon and the Charter of the City of Springfield, is authorized under the provisions of ORS Chapter 402 to establish by resolution the adoption of the January 2020 Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan; and

WHEREAS, the Springfield Utility Board recognizes the threat that natural hazards pose to people and property within our community; and

WHEREAS, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

WHEREAS, the Federal Emergency Management Agency (FEMA) requires jurisdictions to update and formally adopt their Natural Hazards Mitigation Plan every five (5) years to be eligible to receive funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, Springfield Utility Board fully participated in the FEMA-prescribed mitigation planning process to prepare this January 2020 "*Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan*"; and

WHEREAS, the Oregon Office of Emergency Management and Federal Emergency Management Agency officials have reviewed the January 2020 "*Eugene-Springfield Area Multi-Jurisdictional Natural Hazard Mitigation Plan"* and approved (January 13, 2020) it contingent upon this official adoption of the participating governments and entities;

NOW THEREFORE BE IT RESOLVED THAT

The January 2020 "Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan" is adopted as an official plan by Springfield Utility Board's Resolution 20-02.

PASSED AND ADOPTED this 12th day of February, 2020, by a vote of 5 for and 0 against.

John DeWenter, Board Chair

ATTEST:

Jeff Nelson, Board Secretary

RESOLUTION 2020-02
RAINBOW WATER DISTRICT
RESOLUTION ADOPTING 2020 NATURAL HAZARDS MITIGATION PLAN

WHEREAS, Rainbow Water District (Rainbow) is a domestic water supply district organized under Oregon Revised Statues (ORS) Chapter 264, and ORS 264.410 provides "the power and authority given to districts is vested in and shall be exercised by a board of five commissioners", and

WHEREAS, Rainbow recognizes the threat that natural hazards pose to people and property within our community; and undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

WHEREAS, Rainbow Water District participated in the December 2014 "Eugene/Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan" and

WHEREAS, the Federal Emergency Management Agency (FEMA) requires jurisdictions to update and formally adopt their Natural Hazards Mitigation Plan every five years to be eligible to receive grant funding from FEMA for disaster mitigation projects; and

WHEREAS, Rainbow participated in the FEMA-prescribed process to prepare this January 2020 "Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan" along with the Cities of Eugene and Springfield, the Eugene Water and Electric Board, and the Springfield Utility Board, with Rainbow providing an opportunity for public comment on February 12, 2020; and

WHEREAS, officials with the Oregon Office and Emergency Management (OEM) and FEMA Region X have reviewed the 2020 Natural Hazards Mitigation Plan and approved it January 13, 2020 contingent upon the official adoption by all participating governments and entities; and

NOW, THEREFORE, BE IT RESOLVED, the Rainbow Water District Board of Commissioners hereby:

- Adopts the January 2020 Natural Hazards Mitigation Plan, replacing the previous plan, and
- The Rainbow Superintendent will submit this adopting Resolution to the Oregon OEM and FEMA Region X officials to enable the Plan's final approval, and
- This Resolution will take effect upon adoption by the Rainbow Board of Commissioners.

ADOPTED AND APPROVED by a vote of 5 Yes votes and Ø No votes, this 12th day of February 2020.

____
President, Board of Commissioners

Attest:

____
Secretary-Treasurer, Board of Commissioners

Acknowledgements

This plan and the work it represents was funded by the City of Eugene, the City of Springfield, Eugene Water & Electric Board, Rainbow Water District, and Springfield Utility Board.

Project Manager
Jessica Gourley, City of Eugene

NHMP Update Project Team
Jessica Gourley – Project Manager, City of Eugene
Kevin Holman, City of Eugene
Carrie Karl, City of Eugene
Ken Vogeney, City of Springfield
Jeannine Parisi, Eugene Water and Electric Board
Tracy Richardson, Springfield Utility Board
Jamie Porter, Rainbow Water District

Vulnerability Assessment Steering Group
Eric Johnson, City of Eugene Public Works – Maintenance Division
Matt Rodrigues, City of Eugene Public Works – Engineering Division
Mel Damewood, Eugene Water and Electric Board – Engineering and Operations Chief
Ken Vogeney, City of Springfield Emergency Management
Kevin Holman, City of Eugene Emergency Management

Vulnerability Assessment Sector Experts
In addition to the steering group listed above, individuals from more than 20 businesses, non-profits and government agencies were consulted for their expertise and perspective during the vulnerability assessment process. A complete list of these participants can be found in Appendix B, Planning and Public Process.

Lane Preparedness Coalition NHMP Subcommittee
Members of the Lane Preparedness Coalition Natural Hazards Mitigation Plan subcommittee contributed time and expertise to the development of this plan.

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1 Mitigation Planning

This document serves as the long-term natural hazard mitigation strategy for the Cities of Eugene and Springfield as well as the Sub-Plan Holders.[1] The following sections make up the Natural Hazard Mitigation Plan 2020.

- *Section One* is an overview of the plan and development process.
- *Section Two* reviews each hazard, how it has historically affected the area, and what are the potential various impacts.
- *Section Three* includes hazard and demographic maps.
- *Section Four* covers the vulnerability assessment process.
- *Section Five* is comprised of the Sub-Plan Holders' annexes.
- *Section Six* is the final section containing appendixes which include all supporting and hazard impact documentation.

1.1 What is Natural Hazard Mitigation?

Natural hazard mitigation is defined as permanently reducing or alleviating the losses of life, property, and injury resulting from natural hazards through long and short-term strategies. Strategies can include policy changes, such as updating ordinances; projects, such as seismic retrofits to critical facilities; or education and outreach to targeted audiences, such as slide risk reduction measures provided to residents in landslide-prone areas.

Engaging in mitigation activities provides jurisdictions with many benefits, including reduced loss of life and property, improved delivery of essential services, economic stability, reduced cost, and a shortened recovery period following natural hazard events.

Finally, mitigating hazards makes financial sense. A report submitted to Congress by the National Institute of Building Science's Multi-Hazard Mitigation Council (MMC) indicated for every dollar spent on mitigation society can expect an average savings of up to six dollars.[2] Successful, hazard mitigation is the responsibility of individuals, private businesses, and all levels of government.

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[1] Eugene Water & Electric Board, Rainbow Water District, and Springfield Utility Board.
[2] United States. National Institute of Building Sciences. *Natural Hazard Mitigation Saves: 2017 Interim Report* Multihazard Mitigation Council - National Institute of Building Sciences.

1.2 Why Develop a Mitigation Plan?

Understanding the relationships between the natural hazards we face, our vulnerable systems, and our existing response capability helps us identify and implement actions aimed at reducing the community's overall risk. The planning process aids in communication, cooperation, and prioritization of mitigation actions within the community. Maintaining a current plan increases the potential for state and federal funding for mitigation and recovery projects.

The Cities of Eugene and Springfield along with Eugene Water & Electric Board (EWEB), Rainbow Water District (RWD), and the Springfield Utility Board (SUB) jointly developed the 2020 Natural Hazards Mitigation Plan (NHMP), which is the third edition of this multi-jurisdictional plan.

1.3 How Does this Plan Work?

This plan is strategic and non-regulatory in nature, meaning it does not set forth any new policies. It does provide:

- A foundation for coordination and collaboration among agencies and the public;
- Identification and prioritization of future mitigation activities; and
- Aid in meeting Federal requirements for assistance programs.

This mitigation plan works in conjunction with other municipal plans and programs, including local comprehensive land use plans, the Eugene-Springfield Multi-Jurisdictional Emergency Operations Plan, the Lane County Natural Hazards Mitigation Plan, local capital improvement plans, the Eugene-Springfield Public Facilities and Services Plan, and the State of Oregon's Natural Hazards Mitigation Plan.

The actions described in this plan are intended to be implemented primarily through existing plans and programs within Eugene and Springfield; however, some of the mitigation actions described may require development of new or adjustments to existing programs, plans, or policies.

1.4 The Eugene-Springfield Area NHMP 2020

The City of Eugene and the City of Springfield have a history of mitigation work and planning spanning decades. One of the most notable efforts in mitigation work has occurred in flood mitigation. The use of parks and open space in and

December 2017. Accessed October 2017.
http://www.wbdg.org/files/pdfs/MS2_2017Interim%20Report.pdf

around the cities and levies has contributed to flood mitigation as demonstrated in the 2019 Spring flooding. Formal planning between the two cities, working as partners, to address natural hazard planning began in 2009. The following sections (Section 1.1 – 1.5.2) provide a high-level overview of historical planning efforts, who was involved in the completion of the 2020 NHMP, the conclusions reached through the plan development, and the cities vital steps forward.

1.4.1 How was the 2020 NHMP Developed?

Previous planning and new information guided the 2020 NHMP mitigation actions items. In 2009, Eugene and Springfield and partner agencies developed the 2009 NHMP for the most significant natural hazards for our area.

In 2013, Eugene and Springfield, with support from the Oregon Partnership for Disaster Resilience, conducted a 2014 Regional Climate and Hazards Vulnerability Assessment,[3] or the 2014 Vulnerability Assessment for short.

In 2014, Eugene and Springfield and partner agencies developed the 2014 NHMP for the most significant natural hazards for our area. This plan was based on many of the findings from the previous 2009 NHMP and the 2014 Vulnerability Assessment.

In 2016 and 2017, the Cities of Eugene and Springfield conducted seismic evaluations of their critical infrastructure. The Oregon Department of Transportation (ODOT) also completed seismic evaluations of priority bridges,[4] and the Oregon Department of Geology and Mineral Industries (DOGAMI) completed an extensive landslide hazard and risk study[5] in central Lane County.

The Eugene Water and Electric Board (EWEB) and Springfield Utility Board (SUB) are both long time participants in the Eugene-Springfield Area Multi-Jurisdictional NHMP. Additionally, the Rainbow Water District participated in the 2020 NHMP update.

EWEB's utility specific NHMP information is in Annex A, Rainbow Water District's is in Annex B, and SUB's is in Annex C. Each participant developed

[3] United States. City of Eugene. Emergency Management. *Regional Climate and Hazards Vulnerability Assessment.* December 2014. Accessed April 2019. https://www.eugene-or.gov/DocumentCenter/View/20644/2014-EugeneSpringfield-Climate-and-Hazards-Vulnerability-Assessment?bidId=.

[4] United States. Oregon Department of Transportation. Bridge and Geo-Environmental Sections Technical Services Branch. *Oregon Highways Seismic plus Report*. OR: Oregon Department of Transportation, 2014. 1-114.

[5] United States. Oregon Department of Geology and Mineral Industries. *Interpretive Map 60: Landslide Hazard and Risk Study of Eugene-Springfield and Lane County, Oregon*. By Nancy Calhoun, William Burns, Jon Franczyk, and Gustavo Monteverde. Portland, OR: Oregon Department of Geology and Mineral Industries, 2018. 1-42.

their own specific annexes to better explain sector-specific risks and mitigation strategies.

The Project Team supporting the 2020 Natural Hazards Mitigation Plan update was composed of the following individuals:

- Jessica Gourley – Project Manager – City of Eugene
- Kevin Holman – City of Eugene
- Carrie Karl – City of Eugene
- Ken Vogeney – City of Springfield
- Jeannine Parisi – Eugene Water and Electric Board
- Tracy Richardson – Springfield Utility Board
- Jamie Porter – Rainbow Water District

In addition to the 2020 Project Team, a Steering Committee and an Advisory Board were formed. Together these entities compose the NHMP Update Committee. A fourth group involved in the plan development included the public. Each group was responsible for the following:

- Project Team was responsible for physically updating and editing the NHMP.
- Steering Committee was composed of departments and sub-plan holders responsible for implementing mitigation items. (Appendix B lists the members of the committee.)
- Advisory Board stakeholders, though not responsible for implementation, lent their knowledge based on their experience, training, or insight to help develop mitigation items.
- The Community – residents of Eugene and Springfield were engaged throughout the NHMP process to offer their insight, input, concerns, and support for hazards as well as possible mitigation items.

A more detailed description and associated documentation of the planning process are provided in Appendix B: Planning and Public Process.

1.4.2 Natural Hazards

This plan focuses on natural hazards affecting Eugene and Springfield.

1.4.3 Mission

The mission of the 2020 NHMP Update Committee was to identify and reduce vulnerabilities to natural hazards, and to make the Cities of Eugene and Springfield more resilient to disasters.

1.4.4 Plan Goals

The NHMP Update Committee compared the goals identified in the Oregon and Lane County NHMP with the (2014) Eugene-Springfield Area Multi-Jurisdictional NHMP. Based on this review, the Committee adjusted the goals to better align with companion plans and reflect current community hazard mitigation needs.

2020 Goals

One:	Save lives and reduce injuries.
Two:	Minimize damage to buildings and infrastructure, especially to critical facilities.
Three:	Minimize economic losses and strengthen the economic well-being of the Eugene-Springfield Metro Area.
Four:	Decrease disruption and speed restoration of public services, businesses, schools, and families.
Five:	Protect environmental resources and utilize natural systems to reduce natural hazard impacts.
Six:	Foster public-private partnerships to achieve mitigation outcomes.
Seven:	Utilize land development codes to mitigate risks posed by natural hazards.
Eight:	Protect natural, historic, and cultural resources.
Nine:	Maintain and enhance current spirit of collaboration, communication, and coordination among non-governmental organizations (NGO), private sector, and public hazard mitigation partners.
Ten:	Integrate local natural hazard mitigation strategies into significant community-wide plans.
Eleven:	Document and evaluate the Eugene-Springfield metro region's progress in implementing hazard mitigation strategies.

1.4.5 Crucial Sectors

During the development of the 2014 Vulnerability Assessment[6] the assessment team identified a unique culture of collaboration and information sharing within our community. They also identified three sectors fundamental to the maintenance, and restoration of all other sectors; electricity, fossil fuels, and transportation.

In addition to assessing the impacts of natural hazards on these sectors, the 2014 Vulnerability Assessment Team investigated the impact of climate change and fossil fuel dependency on the sectors' ability to mitigate, respond to, and recover from natural disasters.

Refer to Section 4 – Risk and Vulnerability, for more information about the risk and vulnerability process used to develop this plan.

1.5 Summary of Risk (2020)

Table 1-1 represents the Risk Assessment Matrix adopted by NHMP Update Committee for the 2020 NHMP.

Table 1-1 Risk Assessment Matrix

Natural Hazard	Risk Rating
Geomagnetic Disturbance (GMD)	Very High
Earthquake	Very High
Winter Storm	High
Drought	High
Wildfire	High
Windstorm	High
Flood Riverine	Moderate
Landslide	Moderate
Flood Stormwater	Low
Extreme Weather	Low
Volcano	Low

1.6 Impacts – Cascading Incidents

In previous versions of this NHMP two impacts, dam failures and hazardous materials, were their own standalone hazards. In risk assessment a natural hazard

[6] United States. City of Eugene. Emergency Management. *Regional Climate and Hazards Vulnerability Assessment.* December 2014. Accessed April 2019. https://www.eugene-or.gov/DocumentCenter/View/20644/2014-EugeneSpringfield-Climate-and-Hazards-Vulnerability-Assessment?bidId=.

is a source of harm or difficulty created by a meteorological, environmental, or geological event. Impacts are the consequences or effects of a hazards on the community and its assets.[7] For this update, four significant impacts or cascading incidents: civil unrest; dam or levee failures; epidemics; and hazardous material spills or releases, were viewed as secondary life threats to the primary natural or biological disaster. These incidents can occur absent of a natural hazard, but such an incident would be human caused, and not due to a natural force; the focus of this plan.

For each hazard the likelihood of it causing one of the four cascading incidents was evaluated and categorized (Figure 1-1 and Table 1-2). A summary of the natech (natural hazard trigged technological disasters) evaluation process is included in Section 4 and an in-depth review of the natech impacts for each natural hazard is located throughout Section 2.

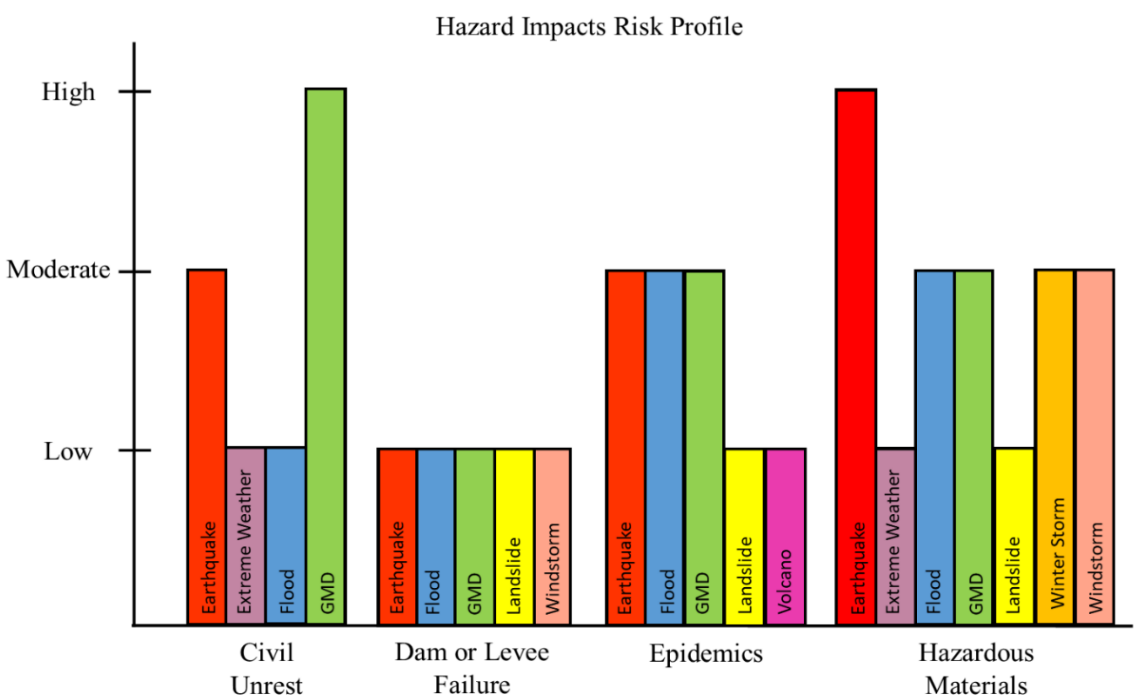

Figure 1-1. The "y" axis represents the level of risk each impact poses to the Cities of Eugene and Springfield while the x axis represents the impact for each specific hazard (the individual bars).

[7] United States of America. FEMA. *Local Mitigation Planning Handbook.* 2013. 5-1.

Table 1-2 Impact Risk	
Level	**Description**
No Known	No known (significant) possibility for impact to occur.
Low	Very unlikely for impact to occur with mitigation.
Moderate	Significant mitigation needed to prevent impact.
High	Still likely to occur even with mitigation.

1.7 Mitigation Strategy Summary

Based on the existing (2014) Eugene-Springfield Area Multi-Jurisdictional NHMP as well as findings from numerous studies and projects completed since its release, the 2020 update committee developed several mitigation actions as summarized in Table 1-3 for the 2020 NHMP.

Prioritization of Mitigation Actions - 2020 NHMP

Eugene and Springfield Emergency Management staff placed a higher priority on a small number of mitigation actions which are identified in bold type in the following table (Table 1-3). The actions were developed using the following information:

- The 2014 Vulnerability Assessment emphasized strengthening the fossil fuel, transportation, and electricity sectors because they are crucial to the operation of all other sectors. Sector experts identified earthquakes, winter storms, floods, and wildfire events as the hazards of greatest concern. Actions supporting these systems were raised in priority.

- The Cities of Eugene and Springfield along with Sub-Plan Holders have done extensive work mitigating natural hazards. Several studies were done to better understand the areas' risk which was also incorporated into evaluating Mitigation Action Items.

- Finally, many community members took time to provide feedback at numerous NHMP public outreach events. This feedback provided input on local hazard mitigation priorities (survey results are detailed in Appendix B). Respondents indicated earthquakes, geomagnetic disturbances, flooding, and winter storms are the hazards the two City governments should prioritize. Respondents also indicated a strong preference for actions protecting utilities and critical facilities.

Based on these criteria and an understanding of local conditions, emergency managers selected those actions most likely to mitigate these priority vulnerabilities.

Additional detail about each of the mitigation actions is outlined in Appendix A. Sub-Plan Holders short form Mitigation Action Item tables are in their specific annex's and on the full action item table in Appendix A. Status updates for 2014 Eugene-Springfield NHMP Action Items are in Appendix E.

Table 1-3 Mitigation Action Items Summary

		Action Name	Mitigation Action
Drought	1	Resistant Landscaping	Adopt drought resistant landscaping policies.
	2	Water Reuse	Pursue a water reuse partnership with MWMC.
Earthquake	3	Local active Transportation Infrastructure Evaluation	Evaluate off-street path bridges, crossing over the Willamette River, to complete a high-level seismic assessment of all major City bridges.
	4	**Local Transportation infrastructure Seismic Upgrades**	**Complete seismic improvements to three of the thirteen priority transportation structures.**
	5	Unreinforced Masonry Building Database	Develop a database of unreinforced masonry buildings (URMs) for first responders to utilize for planning and response operations.
	6	**Springfield Critical Facilities Retrofit**	**Implement phase two of the seismic retrofit of Springfield City Hall and three Springfield Fire Stations.**
	7	**Emergency Fuels Assessment - Phase II**	**Finish phase two of the Emergency Fuels Assessment for Lane County.**
	8	**Increased Fuel Capacity**	**Research methods to increase fossil fuel capacity around critical facilities; such as upgrading generator fuel tanks to high capacity tanks.**
	9	**Seismically Retrofit Eugene Fueling Station**	**Seismically retrofit the Eugene fueling station and associated buildings to ensure it is usable after a Cascadia Subduction Zone (CSZ) earthquake.**
	10	Earthquake Damage Study	In partnership with DOGAMI, update the earthquake damage estimate study for the Eugene-Springfield area.
	11	Seismic Upgrades – Eugene	Finish seismic upgrades to City owned facilities.
	12	Wastewater Pump Station Retrofit	Retrofit the Pump Stations to meet current seismic standards.
Extreme Weather	13	Outreach Awareness	Research and incorporate extreme weather safety awareness into the Cities' public outreach program.

Table 1-3 Mitigation Action Items Summary

		Action Name	Mitigation Action
Flood Riverine	14	Update Floodplain Maps	Actively seek funding to update the Eugene-Springfield floodplain maps focusing on the Willamette River through Eugene and the Mill Race, Willamette River through Glenwood, and the 42nd St Levee seclusion zone in Springfield.
Flood Riverine	**15**	**Levee Certification**	**Seek and maintain certification of the 42nd Street Levee and other flood control structures within Springfield.**
Flood Riverine	16	Streambank and Erosion Control	Stream bank stabilization near the 42nd street levee.
Flood Stormwater	17	Stormwater Improvements	Projects include culvert replacements and streambank stabilization. Using prioritization criteria, the highest priority stormwater capital projects are selected for inclusion in the Cities' Capital Improvement Programs. Projects prioritization criteria include whether a project addresses a potential risk to life or property (e.g. flooding), and whether it resolves an ongoing repetitive issue.
Flood Stormwater	18	Stormwater Master Plan Updates	Update the City of Eugene's 2002 Stormwater Basin Plan and Springfield's 2008 Stormwater Facility Master Plan.
Flood Stormwater	19	Stormwater and Climate Change Impacts	Evaluate stormwater design standards taking into consideration climate change modeling.
Geomagnetic Disturbance (GMD)	20	Continuity of Operations Plans	Develop Continuity of Operations Plans (COOP) for the City of Eugene's Public Works, Police, and Fire departments, and all Springfield departments.
Landslide	21	Analysis of 2018 DOGAMI Landslide Study	Using the DOGAMI landslide study released the summer of 2018 (IMS-60), determine areas and buildings at risk from landslides and propose comprehensive land use policies and construction standards accordingly.
Wildfire	**22**	**Fuels Reduction**	**Reduce fuels on public lands, focusing on the hillsides in the southern portions of both Cities.**
Wildfire	23	Community Wildfire Protection Plan (CWPP)	Develop the Eugene-Springfield Community Wildfire Protection Plan (CWPP).

Table 1-3 Mitigation Action Items Summary

		Action Name	Mitigation Action
	24	Update the Wildland-Urban Interface (WUI) Plan	Update the Eugene-Springfield WUI plan and address access routes.
	25	Species Specific Tree Removal	Identify and remove species with known failure profiles and potential defects. Plant or replant drought tolerant and disease, pest and damage resistant tree species. Work with City departments, contractors and non-profits to complete this work.
Windstorm	**26**	**Defective Tree Maintenance**	**Utilize contract crews to perform maintenance pruning. Provide clearance and mitigate defects, such as overextended branches prone to failure under increased loads, along major arterials and priority traffic routes. Unhealthy or structurally unsound trees will be removed and replanted.**
Winter Storm	27	Sheltering	Develop a consolidated plan for community sheltering and associated outreach needs to provide sheltering, during large scale events or incidents when American Red Cross resources are diverted elsewhere.
Volcano	28	Lahar Risk Study	Evaluate the lahar risk to the McKenzie River valley.
	29	Ash Removal	Research ash removal methods.
Multi-Hazard	30	Food Supplier Coalition	Develop a coalition of food suppliers to identify options to address supply chain concerns after a major disaster.
	31	Vulnerable Populations Two Weeks Ready	Utilizing relevant vulnerable populations maps developed for the Lane Livability Consortium, develop an outreach plan to engage vulnerable populations to be Two Weeks Ready with emergency supplies.
	32	Long-term Care and Nursing Home Facilities Emergency Planning Assistance	Support and assist Lane County Public Health in developing and conducting trainings or outreach on emergency preparedness and planning for long-term and nursing home facility leadership as they take steps to comply with the Emergency Preparedness Rule set forth by the Centers for Medicare and Medicaid Services.
	33	Public Safety Communications Reliability	Work with the Lane Radio Interoperability Group (LRIG) System partners to develop a first responder communication system with public safety grade reliability.
	34	Damage Assessment Plan	Finalize the Eugene-Springfield Damage Assessment Plan
	35	**Mass Evacuation**	**Develop and exercise a City evacuation plan**

1.8 Plan Adoption, Implementation and Maintenance

The Eugene-Springfield Natural Hazard Mitigation Plan originally adopted in 2009 and later updated in 2014 and 2020 will be due for revision and subsequent adoption in 2025. State, tribal, and local governments engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural disasters and develop long-term strategies for protecting people and property from future hazard events.

This section details the formal process to ensure the Eugene-Springfield NHMP remains an active and relevant document. The plan implementation and maintenance processes include a schedule for monitoring and evaluating the plan annually, as well as producing an update every five years. Finally, this section describes how Eugene and Springfield will integrate public participation throughout the plan's maintenance and implementation process.

1.8.1 Plan Review, Update, and Adoption 2020

The process for plan review, update, and adoption was conducted in the following order.

Step 1 - Emergency Management planners assigned to the NHMP and appropriate community partners, updated and re-evaluated this latest version of the NHMP based on current knowledge, accuracy, and relevance of the natural hazards in our area. Planners developed, from the existing plan, a new and updated edition called the NHMP 2020. Adhering to Federal Emergency Management Agency (FEMA) requirements, planners included local outreach activities to engage the community in determining needs and concerns, as well as captured their input for further plan revisions.

Step 2 - The draft Eugene-Springfield Area Multi-Jurisdictional NHMP 2020 was reviewed by both Emergency Managers. Updates and corrections were made as needed.

Step 3 - On or before September 20, 2019 the Cities jointly submitted the draft to the State Hazard Mitigation Officer at the Oregon Military Department, Office of Emergency Management (OEM).

Step 4 - OEM reviewed the plan and provided comment, requested revisions, and or retractions by the cities or their sub-plan holders.

Step 5 – Upon the Cities completing the requested edits, OEM determined the plan complete and ready for FEMA's review and subsequent approval. OEM then submitted the NHMP 2020 to FEMA Region 10. The Cities also submitted the NHMP 2020 to Bonneville Power Administration (BPA)[8] and neighboring jurisdictions[9] for review.

Step 6 - FEMA and neighboring jurisdictions reviewed the plan and provided comment, requested revisions, and/or retractions by the Cities or their sub-plan holders.

Step 7 - Upon the Cities completion of the requested edits, FEMA provided all entities an "Approvable Pending Adoption" letter at which point the plan was adopted by local governing bodies.

Step 8 - After the plan was adopted by all entities, the adoption resolution was submitted to FEMA. Once FEMA received this documentation each multi-jurisdictional holder was awarded their approval letter.

Step 9 - The City of Eugene and City of Springfield elected Councils provided final jurisdictional approval as the governing body for the City of Eugene and the City of Springfield.

Following completion of the nine-step approval process Eugene, Springfield, EWEB, RWD, and SUB became eligible for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program, and the Flood Mitigation Assistance Program. Throughout the process both Cities worked closely with sub-plan holders to add their annexes. This review and subsequent update adheres to the provisions and federal criteria outlined in the FEMA Interim Final Rule 44 CFR Part 201.

1.8.2 Implementation Coordination (2020 and Beyond)

Convening

Eugene and Springfield Emergency Management will jointly maintain a Project Team to oversee the implementation, by the Steering Committee, of the Eugene-Springfield NHMP.

Eugene and Springfield Project Team responsibilities include:

- Coordinating Steering Committee meeting dates, times, locations, agendas, and member notification;
- Documenting outcomes of Committee meetings;
- Engaging Advisory Board members;
- Incorporating, maintaining, and updating the jurisdiction's natural hazard risk GIS data elements;

[8] BPA is cited as a source of power by our sub-plan holders.
[9] Coburg, Cottage Grove, Creswell, Junction City, Lane County, Santa Clara, and Veneta.

- Prioritizing new study and hazard research needs;
- Serving as a communication conduit between the Steering Committee and key plan stakeholders;
- Submitting future updates to OEM for review;
- Utilizing the Risk Assessment as a tool for prioritizing proposed natural hazard risk reduction projects; and
- Developing the 2025 Eugene-Springfield NHMP.

Roles and Responsibilities

To ensure the entire community is involved, this NHMP update includes roles and responsibilities of NHMP members. The NHMP Project Team manages three main entities as part of the NHMP Update Committee. These entities and their associated responsibilities for maintaining and developing this multi-jurisdictional plan are as follows:

- Steering Committee is composed of departments and sub-plan holders who are responsible for development and implementation of mitigation items.
- Advisory Board stakeholders lend their knowledge based on their experience, training, or insight to help develop mitigation items.
- The Community – residents of Eugene and Springfield offer their support and provide insight, input, and concerns regarding possible mitigation items.

Implementation

The Cities emergency management staff and sub-plan holders lead the implementation of the plan in coordination with Steering Committee members. Following is a list of their duties for implementation of the current update in 2020 and the next update in 2025.

Emergency management staff:

- Evaluate funding opportunities such as the Pre-Disaster Mitigation Grant Program, Hazard Mitigation Grant Program, and Flood Mitigation Assistance Program;
- Consult with partner agencies, businesses, and organizations on implementing projects;
- Convene the NHMP Steering Committee on a quarterly basis;
- Document successes and lessons learned;
- Evaluate and update the NHMP following a disaster; and
- Evaluate and update the NHMP in accordance with the prescribed schedule.

Plan Maintenance

The NHMP Steering Committee is required to meet biannually. Eugene and Springfield Emergency Management staff schedule four meetings each year and typically meet quarterly.

During these meetings the NHMP Steering Committee will review the progress on mitigation actions, discuss implementation challenges and opportunities, invite guest presenters to provide technical information, and annually review priorities (as detailed below under Annual Review and Update).

Ongoing Annual Review and Update

The Steering Committee will use one of the quarterly meetings to review and maintain the NHMP, including the following tasks:

- Review progress toward mitigation goals made over the previous year;
- Review and re-evaluate priority of remaining mitigation actions;
- Review and adjust priorities, as needed;
- Consider new mitigation actions for inclusion within the plan;
- Consider adjustments to existing mitigation actions to improve feasibility, add critical detail, or refocus the strategy;
- Consider additional implementation partners as necessary, and develop a plan for their inclusion;
- Review public outreach conducted over the previous year; and
- Identify opportunities for outreach over the coming year.

Ongoing Public Involvement

The City of Eugene, City of Springfield, EWEB, RWD, and SUB will continue to share information about, and gather input on, the Natural Hazards Mitigation Plan. At least once a year the Cities will host presentations for the public to provide information, describe progress toward implementation, and collect feedback on the NHMP. Presentations through the Eugene-Springfield Community Emergency Response Team (CERT) program or Lane Preparedness Coalition meetings hosted quarterly will provide engagement opportunities for the interested public.

During the last two years of the NHMP update cycle, each jurisdiction will hold a minimum of one NHMP event. For the City of Eugene this also includes National Flood Insurance Program (NFIP) and Community Rating System (CRS) outreach. During these events, the community will be updated on mitigation projects, and given an opportunity to provide input on mitigation items.

2 Hazard Descriptions

2.1 Hazard Descriptions

The Cities of Eugene and Springfield are subject to the following natural hazards, listed alphabetically and without considering risk or mitigation priorities:

- Drought
- Earthquake
- Extreme Weather
- Flood
- Geomagnetic Disturbance (GMD)
- Landslide
- Volcano
- Wildfire
- Windstorm
- Winter Storm

Additionally, the Eugene-Springfield NHMP addresses four “non-natural” hazards or impacts. These four impacts may occur due to natural hazard incidents:

- Civil Unrest
- Dam or Levee Failure
- Epidemics
- Hazardous Materials

The following sections identify and profile the location, extent, previous occurrences, and future probability of each hazard listed above. Additional information on many of these hazards can be found in the Oregon Natural Hazards Mitigation Plan – Region 3: Regional Profile.[10]

[10] United States. Oregon Department of Land Conservation and Development. *Oregon Natural Hazards Mitigation Plan 2015*; *Chapter 2 Risk Assessment*; *Region 3*. September 2015. Accessed August 2019. https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP.pdf

2.2 Drought

Drought is a prolonged period of dry weather which persists long enough to cause adverse deficiencies in the water supply. Droughts are a slow-onset hazard, meaning over time they can have severe impacts on agriculture, municipal water supplies, recreational resources, and wildlife. A prolonged drought poses a significant threat to the economy.

2.2.1 Causes and Characteristics of the Hazard

Droughts are caused by the lack of precipitation in large geographic areas typically across counties, states, or regions. Generally, precipitation occurs in the Pacific Northwest as rain in the coastal regions and snow in the higher elevation mountainous areas. Rain and snowfall help to sustain the State's aquifers and provide river flow. Aquifers and rivers play a critical role by providing irrigation and potable water throughout the region. Snowpack and aquifers act as forms of natural water storage, balancing out the ups and downs of annual precipitation levels.

Short term effects of drought include declining stream, river, reservoir, lake, and ground water levels. The decline reduces agricultural yields, increases the potential for wildfires, and makes it difficult to maintain satisfactory quantities of municipal and private water levels. Long term effects of a depleted water supply can affect the economic viability of a community. According to NOAA, drought ranks second for the most economically destructive weather- related incident with losses around $9 billion per year.[11]

The three types of drought are meteorological, hydrological, and agricultural.

1. Meteorological drought is the most well-known and is due to low or no precipitation compared to the regional average. It is highly specific to a region.

2. Hydrological drought is when decreased precipitation affects soil moisture, groundwater, and snowpack as well as streamflow, lake, and reservoir levels.

3. Agricultural drought occurs when the available water supply cannot meet crop demand. It can occur in the absence of a Meteorological Drought due to timing of water availability or decreased access. (Figure 2-1)

[11] United States. NOAA National Centers for Environmental Information. *DROUGHT: Monitoring Economic, Environmental, and Social Impacts*. Accessed October 2017. https://www.ncdc.noaa.gov/news/drought-monitoring-economic-environmental-and-social-impacts

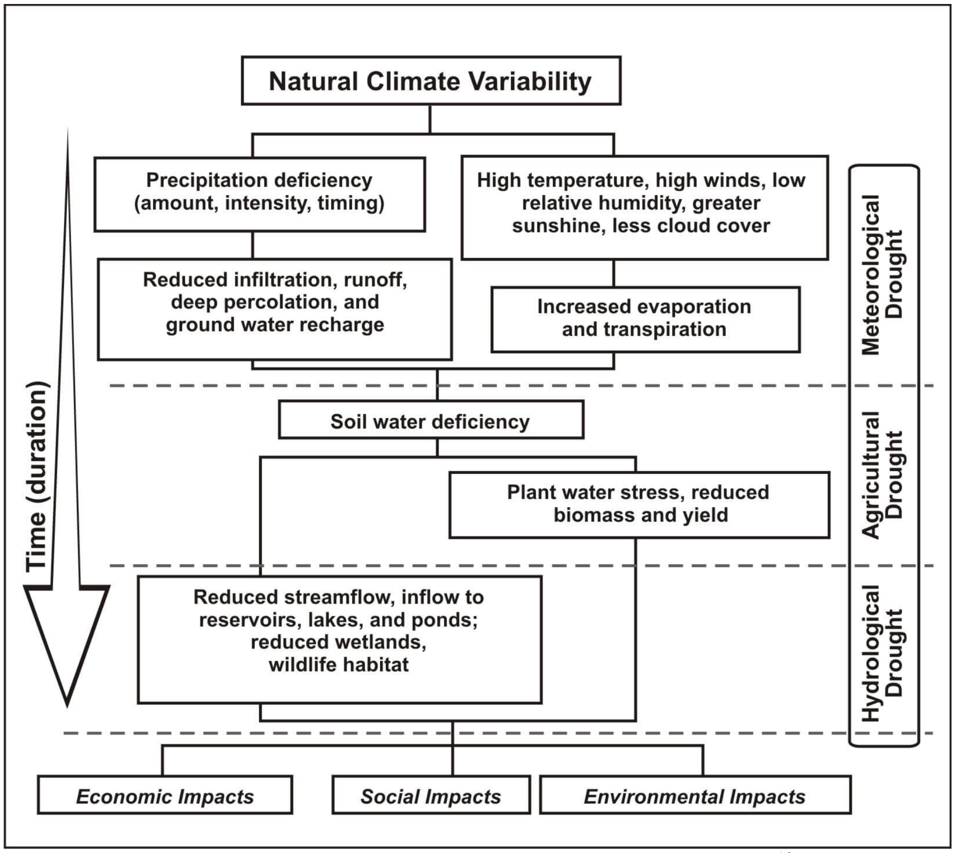

*Figure 2-1. Types of Drought (*National Drought Mitigation Center)[12]

2.2.2 Climate Change

Since the mid-1900s, the mountains in the Pacific Northwest have experienced a decline in spring snowpack due to a change in precipitation type from snow to rain and a shift in the timing of snowmelt. Warmer temperatures are causing earlier snowmelts which can lead to the water supply being increasingly out of sync with the area's typical water demands.[13] The National Climate Assessment predicts a slight decrease in the average annual precipitation and an increase in temperatures. This could mean longer, more severe, droughts.[14]

2.2.3 History of the Hazard in Eugene-Springfield

The National Drought Mitigation Center at the University of Nebraska-Lincoln tracks drought conditions across the country. Data can be broken down at the county or watershed basin levels. This data is recorded as a percentage of the area

[12] United States. University of Nebraska National Drought Mitigation Center. *Types of Drought.* Accessed August 2019. https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx

[13] Cook, Edward R., Richard Seager, Mark A. Cane, and David W. Stahle. *North American drought: reconstructions, causes, and consequences.* (Earth-Science Reviews 81, no. 1, 2007), 93-134.

[14] United States. US Global Change Research Program *National Climate Assessment Overview: Region Impacts.* 2014. Accessed October 2017. http://nca2014.globalchange.gov/highlights/overview/overview.

experiencing abnormally dry conditions. As shown in Figure 2-2, 100% of Lane County experienced severe droughts in 2001, 2014, and 2015.

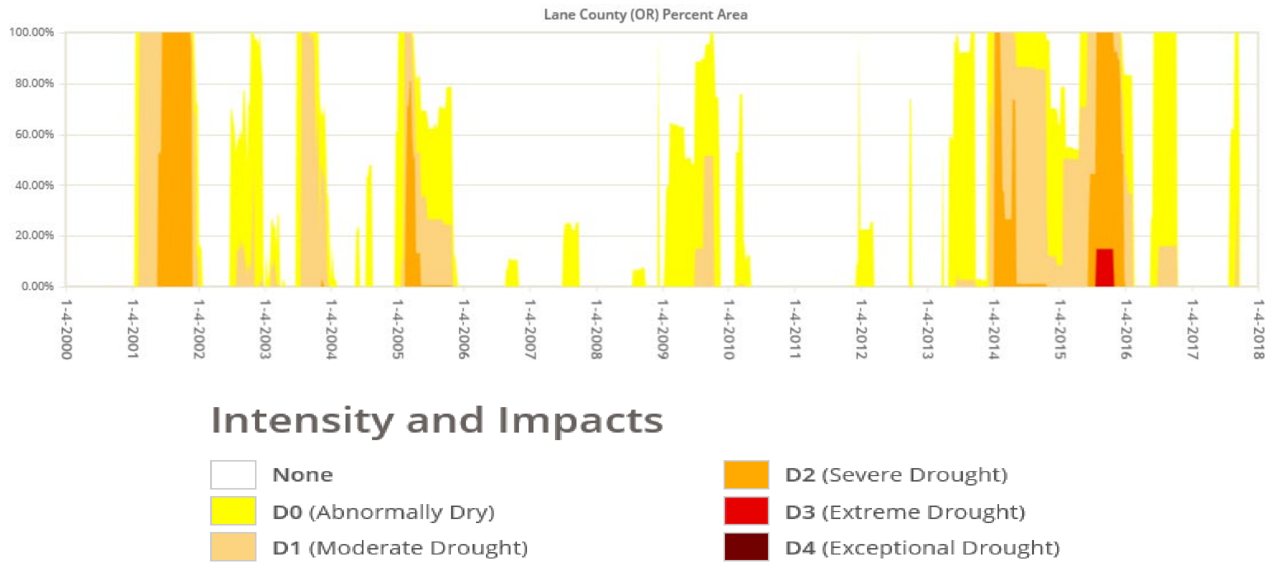

Figure 2-2. Source: National Drought Mitigation Center – *http://droughtmonitor.unl.edu/Data/Timeseries.aspx*

2.2.4 Impacts – Cascading Incidents

Civil Unrest

In the Eugene-Springfield area, civil unrest is not a known impact of droughts.

Dam or Levee Failure

Dam or levee failure is not a known impact of droughts.

Epidemics

Epidemics are not a known significant impact of droughts in the Eugene-Springfield area.

Hazardous Materials

Hazardous Material spills are not a known significant impact of droughts.

2.2.5 Probability of Future Occurrence

Three severe droughts have occurred in Lane County since 2000. In addition, on September 30, 2015 some of the nation's top water scientists, lawyers, and policy-makers convened in Eugene, Oregon, to discuss the severe drought the area was experiencing. They concluded droughts in Oregon are likely to become more frequent and severe, largely due to climate change.[15] Based upon these recent events the probability for future severe droughts is high.

2.2.6 Vulnerability and Capacity Assessment

Droughts are typically associated with summer, but often start during winter months with declining precipitation levels. Drought forecasting is commonly generated through temperature and ocean current patterns relative to recent and current conditions. This allows scientist to predict future droughts well before they occur. Drought is classified as having a high vulnerability level because a severe drought could impact every citizen in the Eugene-Springfield area. Despite being vulnerable to this hazard, the Eugene-Springfield area has a high capacity to respond to and recover from droughts. This is largely due to the slow onset of a drought and available resources.

2.2.7 Risk Assessment

The probability of drought in the Eugene-Springfield area is high and the vulnerability and capacity to deal with a drought are also high. Based on these factors, the Eugene-Springfield area's risk to this hazard is categorized as high. For a summary of Impact Risks see Table 2-1.

Table 2-1 Drought - Impact Risks

Cascading Incident	Ranking
Civil Unrest	No Known
Dam or Levee Failure	No Known
Epidemic	No Known
Hazardous Materials	No Known

2.2.8 Existing Hazard Mitigation Activities

While drought was referenced in prior editions of this NHMP, a risk assessment of drought was not included. Therefore, no existing hazard specific mitigation activities were identified in those prior plans.

2.3 Earthquake

The 2015 Oregon Natural Hazards Mitigation Plan – Region 3 Profile determined the chief earthquake hazard for the Mid/Southern Willamette Valley is the Cascadia

[15] Oregon. Oregon Environmental Council Samantha, Murray. *Drought is the "New Normal.* September 30, 2015. Accessed October 2017. http://www.oeconline.org/drought-is-the-new-normal/.

Subduction Zone (CSZ) or combined crustal events.[16] Given the potential for damage and the probability of a CSZ occurrence, Eugene and Springfield are primarily focused on a potential CSZ incident for earthquake mitigation planning purposes.

2.3.1 Causes and Characteristics of the Hazard

Seismic incidents were once thought to pose little or no threat to Oregon communities. However, recent earthquakes and scientific evidence indicate the risk to people and property is much greater than previously considered. Oregon, and the Pacific Northwest in general, are susceptible to earthquakes from four sources:

1. The offshore Cascadia Subduction Zone;
2. Deep intraplate incidents within the subducting Juan de Fuca Plate;
3. Earthquakes associated with renewed volcanic activity; and
4. Shallow crustal incidents within the North American Plate.

An earthquake could impact the entire Eugene-Springfield metro area as well as surrounding areas. The specific hazards associated with an earthquake include:

Ground Shaking

Ground shaking is defined as the motion of seismic waves felt on the Earth's surface caused by an earthquake. Ground shaking is the primary cause of earthquake damage.

Ground Shaking Amplification

Ground shaking amplification refers to how soils and soft sedimentary rocks, located near the surface, affect ground shaking from an earthquake. They can increase or decrease the amplification as well as the frequency of the shaking.

Surface Faulting

Surface faulting occurs when displacement reaches the earth's surface during a movement along a fault. Such faulting can result from movement deep within the earth or at the surface.

Earthquakes occurring from deep-lying faults usually create only ground shaking.

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[16] United States. Salem, OR. Oregon Military Department Office of Emergency Management. *Oregon Natural Hazards Mitigation Plan.* 2015. Accessed October 2017. https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP.pdf

Earthquake-Induced Landslides

Landslides occur due to the shaking motion of an earthquake destabilizing the ground. Areas already prone to landslides have a much higher risk of an incident occurring during an earthquake.

Liquefaction

Liquefaction is a process by which water-saturated sediment temporarily loses strength and acts as a fluid instead of a solid. As the sediment loses strength, it also loses the ability to support weight. This effect can be caused by ground shaking.

Severity

The severity of an earthquake is dependent upon several factors including the distance from the earthquake's source (epicenter,) the ability of the soil and rock to conduct seismic energy, the degree (i.e. angle) of slope, the composition of slope, the magnitude of the earthquake, and the type of earthquake.

Maps showing the location of various earthquake related hazards are in Section 3.

2.3.2 Climate Change

At this point, it is unknown how climate change may affect how an earthquake impacts Eugene and Springfield. Changing soil conditions, due to climate change, could affect how earthquakes propagate throughout the area, but the extent or effect of this factor is unknown at this time.

2.3.3 History of the Hazard in Eugene-Springfield

Historically, earthquakes of sufficient intensity to cause significant damage in the Mid/Southern Willamette Valley region have occurred as offshore Cascadia Subduction Zone (CSZ) earthquakes of magnitudes of around 8 to 9. Approximate years of significant CSZ incidents are:

- 1400 BCE
- 1050 BCE
- 600 BCE
- 400 CE
- 750 CE
- 900 CE
- 1700 CE

The Cascadia Subduction Zone is a 620-mile fault line off the coast of Northern California, Oregon, Washington, and Southern British Columbia. When the fault moves, causing an earthquake, it is called a "rupture." The CSZ does not always rupture along its entire length. Research suggests, over the last 10,000 years the entire fault has ruptured 20 times with a magnitude 9.0 or larger. Three quarters of the fault has ruptured 2 to 3 times producing an earthquake between 8.8 and 8.5 magnitudes. The southern portion has ruptured 19 times producing earthquakes between a magnitude 7.6 and 8.5.[17] (Figure 2-3 and 2-4)

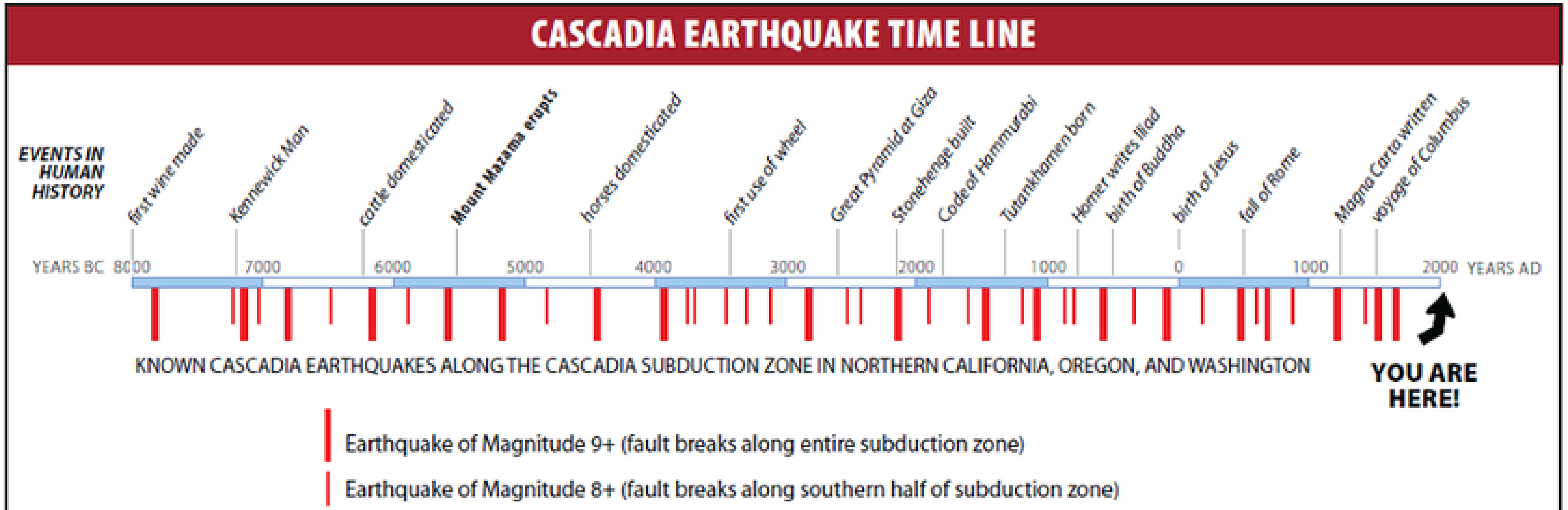
Native American oral records and geologic evidence has shown the most recent Cascadia Subduction Zone (CSZ) earthquake occurred in January 1700 with an approximate magnitude of 9.0. The earthquake generated a tsunami striking Oregon, Washington, and Japan. Native American villages along the Oregon coast were destroyed. There are no known reports of structural damage from earthquakes occurring or felt in the Eugene-Springfield area in recent history. A map of local historic earthquakes is included in Section 3, within the hazard maps.

Since November 2014 there have been three smaller crustal earthquakes in the Eugene and Springfield area. These incidents occurred on:

- 11/12/2014 – 14 Km East of Coburg, Oregon – Magnitude 2.6
- 01/12/2015 – 13 Km East of Coburg, Oregon – Magnitude 2.6
- 07/04/2015 – 15 Km East Northeast of Springfield, Oregon – Magnitude 4.8

Even though no major damages were reported for these incidents, they are a reminder a CSZ earthquake is not the only threat the area faces. Due to the potential severity of a CSZ earthquake, it is the goal of the Multi-jurisdictional NHMP partners to prepare for, and mitigate the risks of, such an incident. By doing this, the Cities of Eugene and Springfield will not only be prepared for a major earthquake from the Cascadia Fault, but also from those closer and more centrally located.

[17] United States. Oregon Department of Geology and Mineral Industries (DOGAMI). *Cascadia Earthquake Facts: What You Need to Know.* Slide 15-16. Accessed November 2017. http://slideplayer.com/slide/3475601/.



Comparison of the history of subduction zone earthquakes along the Cascadia Subduction Zone in northern California, Oregon, and Washington, with events from human history. Ages of earthquakes are derived from study and dating of submarine landslides triggered by the earthquakes. Earthquake data provided by Chris Goldfinger, Oregon State University; time line by Ian P. Madin, DOGAMI.

Figure 2-3. Source: Oregon Resilience Plan – *Cascadia Earthquake Time Line*

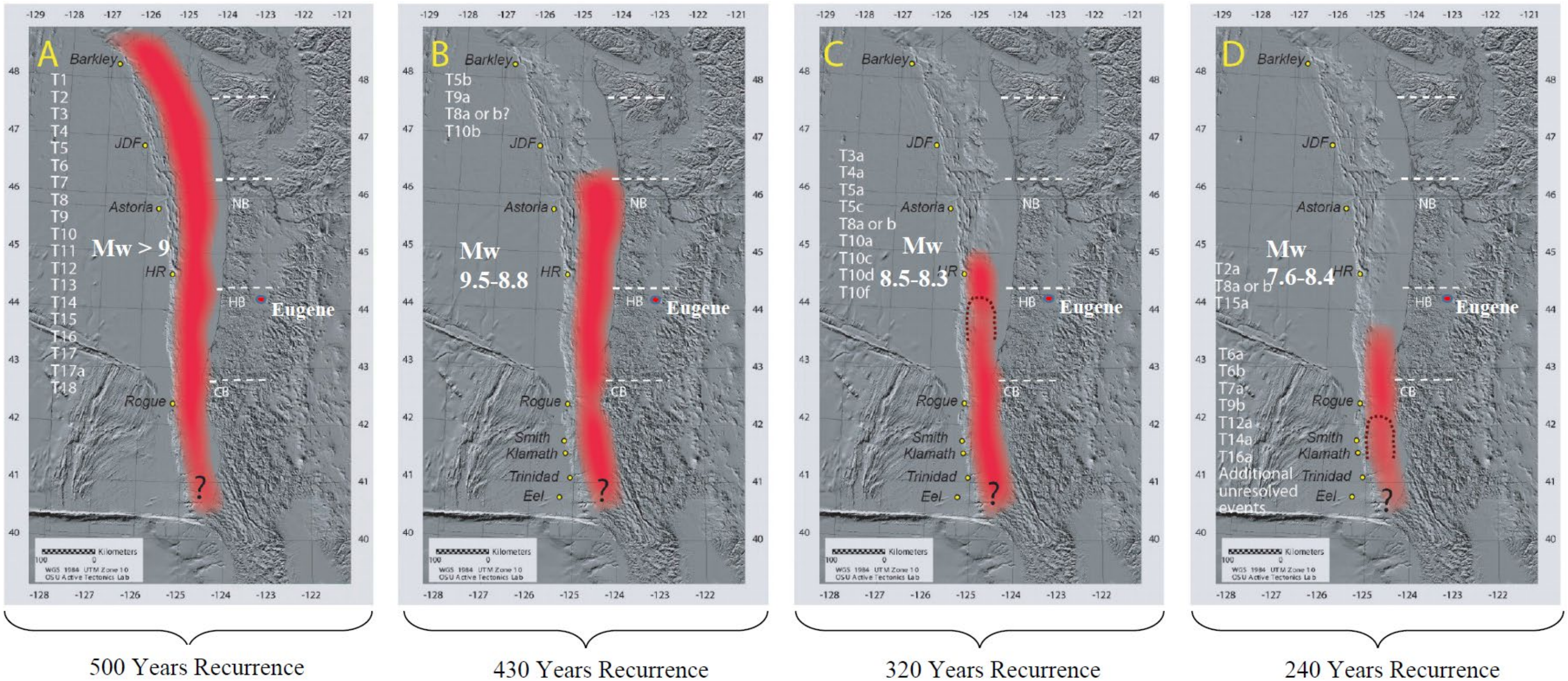


Figure 2-4. Source: Oregon Department of Geology and Mineral Industries – *Cascadia Subduction Zone Earthquakes.* The white lettering and numbering on the left indicates significant turbidite samples showing over 42 earthquakes in the last 10,000 years. Mw denotes the average magnitude of different fault ruptures.

2.3.4 Impacts – Cascading Incidents

Civil Unrest

Due to misinformation and the chaotic nature of incidents after a major natural disaster, it is difficult to determine the frequency of natural hazard induced civil unrest. One study cites the incidents of hurricane Katrina and the media's role in over broadcasting minor looting or rioting activities giving an impression such actions were prevalent.[18]

A study by the University of Otago (New Zealand) determined earthquakes and volcanic eruptions pose the highest risk of civil unrest in areas with income inequality, mixed political regimes, marginalization of certain groups, and when the State's capacity and legitimacy is weakened.[19] Figure 4-4 in Section 4 highlights several conditions noted as contributing factors for civil unrest after a natural disaster.

History of Impact in Eugene-Springfield

There have been no incidents of civil unrest in the aftermath of an earthquake in Eugene or Springfield. While some studies have determined disaster impacted victims respond and adapt well, others have concluded there is a higher chance of violence when certain conditions are met.[15, 16] Conflicting data and a wide range of contributing factors make it difficult to determine the likelihood of civil unrest occurring in the Eugene-Springfield area after a major earthquake.

Despite the difficulties of predicting such an incident, it is safe to assume the area will experience many, if not all, of the contributing factors identified for civil unrest. This could result in anything from small ad-hoc looting incidents to large scale violent civil unrest. Additionally, on multiple occasions riots not associated with a disaster have occurred in Eugene, which indicates the area is already susceptible to such incidents.

Risk of Impact

Based on historical occurrences of civil unrest after disasters along with our area's societal composition, the risk of an earthquake induced civil unrest incident occurring is moderate.

[18] Tierney, Kathleen, Christine Bevc, and Erica Kuligowski. "Metaphors matter: Disaster myths, media frames, and their consequences in Hurricane Katrina." *The annals of the American academy of political and social science* 604, no. 1 (2006): 57-81

[19] Nel, Philip, and Marjolein Righarts. "Natural disasters and the risk of violent civil conflict." *International Studies Quarterly* 52, no. 1 (2008): 159-185.

Dam or Levee Failures

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

There are several ways an earthquake can cause an earthen fill dam, embankment dam, or levee to fail.

Compaction failure

The most common mode of dam failure, due to an earthquake, occurs when the embankment is not properly compacted. Dams can settle or spread laterally. By itself, such settlement does not generally lead to immediate failure. However, if the reservoir is full, relatively minor amounts of settling may cause overtopping to occur, resulting in scour and erosion which could progress to failure.

Structural failure

Ground shaking can also cause structural failures or overtopping of dams. For any dam, improper design or construction, or inadequate preparation of foundations and abutments can also cause failures.

Landslide tsunamis

Landslides into the reservoir, which may occur on their own or triggered by earthquakes, may lead to surge waves which overtop dams, or hydrodynamic forces which cause dams to fail under the unexpected load.

Seismic Seiches

Overtopping or overloading of a dam structure can also occur when an earthquake causes seismic seiches (waves) in the reservoirs. A seismic seiche is a standing wave in which the largest vertical oscillations are at each end of a body of water with very small oscillations at the center.

Equipment Failure

An earthquake can damage spill ways, gates, turbines, and electrical equipment used to operate the dam. When such failures occur water can quickly rise behind a dam causing it to be overtopped.

More information on local dams is in Appendix H.

History of Impact in Eugene-Springfield

There have been no dam failures in Oregon due to an earthquake. No historical local occurrences have been recorded, but the impact of large earthquakes on dams has been observed in other areas. Research shows 1.5 percent of embankment dam failures have been attributed to earthquakes, which is the most common form of dam to fail in a seismic incident.[20] According to the International Commission on Large Dams (ICOLD), until the 2011 earthquake in Japan no casualties had been attributed to a dam or levee failure induced by an earthquake.[21]

The 2008, magnitude 8.0, earthquake in China caused 1,803 concrete and embankment dams, and 403 hydropower plants to be damaged with no complete failures.[22] The 2010, 8.8 magnitude, earthquake in Chile damaged several dams, also with no complete failures. During the 2011 earthquake in Japan roughly seven dams and hundreds of levees had suffered damage. Only one of these, the Fujinami irrigation dam, had a complete failure resulting in the only known casualties from an earthquake induced dam failure. This failure destroyed five homes and killed eight people. It is thought this impact was magnified by inadequate design and construction.[23]

Risk of Impact

Based on history and the condition of the dams and levees in and around the Eugene and Springfield area, the risk from an earthquake induced failure is low.

Epidemics

Historically, fears of disease outbreaks after a natural disaster have been a prominent concern. Despite this, epidemics following natural disasters are rare, especially in developed countries.[24] [25] After a natural disaster, water related

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[20] United States. US Army Corps of Engineers and US Department of the Interior. *Best Practices in Dam and Levee Safety Risk Analysis IV-6 Seismic Risks for Embankments.* April 2, 2015. Accessed October 2017. https://www.usbr.gov/ssle/damsafety/risk/BestPractices/Presentations/IV-6-20150402-PP.pdf

[21] Wieland, Martin. "Dam safety and earthquakes." *International Water Power & Dam Construction,* August 2010, 12-14. Accessed October 2017. https://www.preventionweb.net/files/15259_9694491.pdf

[22] United States. United States Society of Dams. *Observed Performance of Dams During Earthquakes Vol. III.* February 2014. Accessed August 2019. https://damfailures.org/wp-content/uploads/2018/02/EQPerfo2_v3.pdf

[23] United States. United States Army Corps of Engineers Portland District. "Don't freak out: Dams generally do well in earthquakes." January 2016. Accessed October 2017. http://usaceportland.armylive.dodlive.mil/index.php/2016/01/shakeout-dont-freak-out-dams-generally-do-well-in-earthquakes/

[24] Lemonick, David M. "Epidemics after natural disasters." *American Journal of Clinical Medicine* 8, no. 3 (2011): 144-152. https://www.aapsus.org/wp-content/uploads/ajcmsix.pdf

[25] Watson, John T., Michelle Gayer, and Maire A. Connolly. "Epidemics after natural disasters." *Emerging infectious diseases* 13, no. 1 (2007): 1-5

communicable diseases and large populations of displaced citizens are primary concerns.

Though diseases can be introduced to a population by emergency personnel, such as the 2010 Cholera outbreak in Haiti, generally, a disease must be endemic prior to the disaster for it to become an epidemic afterward. Cold conditions favor airborne pathogens while warm weather favors waterborne pathogens. Large dust clouds generated by an earthquake can also disperse a variety of spores causing respiratory illnesses.

History of Impact in Eugene-Springfield

There have been no post-earthquake epidemics in the Eugene-Springfield area. The worldwide risk of communicable diseases after an earthquake is deemed a moderate risk for person to person, water, and food borne transmission paths. Contributing factors to disease transmission are environmental considerations, endemic organisms, population characters, overcrowding, pre-incident structure and type of healthcare system, immunization levels, and the magnitude of the disaster itself.[26]

Though not an epidemic per se, our area may see an increase of respiratory illnesses after a major earthquake in which homes and buildings are destroyed. This is due to dangerous mold, common to our area, being released into the surrounding environment. Those with compromised immune systems or existing respiratory complications would be at a higher risk than the general population.

Risk of Impact

Based on historical occurrences of earthquake induced epidemics along with our area's societal composition, the risk from this impact occurring is moderate.

Hazardous Materials

Worldwide, there have been many earthquake induced hazardous material (HazMat) spills.[27] Given increases in industrial development and population

[26] Sandrack, C. "Infectious Diseases After Natural Disasters." *California Preparedness Education Network.* A program of the California Area Health Education Centers. March 7, 2006. Funded by HRSA Grant. PowerPoint presentation online. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwixjd6Gv6HZAhVC-GMKHTK1CMAQFgguMAE&url=http%3A%2F%2Fwww.aapsus.org%2Fwp-content%2Fuploads%2Fajcmsix.pdf&usg=AOvVaw3FpqcwnfbDsr_FktcQtDGn. Accessed October 09, 2017.

[27] Reitherman, Robert K. *Earthquake-Caused Hazardous Material Releases*. Proceedings of 1982 Hazardous Material Spills Conference Proceedings, Wisconsin, Milwaukee. Rockville, MD: Government inst., 1984. 170-77

density in areas prone to natural hazards, the odds of human exposure to hazardous materials, after a seismic incident, is also increasing.[28]

Earthquakes not only cause HazMat spills, they may also obstruct emergency personnel incident response. Response to the natural disaster itself may divert resources which would otherwise be dedicated to the spill or release. Restricted site and life line access along with limited resources such as personnel and equipment can further slow a HazMat response. This chaotic post disaster environment poses significant challenges to first responders' primary missions of containing the hazardous material and stabilizing the scene.

More information on HazMat spills and releases is in Appendix I.

History of Impact in Eugene-Springfield

There have been no earthquake induced HazMat spills or releases in the Eugene-Springfield area. Despite this, with the threat posed by the Cascadia Subduction Zone, and numerous sources of hazardous materials within the Cities, such an incident occurring is of concern. Historically, earthquakes have caused HazMat incidents by sloshing vats, damaging connections and piping on tanks, tank collapses, truck accidents, and train derailments.

Some notable earthquake induced hazardous material incidents include:

- 1994 Northridge, CA-magnitude 6.7: 9 petroleum pipeline ruptures, 752 natural gas line breaks, and 60 emergency HazMat incidents
- 1987 Whittier Narrows, CA-magnitude 5.9: 1411 natural gas line breaks and 30 HazMat releases
- 1989 Loma Prieta, California-magnitude 6.9: 300-400 natural gas line breaks and 300 hazmat releases

Risk of Impact

Based on the amount of hazardous materials in and around the Eugene-Springfield area, and historical occurrence of earthquake induced HazMat spills or releases in other parts of the County, the risk from this impact occurring is high.

2.3.5 Probability of Future Occurrence

The State estimates earthquake probability for the mid-Willamette Valley region in two ways. One way uses a probabilistic model which considers all known

[28] Young, Stacy, Lina Balluz, and Josephine Malilay. "Natural and technologic hazardous material releases during and after natural disasters: a review." *Science of the Total Environment* 322, no. 1-3 (2004): 3-20. doi:10.1016/s0048-9697(03)00446-7.

information about possible earthquakes on Oregon faults. This model presents an expected level of damage associated with an earthquake with a 2-percent chance of occurring in the next 50-years. This probabilistic model suggests the Eugene-Springfield area can expect the partial collapse of weak buildings and the movement of unsecured wood-frame houses.

While all earthquakes possess the potential to cause major damage, subduction zone earthquakes pose the greatest danger due to the severity, duration, and extent of ground shaking. Within Oregon, a major CSZ incident could generate an earthquake with a magnitude of 9.0 or greater, likely resulting in significant damage and loss of life in Eugene-Springfield. Another way to assess the probability of an earthquake for Oregon communities west of the Cascades is to consider the CSZ incident independently.

According to the Oregon NHMP, the reoccurrence interval period for the largest of the CSZ earthquakes (magnitude 9.0+) is 530 years with the last incident occurring 320 years ago in January of 1700. The probability of a 9.0+ CSZ incident occurring in the next 50 years ranges from 7 - 12%. Notably, 10 - 20 "smaller" magnitude 8.3 - 8.5 earthquakes identified over the past 10,000 years affected only the southern half of Oregon and northern California. The average reoccurrence interval period for these incidents is roughly 240 years. The combined probability of any CSZ earthquake occurring in the next 50 years is 37 - 43%. This puts the odds of having a significant (magnitude 8.0+) earthquake from the Cascadia fault line at roughly one in three over the next 50 years.[29]

Eugene-Springfield categorizes the probability of a CSZ incident as moderate and the probability of intraplate and crustal earthquakes as low. Given the potential for damage and the probability of occurrence, Eugene-Springfield is primarily focused on a potential CSZ incident for earthquake mitigation planning purposes.

2.3.6 Vulnerability and Capacity Assessment

In 2014 the Cities of Eugene and Springfield conducted a Regional Climate and Hazards Vulnerability Assessment to inform the prior edition of the NHMP. The Project Team, for this edition, determined the vulnerabilities listed below generally remain valid for preparing this edition. The assessment team met with local and regional experts in the communication, drinking water, electricity, food, healthcare, housing, natural systems, public health, public safety, transportation, stormwater, and wastewater sectors. The assessment identifies the following specific earthquake-related vulnerabilities:

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29 United States of America. Oregon National Guard. Office of Emergency Management. *Oregon Natural Hazards Mitigation Plan: Region 3 - Mid/South Willamette Valley.* Salem, OR: Office of Emergency Management, 2015. 534-46.

- Except for natural systems, all sectors are extremely sensitive to a magnitude 9.0 CSZ earthquake incident.
- Very little has been done to prepare any systems, infrastructure, or personnel to handle the initial impact and ongoing response and recovery from a CSZ incident.
- Exceedingly limited staff availability in the aftermath of a severe earthquake will create problems and challenges difficult to predict or mitigate.
- Every sector will experience substantial failures and interruptions unfamiliar to the area and therefore difficult (though possible) to plan for.
- Very few Eugene and Springfield residents have first- hand experience with a major earthquake, making it difficult to describe the potential experience and results.

Additional system vulnerability details are included in Section 4 as part of the 2014 Climate and Hazard Vulnerability Assessment Report.

In 2007, the Oregon Department of Geology and Mineral Industries (DOGAMI) completed a rapid visual screening (RVS) of educational and emergency facilities in communities across Oregon, as directed by the Oregon legislature in Senate Bill 2 (2005). RVS is a technique, used by the Federal Emergency Management Agency (FEMA), known as FEMA 154, to identify, inventory, and rank a building's potential vulnerability to seismic incidents. DOGAMI surveyed a total of 3,349 buildings, giving each a low, moderate, high, or very high rating for collapse potential from a high magnitude earthquake. The RVS assessed a total of 174 buildings in the Eugene-Springfield area.[30]

It is important to note these rankings represent a probability of collapse based on limited observed and analytical data and are therefore approximate rankings. To fully assess a building's collapse potential, a detailed engineering study completed by a qualified professional is required, but the RVS study can help prioritize which buildings to survey.

Table 2-2 shows the number of Oregon education and emergency services buildings surveyed in Eugene and Springfield with their respective rankings. Based on the RVS study, Eugene and Springfield performed further seismic evaluations on much of their critical infrastructure. These more detailed assessments resulted in a prioritized list of facilities in need of seismic retrofits. Several of these sites have already undergone seismic retrofitting work, and funding for more projects is being actively pursued.

[30] United States. State of Oregon Department of Geologic and Mineral Industries. *Statewide Seismic Needs Assessment: Implementation of Oregon 2005 Senate Bill 2 Relating to Public Safety, Earthquakes, and Seismic Rehabilitation of Public Buildings.* May 22, 2007. Accessed August 2019. https://www.oregongeology.org/rvs/default.htm

Table 2-2 Building Level of Collapse Potential for Eugene and Springfield

City	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100 %)
Eugene	56	52	29	0
Springfield	28	4	3	2

Table 2-2. Source: DOGAMI 2007 – *Open File Report 07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.*

More recently, Oregon published the Oregon Resilience Plan. Findings in the plan suggest communities in the Willamette Valley can expect the following potential impacts to critical service sectors following a CSZ incident:

Table 2-3 Critical Service Impacts

Critical Service	Estimated Time to Restore
Electricity	1 to 3 months
Police/Fire Stations	2 to 4 months
Drinking Water	1 year
Critical Service	**Estimated Time to Restore**
Sewer	1 month to 1 year
Top-priority Highways (partial restoration)	6 to 12 months
Healthcare Facilities	18 months

Table 2-3 Source*:* Oregon Resilience Plan, February 2013.

The Steering Committee ranked Eugene-Springfield's vulnerability to all earthquakes (crustal, intraplate, and subduction earthquake incidents) as 'high' because more than 10% of the population would likely be impacted by each type of earthquake. The probability of an earthquake occurring is difficult to determine. A Cascadia Subduction Zone incident currently has a one in three chance of happening in the next 50 years. For other faults capable of producing earthquakes the odds of an incident occurring are 2% in the next 50 years. For these reasons, the probability of an earthquake, regardless of the source, is moderate. Due to the large geographical scale of an earthquake and limited resources to deal with such an incident, Eugene and Springfield's capacity to respond to, and recover from, an earthquake is low.

2.3.7 Risk Assessment

DOGAMI has developed two earthquake loss models based on the most likely sources for an Oregon earthquake. One model uses a Cascadia Subduction Zone (CSZ) earthquake, and the other uses a magnitude 6.5 arbitrary crustal earthquake. Both models are based on HAZUS-MH software currently used by FEMA as a means of determining potential losses from earthquakes.

The CSZ scenario model is based on a potential 9.0 magnitude earthquake generated off the Oregon coast. The model does not consider a tsunami, which would likely develop from the earthquake incident. The magnitude 6.5 arbitrary crustal earthquake scenario model does not look at a single earthquake (as in the CSZ model). It encompasses many faults, each with a 2% chance of producing an earthquake in the next 50 years. The model assumes each fault will produce a single “average” earthquake during this time.

The models contain a high degree of uncertainty and should be used only for general planning purposes. Though these models were considered when evaluating the risk from earthquakes to the Eugene-Springfield area, they need to be updated to include local infrastructure data. The existing earthquake loss models are found in the 2014 Eugene-Springfield NHMP as well as the 2015 Oregon NHMP. Updated studies will be pursued by DOGAMI and the Cities for the 2025 NHMP update.

Eugene and Springfield categorize the probability of a Cascadia Subduction Zone (CSZ) earthquake or intraplate and crustal earthquakes as moderate. Vulnerability to an earthquake is high while capacity to deal with such incidents is low. The overall risk rating to earthquakes is very high.

For a summary of Impact Risks see Table 2-4.

Table 2-4 Earthquake - Impact Risks

Cascading Incident	Ranking
Civil Unrest	Moderate
Dam or Levee Failure	Low
Epidemic	Moderate
Hazardous Materials	High

2.3.8 Existing Hazard Mitigation Activities

Eugene and Springfield have taken steps to mitigate earthquake risks. Efforts include:

- Enforcing of the International Building Codes and Oregon Structural Specialty Code, both of which address earthquake mitigation measures for new construction.
- Creating and training a Damage Assessment team for evaluating structural damage to buildings and bridges after an earthquake. This team includes staff members from Lane County, Eugene, and Springfield.
- Moving the City of Eugene police, fire, City management, and administration functions out of City Hall due to the building’s seismic deficiency. Eugene is currently in the process of designing a new City hall.
- Constructing an enlarged, seismically sound, emergency operations center (EOC) with a larger generator and increased food, water, and fuel storage.

The EOC acts on the City's behalf to link our emergency responders with mutual-aid, local partners, and County, State, and Federal response agencies.

- Conducting community outreach to support our resiliency strategy by increasing community personal preparedness. A prepared community eases the burden on first responders by reducing the immediate need for food, water, and personal care for individuals in the days and weeks following a disaster or emergency.
- Connecting the City of Eugene to data and voice through a portable redundant communications system using satellite technology. This system allows the Eugene EOC to communicate beyond our local radio and microwave footprint in a degraded communications environment.
- Constructing seismic retrofits for several critical City-owned bridges.
- Initiating seismic retrofits to Springfield City Hall with additional retrofits to be performed pending available funding.

2.4 Extreme Weather

Extreme weather includes hail, lightning, tornados, and severe heat. The Eugene-Springfield area has had documented occurrences of all four of these meteorological incidents though they tend to be infrequent resulting in little to no damage. It is possible more damaging incidents could occur in the future.

2.4.1 Causes and Characteristics of the Hazard

Thunderstorms

Thunderstorms can produce wind, hail, lightning, and even tornadoes. A combination of unstable air, moisture, and an upward lifting motion forms a thunderstorm. Generally, this upward motion, convection, is produced by surface heating. Convection forces the warmer air up into a cooler air mass causing instability.

A thunderstorm has three stages of development:

- Developing
- Mature
- Dissipating

The mature phase of a thunderstorm is the most likely time for hail, heavy rain, lightning, strong winds, and tornadoes. Once enough precipitation has accumulated the updraft is overcome by the downdraft and the dissipating stage begins. Lightning can remain a danger throughout all three stages of a storm.[31] (Figure 2-5)

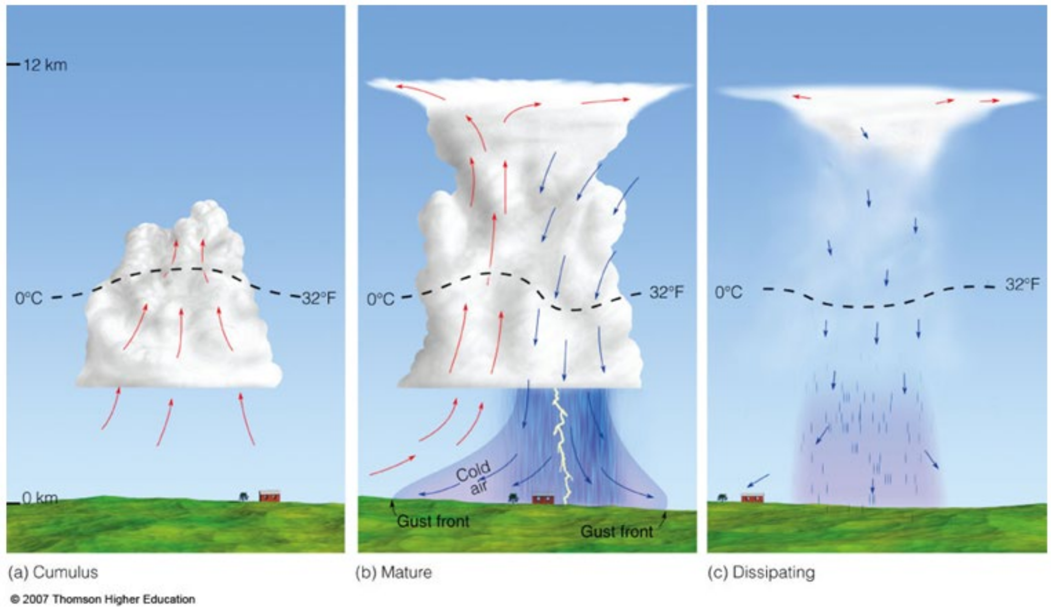

Figure 2-5 Three different stages of thunderstorm development. Source: Global Sailing Weather - h*ttp://globalsailingweather.com/thunderstorms.php*

Hail

Hail occurs when updrafts in a thunderstorm carry raindrops into extremely cold areas of air where they freeze into balls of ice. This cycle is repeated, and the ball of ice grows, until the storm's updraft is no longer able to support the weight of the ice. The hail then falls to the ground when the size of hail is too large for the storm to support or the updraft weakens.

Large hail can cause significant damage. Usually, hail is pea to marble size, but large storms can produce larger hail. The largest hail ever recorded in the United States was in Vivian, SD. It had a diameter of 8 inches, a circumference of 18.62 inches, and weighed 1 lb. 15 oz.[32] Hail with an inch diameter is considered severe, but there are only anecdotal accounts of such weather phenomenon occurring in the Eugene-Springfield area.

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[31] United States. NOAA The National Severe Storms Laboratory. *Thunderstorm Basics*. Accessed November 2017. http://www.nssl.noaa.gov/education/svrwx101/thunderstorms/.
[32] United States. NOAA The National Severe Storms Laboratory. *Hail Basics*. Accessed November 2017. http://www.nssl.noaa.gov/education/svrwx101/hail/.

Tornadoes

Tornadoes are the most violent of all atmospheric storms.[33] They are a narrow fiercely rotating column of air. Tornadoes become visible when there is enough condensation of water droplets, dust and debris. Once on the ground, tornadoes can cause significant property damage and threaten human life (Picture 2-1).

Tornadoes form at the base of a thunderstorm (Figure 2-6). This weather phenomenon can happen any time of the year, but in Oregon they most often occur during the milder months of fall and spring.[34] When over water, a tornado is referred to as a waterspout.

Picture 2-1. Source: KPTV-*Manzanita, Oregon tornado damage October 2016*

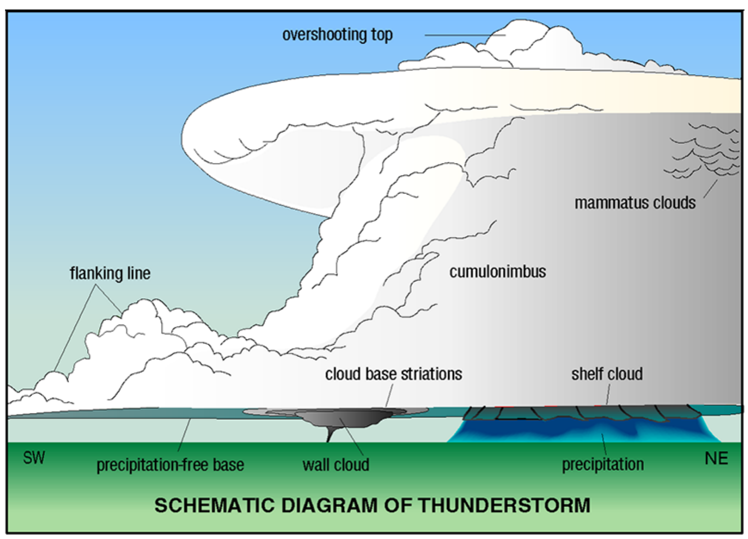

Figure 2-6. Source: National Severe Storms Laboratory NOAA - https://www.nssl.noaa.gov/education/svrwx101/tornadoes/

[33] "Tornado Basics." NOAA National Severe Storms Laboratory. Accessed November 08, 2017. http://www.nssl.noaa.gov/education/svrwx101/tornadoes/

[34] Livingston, Ian. "Monthly tornado averages by state and region." U.S. Tornadoes. March 16, 2013. Accessed November 08, 2017. http://www.ustornadoes.com/2013/03/19/monthly-tornado-averages-by-state-and-region/

Severe Heat

Severe heat incidents are possible, though historically rare, in Eugene and Springfield. When they do occur, severe heat incidents tax utility systems and endanger the health of some citizens, particularly the elderly, the very young, and those with compromised health. Heat is the number one weather related killer in the United States.[35] Heat related illnesses include heat cramps, exhaustion, and stroke. Heat stroke is a life-threatening condition.

Generally, a period of severe heat, often referred to as a "heat wave," is caused by a trapped or stagnant air pattern. The air mass does not move, but rather remains in an area, progressively warming. This is commonly seen when high-pressure systems push air downward preventing it from rising to cooler portions of the atmosphere.

2.4.2 Climate Change

Climate change will affect all four of these weather incidents, although the extent and severity of these affects are unknown. Climate change is expected to increase both summertime high and low temperatures, thereby reducing the natural cooling of homes, buildings, and heat absorbing surfaces such as concrete and asphalt.[36] Most residents in Eugene and Springfield lack mechanical cooling systems, putting them at greater risk of heat illnesses during an extreme heat incident.

2.4.3 History of the Hazard in Eugene-Springfield

Thunderstorms

Lightning can occur in conjunction with thunderstorms in the Eugene-Springfield area (Picture 2-2). Lightning damage to buildings or infrastructure is generally minor and few practical mitigation alternatives are applicable to lightning, other than installing lightning arrestors on critical facilities subject to lightning damage. In Oregon, casualties from lightning are very low, with a total of 7 deaths and 19 injuries reported over a 35-year period.[37] The level of risk posed by lightning strikes is very low. Public education about safe practices during electrical storms is the only available mitigation measure.

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[35] Borden, Kevin A., and Susan L. Cutter. "Spatial patterns of natural hazards mortality in the United States." *International Journal of Health Geographics* 7, no. 64. December 2008. https://ij-healthgeographics.biomedcentral.com/articles/10.1186/1476-072X-7-64

[36] United States. Oregon Department of Land Conservation and Development. *The Oregon Climate Change Adaptation Framework.* December 2010. Accessed August 2019. https://www.oregon.gov/lcd/Publications/Climate_Change_Adaptation_Framework_2010.pdf

[37] United States. NOAA National Weather Service. *Lightning Deaths by State.* Accessed August, 2019. https://www.weather.gov/cae/lightningdeaths.html

Picture 2-2. Source: The Register Guard - Skinner Butte Aug. 22, 2013.

Hail

Hail incidents are possible in the Eugene-Springfield area, generally during summer thunderstorms. Hail damage is usually minor and few practical mitigation alternatives are applicable.

Tornadoes

Tornadoes do occasionally occur in Oregon; however, it is not among the 39 states with any reported tornado deaths since 1950. The tornado originated in Portland Oregon causing significant damage and traveled in a northern direction to Vancouver Washington. It crossed over the Columbia River, and entered Vancouver Washington where it killed 6 people. In total, 300 people were injured during this incident.

NOAA records (Portland office) show five historical tornadoes in Lane County.

- November 24, 1989: a tornado touched down in the south hills of Eugene, uprooting several tall fir trees, and damaging utility lines and a camper, but causing no injuries.
- 1984: a small tornado was reported near Junction City with damage to a barn and shelter.
- 1975: a poorly documented tornado may have occurred near Eugene, with very minor damage.
- 1951: a small tornado touched down near Eugene destroying a barn.
- 1937: a possible tornado uprooted hundreds of trees and demolished summer homes and camps near McKenzie Bridge.

In addition to these five historic tornadoes, on April 14, 2015 an EF-0 (Enhanced Fujita) tornado touched down at Lane Community College. The funnel cloud was reported to have remained on the ground for a minute.[38] Damage was sustained by several cars lifted by the tornado. One of the cars had two people in it, but no injuries were reported. This tornado resulted in $(2015)25,000 dollars in damage.[39] (Picture 2-3)

Picture 2-3. Source: OregonLive – Lane Community College Tornado.

Severe Heat

The summer of 2014 set a record for the number of days with high temperatures over 90 degrees.[40] From the end of July into the beginning of August 2017 the area saw one of its longest heat waves in history. The first nine days were the hottest period on record according to data compiled by the Southeast Regional Climate Center.[41] During this period of severe heat Eugene and Springfield opened several

[38] Binder, Melissa. "Tornado touches down near Eugene, flips car at Lane Community College." April 15, 2015. Accessed August 2019. https://www.oregonlive.com/pacific-northwest-news/2015/04/tornado_touches_down_near_euge.html

[39] United States. Lane County. Emergency Management. *Lane County Multi-Jurisdiction Hazard Mitigation Plan.* April 2017. Accessed November 6, 2017. https://www.lanecounty.org/cms/One.aspx?portalId=3585881&pageId=15929453

[40] United States. Wihtol, Christian. The Register Guard. *Sizzling Summer.* Accessed August 2019. http://registerguard.com/rg/news/local/32166313-75/hot-summers-better-get-used-to-em.html.csp

[41] United States. Erdman, Jon. The Weather Channel. "Record Pacific Northwest Heat Wave Finally Comes to a Close." August 13, 2017. Accessed November 2017. https://weather.com/forecast/regional/news/pacific-northwest-heat-relief-washington-oregon-aug2017 https://weather.com/forecast/regional/news/pacific-northwest-heat-relief-washington-oregon-aug2017

"cooling centers" for people to escape the unsafe temperatures.[42] According to Kathie Dello at the Oregon Climate Change Research Institute, these are the types of conditions we should expect to see in the future.

2.4.4 Impacts – Cascading Incidents

Civil Unrest

In the Eugene-Springfield area, due to the limited frequency and size of hail, thunderstorm, or tornado events, a civil unrest incident is unlikely for these weather hazards. It is possible a prolonged heat wave could produce many of the contributing factors often seen with civil unrest (Figure 4-4). Such an incident has not occurred in the area. Therefore, the Eugene-Springfield area does not expect such a situation to occur within the next five to ten years.

History of Impact in Eugene-Springfield

There have been no incidents of civil unrest in the aftermath of an extreme weather incident in Eugene or Springfield.

Risk of Impact

Based on historical occurrences of civil unrest after natural disasters, along with the area's societal composition, the overall risk of a civil unrest event developing due to an extreme weather incident is low, mainly due to the possibility of such incidents developing during a severe and prolonged heat wave.

Dam or Levee Failure

Extreme weather may cause a dam or levee failure if electrical systems are affected and/or conditions are severe enough to cause overtopping or erosion. It is difficult to determine how many levees have failed due to this hazard because of the incomplete inventory and monitoring systems in place within the United States for such structures.

More information on dams and levees is located in Appendix H.

History of Impact in Eugene-Springfield

There have been no incidents for a dam or levee failures due to an extreme weather incident in the Eugene-Springfield area.

[42] United States. Eugene. KVAL News. "Beat the Heat!" July 31, 2017. Accessed August 2019. https://kval.com/news/local/beat-the-heat-heres-where-to-chill-in-eugene-with-scorching-weather-on-the-way

After reviewing 90 dam failures dating from 1802 to 2015, only one was attributed to extreme weather. In 1986, a lightning strike caused electrical failures at two Upriver power plants in Spokane, Washington. The turbines stopped working, and water quickly rose behind the dam. Backup power systems failed, and spillway gates were not raised in time, causing the dam to be overtopped. The facility sustained almost $(1986)11.5 million in damages, but no reported fatalities. The subsequent investigation determined several design and operational errors contributed to the failure.[43]

As the Upriver Dam incident shows, a direct hit by an extreme weather incident could cause a dam or levee to fail though this is extremely rare.

Risk of Impact

Based on historical occurrences and the condition of dams and levees in and around the Eugene and Springfield area, the risk from an extreme weather induced failure is low.

Epidemics

Epidemics are not a known significant impact of an extreme weather incident.

Hazardous Materials

Hazardous material incidents can occur if weather incidents directly impact a hazardous material facility, or its operational components. Due to the limited scale of these weather incidents, response to such a HazMat situation would likely experience little to no interference.

More information on HazMat spills and releases can be found in Appendix I.

History of Impact in Eugene-Springfield

There have been no incidents of hazardous material spills or releases in the aftermath of an extreme weather incident in Eugene or Springfield. Data collected throughout the United States shows tornadoes and thunderstorms do cause some HazMat incidents.[44] A 2015 review of natech (natural hazard triggered technological disasters) incidents effecting the U.S. oil industry determined hail,

[43] Hokenson, Reynold A., W. Lowell Shelton, William M. Verigin, George W. Miller, and Mallur R. Nandagopal. "Upriver Dam Hydroelectric Project Rehabilitation After Failure, Part A: Failure Investigation and Lessons to be Learned." Civil Engineering Database. January 01, 1988. Accessed November 30, 2017. http://cedb.asce.org/CEDBsearch/record.jsp?dockey=0055754

[44] Turkey. Sengul, Hatice, Nicholas Santella, Laura J. Steinberg, and Ana Maria Cruz. "Analysis of hazardous material releases due to natural hazards in the United States." *Disasters* 36, no. 4 (2012): 723-743. Hacettepe University Department of Environmental Engineering.

heat, and tornadoes can cause oil spills however, they do not account for a significant number of incidents.

Lightning does account for a sizable portion of natech incidents in the oil industry. In the United States, 8,121 barrels were released from pipelines, 6,134 barrels from aboveground storage units, and 7,786 barrels from pump/meter stations due to lightning damage. Lightning is the third most costly natural hazard to oil infrastructure, with over $120 million in damages. Lightning accounts for five of the twenty-four most significant natech incidents, with respect to economic costs, from 1994 to 2012.[45]

Risk of Impact

Based on the amount of hazardous materials in and around the Eugene-Springfield area, and the historical occurrence of extreme weather impacting HazMat facilities, the risk of impact is low.

2.4.5 Probability of Future Occurrence

The probability of experiencing an extreme weather incident is moderate for the Eugene-Springfield area. It is likely at least one of these extreme weather incidents will happen on a scale severe enough to cause property damage or threaten life within the next 35 to 75 years.

2.4.6 Vulnerability and Capacity Assessment

The loss of life as well as economic and property concerns are significant with extreme weather incidents. Unlike severe heat, tornado, hail, or thunderstorms may geographically affect a small portion of the population. For this reason, it is determined the Eugene-Springfield area's vulnerability to such incidents is low. Additionally, the area's capability to respond to, and recover from, an extreme weather incident is high.

2.4.7 Risk Assessment

Based on the probability of future occurrence, vulnerability, and capacity to deal with extreme weather, the Eugene-Springfield area's risk to this hazard is categorized as low.

For a summary of Impact Risks see Table 2-5.

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[45] Girgin, Serkan, and Elisabeth Krausmann. "Lessons learned from oil pipeline natech accidents and recommendations for natech scenario development." *JRC Science and Policy Report, EUR* 26913 (January 2015). http://publications.jrc.ec.europa.eu/repository/handle/JRC92700

Table 2-5 Extreme Weather - Impact Risks	
Cascading Incident	**Ranking**
Civil Unrest	Low
Dam or Levee Failure	No Known
Epidemic	No Known
Hazardous Materials	Low

2.4.8 Existing Hazard Mitigation Activities

Extreme Weather is a new addition to this NHMP update, so hazard specific mitigation activities have yet to occur.

2.5 Flood

The probability of riverine flooding in Eugene and Springfield is moderate, and the probability is high for stormwater system flooding. The vulnerability in Eugene and Springfield for riverine flooding is moderate and for stormwater system flooding is low. A moderate vulnerability indicates 10% to 69% of the population would be impacted, and a low vulnerability indicates less than 9% of the population would be impacted (Table 4-1).

2.5.1 Cause and Characteristics of the Hazard

The Eugene-Springfield area considers two primary flood hazard categories: riverine flooding and stormwater system (urban) flooding. Riverine flooding occurs when water overtops the banks of a naturally occurring waterway, while urban flooding is most often caused by inadequate stormwater drainage systems or maintenance.

The Eugene-Springfield area is subject to flooding from several sources, including:

- Riverine flooding from the Middle Fork of the Willamette River, the Willamette River, and the McKenzie River;
- Riverine flooding from numerous smaller creeks and sloughs; and
- Local stormwater drainage flooding.

Flooding in Eugene and Springfield typically occurs in December and January. Incidents are usually associated with La Niña conditions, which result in prolonged rain and rapid snowmelt on saturated or frozen ground. This sudden influx of water causes rivers to swell, forcing tributary streams to back up and flood communities. Eugene-Springfield is largely protected from riverine flooding by multiple upstream flood control dams in both the McKenzie and Willamette River watersheds.

2.5.2 Climate Change

Though the full extent of climate change's effect on flooding is unknown, existing research shows it will influence this hazard. Summer precipitation is projected to decline by as much as 30%. This will be accompanied by less frequent, but heavier downpours.[46] Already, the Northwest has experienced a 12% increase in very heavy precipitation incidents (the heaviest 1%) from 1958 to 2012.[47] Though there are many contributing factors for flooding, climate change is expected to increase flood risk in water basins with both rainfall and late spring snowmelt-related runoff peaks.

Warmer winter temperatures will lead to more precipitation falling as rain instead of snow, which reduces the amount of water stored as snow and increases wintertime river flows. Increased potential for heavier precipitation incidents will also exacerbate the risk of flooding. The Oregon Climate Change Adaptation Framework lists 11 risks including "increased frequency of extreme precipitation incidents, and incidence and magnitude of damaging floods."[48]

2.5.3 History of the Hazard in Eugene-Springfield

Flooding has been recorded in Eugene and Springfield ever since the first European settlers arrived in the area in the mid-1800s. The FEMA Flood Insurance Study (FIS) for Lane County (June 2, 1999) summarizes the history of major historical floods in the Eugene- Springfield area. Major floods occurred in 1861, 1890, 1945, 1956, 1964 and 1996. The 1964 flood was the largest flood incident recorded in Lane County.

Notably, the construction of flood control dams in the 1940s-1960s has substantially reduced the potential for significant riverine flooding in Eugene and Springfield. These dams have reduced the expected base flood discharges of water flowing into the local rivers. Accordingly, expected flood elevations and overall flood potential for major incidents along the rivers have been substantially reduced.

In addition to the flood control dams, the U.S. Department of Agriculture Soil Conservation Service (now known as the Natural Resource Conservation Service) and Lane County constructed a flood control levee in 1960 to protect a large area of Springfield from McKenzie River flooding. Ownership and maintenance responsibilities for this levee transferred to the City of Springfield in 1983. This

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[46] U.S. Global Change Research Program. *Climate Change Impacts in the United States: The Third National Climate Assessment*. By Jerry M. Melillo, Terese Richmond, and G.W. Yohe. 2014. 487-513.
[47] United States. Environmental Protection Agency. Office of Policy. *Adapting to Climate Change Northwest.* June 2016. Accessed November 13, 2017. EPA-230-F-16-018 https://www.epa.gov/sites/production/files/2016-07/documents/northwest_fact_sheet.pdf
[48] The Oregon Climate Change Adaptation Framework. Oregon Department of Land Conservation and Development. December 2010. https://drought.unl.edu/archive/plans/Climate/state/OR_2010.pdf

levee, known today as the 42nd Street Levee, successfully contained the January 1964 and February 1996 flood incidents.

The flood hazard areas shown on the current Flood Insurance Rate Maps (FIRM) for Eugene-Springfield assume the dams are operating properly. Dam failure hazards are not addressed by the FIS or the FIRM.

Despite the reduction in flood potential from the construction of dams, the Eugene-Springfield area continues to have flood risk from major rivers as well as from the numerous creeks and sloughs running through the area. Flood risk on these smaller streams has not been reduced by the dams on the larger rivers and their tributaries.

A historic statewide flood incident with local impacts occurred in February 1996. Unusually heavy rains over the four-day period from February 5th to February 8th resulted in significant flooding on numerous rivers and streams throughout western Oregon. During the incident, rising waters in the McKenzie River forced the evacuation of 1,200 to 1,500 people in low-lying areas of Springfield. In the Springfield/Thurston area along the McKenzie River, 35-40 homes, about 20 private roads and bridges, and roughly 20 vehicles were damaged.

Widespread flooding during February 1996 was also experienced in the Mohawk Valley from Marcola to Springfield with flooded homes on Sunderman Road and Goat Road. The Springfield Golf Course suffered substantial damage with about 6 inches of silt and debris deposited on the greens and fairways. There were widespread road closures in Lane County and Interstate 5 had water flowing across it just north of Eugene near the Boston Mill Road overpass.[49]

In December of 2005, days of heavy rains led to flooding on the Mohawk River near Springfield. The flood stage of the Mohawk is 15 feet. On December 31st, the river was at 18 feet. This area flooded again in January 2006 (reaching 17.8 feet), in 2012 [reaching 17.8 feet on January 19th (Figure 2-4)], and in December 2015 (reaching 15.42 feet.)[50]

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[49] United States. NOAA National Weather Service. *Flooding in Oregon.* Accessed August 2019. https://www.weather.gov/safety/flood-states-or

[50] US Department of Commerce, NOAA, National Weather Service. "Mohawk River (OR) Near Springfield Water Gauge - Historic Crests." NOAA. Accessed November 17, 2017. http://water.weather.gov/ahps2/crests.php?wfo=pqr&gage=spro3&crest_type=historic.

Picture 2-4 Source: Michael Ciaglo/Oregon Daily Emerald. *University of Oregon student watches water from the Mohawk River flow over a driveway in northern Springfield 2012.*

2.5.4 Impacts – Cascading Incidents

Civil Unrest

In the Eugene-Springfield area, a civil unrest incident induced by a flood would be unlikely. Many of the motives, incentives, and opportunities highlighted in Figure 4-4 would not be present during a flood. Nevertheless, a flood-induced civil unrest incident could occur under the right conditions.

History of Impact in Eugene-Springfield

There have been no incidents of civil unrest in the aftermath of a flood in Eugene or Springfield.

Risk of Impact

This impact is categorized low risk to the area.

Dam or Levee Failure

It is important to note the information located within this subsection only covers basic methods of flood-induced dam failure. There are many flood control measures employed by dams. What measures the nine dams upstream of the Eugene-Springfield area utilize is unknown, however. Generally, information on dams and dam operations is protected due to security concerns; known public information on local dams can be found in Appendix H.

The failure rate for dams is less than 1%,[51] with overtopping due to flooding accounting for 34% of the failures. Embankment dams cannot normally withstand a significant overtopping incident. For embankment dams, the most common failure mode is erosion during prolonged periods of rainfall and flooding.

When reservoirs are full and water inflow rates exceed the capacity of the controlled release mechanisms (spillways and outlet pipes), overtopping may occur. Overtopping can scour and erode the dam itself and/or the abutments which may lead to partial or complete failure of the dam. Especially for embankment dams, internal erosion, piping, or seepage through the dam's foundation or abutments can also lead to failure.

Willamette River Basin dams are designed for spillway opening only during infrequent severe events. Increased use can cause wear on spillway parts and lead to greater maintenance needs and an increased risk of failure. Vegetative growth and burrowing animals can cause erosion and weakening of smaller dams which can also be a common cause of failure.

Levees are very similar to dams but are only used for flood control. They run parallel to the body of water. Both dams and levees fail in similar ways. Most levees in the United States (97%) are operated and maintained by local governments or private entities.[52]

History of Impact in Eugene-Springfield

There have been no reported flood-induced dam failures for the Eugene or Springfield area. Although the likelihood of failure is very low, all dams upstream from the Eugene-Springfield area have the potential of causing widespread flooding, should they fail. Nine dams in the area could significantly impact the area if any one of them was to fail (Appendix H).

All the major dams which could affect the area were built to flood standards and the probability of a failure is low according to the Army Corp of engineers. Additionally, the Hills Creek Dam is likely to withstand floods at least as large as a 1,000-year incident without damage expected.

There are several non-certified levees in the Eugene-Springfield area. Though a failure of one of these structures would be limited in scope, compared to a dam failure, the likelihood of such an incident occurring is unknown.

[51] "Dams' safety is at the very origin of the foundation of ICOLD." ICOLD. Accessed November 15, 2017. http://www.icold-cigb.net/GB/dams/dams_safety.asp
[52] United States. Army Corps of Engineers. FEMA. *National Levee Database*. Accessed August 2019. https://levees.sec.usace.army.mil/#/public-dashboard

Risk of Impact

Though a flood-induced dam failure is slightly more likely to occur than an earthquake-induced failure, the likelihood of such an incident happening is still low.

Epidemics

The risk of a flood-induced epidemic is low unless there is significant population displacement and/or water source contamination.[53] A study in the American Journal of Clinical Medicine determined the possibility of contracting a person-to-person, waterborne, or foodborne communicable disease during a flood is a moderate risk. The World Health Organization (WHO) does note an increase in water- and vector- borne diseases seen with floods. Flood waters also increase the risk of infection.

The only epidemic-prone infection is leptospirosis which is transmitted from items contaminated with rodent urine. Vector-borne diseases often seen after flooding are malaria and West Nile virus. Waterborne diseases include leptospirosis, hepatitis A, and cholera.[54]

History of Impact in Eugene-Springfield

There have been no cases of flood-induced epidemics in the Eugene-Springfield area. Nationally, there have been several increases in communicable diseases after a water-related disaster, but the majority of these were small. The major factor in flood-induced epidemics is the contamination of drinking water. The risk of outbreaks can be minimized, however, if the risk is recognized and alternative water treatment measures utilized, both of which occurred in the Iowa and Missouri floods of 1993.

Risk of Impact

Considering the odds of an epidemic increase after a flood, some actions, possibly significant ones, need to be taken to prevent an epidemic from occurring. The risk from this impact is categorized as moderate.

Hazardous Materials

Though the size and scope of a HazMat release is largely dependent on the type of material involved, the release of the material may be caused by natural hazards such as floods and rain. Whether it is biological waste released from backed up sewer systems, the release of household chemicals, or large-scale releases from chemical plants, almost all floods release some hazardous materials. These incidents can

[53] "Flooding and communicable diseases fact sheet." WHO. Accessed November 2017. http://www.who.int/hac/techguidance/ems/flood_cds/en/

[54] Ibid

occur when tanks are swamped, or equipment needed to contain a chemical is compromised or destroyed by flood water.

In addition to potentially causing a release of hazardous materials, floods can spread the spill further than in non-flooding situations. Floods can also severely hamper response to an incident and any necessary evacuations.

History of Impact in Eugene-Springfield

There have been no reports of significant flood-induced hazardous material spills or releases in the Eugene-Springfield area. Some notable flood-induced HazMat incidents from around the world include:

- 1976 floods in Southern Idaho where at least 2000 pounds of granular Di-Syston® and 200 gallons of liquid Furadan® in addition to unknown quantities of DDT, PCBs, Guthion®, Dinitro®, 2,4-D, Thimet®, Syston®, and malathion were released from three commercial facilities and storehouses on farms;
- 1993 Midwest floods in the U.S. where 22 Superfund sites possibly containing toxins such as benzene, toluene, lead, and chromium, as well as household paints, solvents, and insecticides, were released in varying quantities;
- 1993 and 1995 floods on the River Meuse which runs through the Netherlands, France, and Belgium where cadmium, zinc, lead, copper, pesticides and PAHs were released; and
- 2017 floods caused by Hurricane Harvey; though exact chemicals and release totals are unknown, at this point, the refrigeration system of one plant was disabled resulting in an evacuation before one of the peroxide tanks spontaneously combusted.[55]

Overall, many flood-induced hazardous material spills are considered small in scale. The risk of flooding to facilities housing hazardous materials is well known, and thus generally well mitigated.

Risk of Impact

Considering the frequency of flood induced hazardous material spills or releases, along with the number of floods and hazardous material facilities in the area, the risk of a HazMat release occurring in the Eugene-Springfield area, due to a flood, is moderate.

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[55] United States "Arkema Inc. Chemical Plant Fire." U.S. Chemical Safety Board. Accessed November 2017. http://www.csb.gov/arkema-inc-chemical-plant-fire-/

2.5.5 Probability of Future Occurrence

The probability of riverine flooding in Eugene-Springfield is moderate and the probability of stormwater flooding is high. A moderate probability indicates one riverine flooding incident is likely in the next 35 to 75 years. A high probability indicates one stormwater flooding incident is likely within the next 35 years.

2.5.6 Vulnerability Assessment and Capacity

The level of flood hazard (frequency and severity of flooding) is not determined simply by whether the footprint of a given structure is or is not within the base floodplain (also referred to as the 100-year floodplain). A common error is to assume structures within the base floodplain are at risk of flooding while structures outside of the base floodplain are not. Some important guidance for interpreting flood hazard is given below.

- Being in the 100-year (or base) floodplain does not mean floods happen once every 100 years. Rather, it means the probability of a flood in the 100-year base flood level or higher has a 1% chance of happening each year.
- Much flooding happens outside of the mapped base floodplain. First, the 100-year flood is by no means the worst possible flood. For flooding along the Willamette River, the 500- year flood is 4 feet higher than the 100-year base flood. Second, many flood prone areas flood because of local stormwater drainage conditions. Such flood prone areas may have nothing to do with the base floodplain boundaries.
- The key determinant of a structure's flood hazard is the relationship of the structure's elevation to the flood elevations for various flood incidents. Thus, homes with first floor elevations below or near the 10-year flood elevation have drastically higher probabilities of flooding than other structures with first floor elevations near the 50-year or 100-year flood elevation.
- Areas protected by flood control levees, such as Springfield's 42nd Street Levee, were originally mapped as being protected from the 100-year flood incident. However, in response to numerous levee failures during Hurricane Katrina, levees now must also be certified as being structurally adequate to retain their accreditation as flood control structures. If the City of Springfield is unable to obtain certification for the 42nd Street Levee, the next update of the flood control maps for the section of the McKenzie River paralleled by the levee may be prepared as if the levee was not in place. This would greatly increase the area of the City within the mapped 100-year floodplain.
- In Oregon, Oregon Administrative Rule 660-008 requires local governments, when planning for needed housing, ensure it is located on buildable land "…suitable, available and necessary for residential uses."

> Land "within the 100-year floodplain" is not considered "suitable and available" under the buildable land definition. Due to State planning requirements, City floodplain development requirements, and the small number of dwelling units located in Special Flood Hazard Areas, the vulnerability of residential development to the flood hazard is low.

Eugene and Springfield are in the process of identifying resources to update flood hazard information through new mapping. Once complete, a thorough quantification of vulnerable structures can be completed, provided the resources are available.

The 2014 Regional Climate and Hazards Vulnerability Assessment found, while flood incidents have the potential to cause severe loss and damage in localized areas, flooding is not likely to result in significant damage to critical systems or systemic failures across multiple sectors. The reason vulnerability to this hazard is rated as moderate for riverine flooding relates to the primary impacts and potential inconvenience for many members of the population (transportation impacts, drain on emergency response resources, etc.). The area's capacity to respond to this hazard is moderate due to resources and the prolonged onset period of flood hazards.

2.5.7 Risk Assessment

FEMA Flood Insurance Rate Maps (FIRMs) are the most comprehensive resource for identifying flooding hazards in the Eugene-Springfield area. The Eugene-Springfield area's most recent FIRMs became effective on June 2, 1999. It is common knowledge the Eugene-Springfield metro area flood maps are based on outdated information. The availability of LiDAR data and other technologies offers superior ability to project and map riverine flooding in the area. Eugene and Springfield are actively working with FEMA and the State of Oregon to identify resources needed to update the Eugene-Springfield regulatory floodplain maps.

Notably, some areas within Springfield have recently been re-mapped. These include the Willamette River through the southern portion of Glenwood, as well as the confluence of the Middle Fork and Coast Fork of the Willamette River.

Flood prone areas of the Eugene-Springfield area include the FEMA-mapped floodplains for major rivers including the Mohawk, McKenzie, and Willamette (including the Middle Fork and the Coast Fork). FEMA-mapped floodplains also include areas along Amazon Creek, Mill Race and several smaller creeks (mostly in the western portion of Eugene).

Historical experience and hydrologic/hydraulic modeling suggest the most problematic areas for local stormwater drainage flooding in Eugene are the Amazon Creek, Willow Creek, and Laurel Hill basins in the South Hills. Drainage problems in these areas are exacerbated by relatively thin, impermeable soils. Vulnerability to local stormwater system flooding is rated low because less than 10% of the population or assets are typically affected. The capacity to address stormwater system flooding is rated high.

Maps showing the location of the floodway and the special flood hazard area (SFHA) are included in Section 3.

For a summary of Impact Risks see Table 2-6.

Table 2-6 Flood - Impact Risks

Cascading Incident	Ranking
Civil Unrest	Low
Dam or Levee Failure	Low
Epidemic	Moderate
Hazardous Materials	Moderate

2.5.8 Existing Hazard Mitigation Activities

Historically, the focus of local stormwater maintenance practices has been limited to drainage and flood control. More recently, the focus has widened to include management of riparian vegetation by allowing it to remain in streams and channels for the beneficial effects of slowing runoff for filtration and sedimentation. Eugene and Springfield have actively pursued several flood hazard mitigation activities to reduce vulnerability to damage and disruption from flooding incidents. Efforts include:

- Both Cities participate in the National Flood Insurance Program, which enables property and business owners to qualify for federally underwritten flood insurance.
- Eugene is a participant in the Community Rating System (CRS) program and has a rating of 7.
- Both Eugene and Springfield have Stormwater Management Plans. The first goal of these plans is to protect citizens and property from urban flooding through planning for and building adequate stormwater systems.
- Springfield owns, operates and maintains the 42nd Street Levee to protect a large area of the City from McKenzie River flooding. Springfield is also working toward obtaining certification and accreditation of this levee.

2.5.9 National Flood Insurance Program Participation

Eugene and Springfield both participate in the National Flood Insurance Program (NFIP). Eugene's initial Flood Hazard Base Map is dated June 7, 1974 and its initial Flood Insurance Rate Map (FIRM) became effective September 29, 1986. As mentioned above, the current effective FIRM date is June 2, 1999. As of October

2018, Eugene has 828 NFIP policies valued at $264,082,600. Cumulatively, since 1978, there have been 17 claims, 10 of which were closed with payment and the rest were closed without payment. Total loss payments amount to $116,465. Eugene also participates in the FEMA Community Rating System (CRS) program. The City has a CRS classification of 7 which translates to a 15% reduction to all NFIP policy premiums in Eugene.

Springfield's initial Flood Hazard Base Map is dated June 18, 1971 and its initial FIRM is dated September 27, 1985. Like Eugene, Springfield's current effective FIRM is dated June 2, 1999. As of May 2018, Springfield has 92 NFIP policies valued at $31,635,700. Cumulatively, since 1978, there have been 27 claims, 22 of which were closed with payment and the rest were closed without payment. Total loss payments amount to $402,491.98. Springfield is working through a Community Assistance Visit (CAV) with Oregon Department of Land Conservation and Development (DLCD) staff. There are 61 Effective Letters of Map Change in Springfield.

2.5.10 Repetitive Flood Loss Properties

No properties are listed on FEMA's repetitive loss or severe repetitive loss lists within Eugene's or Springfield's jurisdictional boundaries.

2.6 Geomagnetic Disturbance (GMD)

The probability and vulnerability of a national-scale GMD affecting the Eugene-Springfield area is high for the worse case predictions. A geomagnetic disturbance is a naturally occurring energy pulse like an electromagnetic pulse (EMP). These incidents are most commonly caused by solar flares but can also come from other natural sources such as lightning. Due to the large scale of GMDs caused by solar flares, this plan will focus primarily on this source for mitigation purposes.

2.6.1 Causes and Characteristics of the Hazard

As mentioned previously, there are several natural causes for geomagnetic disturbances, but solar flares are the largest and potentially most destructive. They occur when there is an explosion which emits the "solar flare" from the magnetic canopy of a sunspot on the Sun. The side-effects of a solar flare are the elements of a GMD which are very similar to a manmade EMP.

When the sun emits a solar flare, X-rays and ultra-violet (UV) radiation are released and travel to earth at the speed of light, ionizing the upper layer of the atmosphere. A severe GMD starts with radio blackouts and GPS navigation errors as a result of the arrival of x-ray and UV radiation. Minutes to hours later, when the energetic particles (protons, electrons, and high atomic number and energy ions) arrive, satellites can be electrified, and their electronics damaged. This can be followed a day or more later by the arrival of coronal mass ejections (CMEs,) which are clouds of magnetized plasma. It is believed a direct hit by an extreme CME may cause widespread power blackouts which could disable everything plugged into a wall socket.[56] Anything running on electricity or utilizing electronics could be damaged or ruined unless properly shielded.

2.6.2 Climate Change

At this point, it is unknown how climate change may affect a major GMD incident.

2.6.3 History of the Hazard in Eugene-Springfield

There are no known instances of a significant GMD affecting the Eugene-Springfield area. Solar flares hit the earth often, also seen as the phenomenon known as the "Northern Lights". Most of the time, however, they do little to no damage. Most people have experienced GMDs in the form of radio and satellite disruptions. What is not as common is the more destructive portion of a solar flare, the CMEs, directly striking earth.

Geomagnetic disturbances fluctuate with the Sun's 11-year Solar Cycle. More solar flares are observed during the Solar Maximum when sunspots and solar activity are at their highest. Scientists number these cycles in sequential order as they occur. Solar Cycle 24 started around December 2008, and the solar maximum was seen around November 2014. Solar Cycle 25 is predicted to start around 2019 or 2020.

One of the strongest GMD incidents to hit earth occurred in 1859 and is dubbed the Carrington Incident. This is believed to be near the peak of Solar Cycle 10. At the time, the Northern Lights could be seen in Cuba, and global telegraph lines sparked causing many fires and service disruptions.[57] The National Academy of Sciences predicts a similar incident occurring now would exceed $2 trillion in damages and recovery would take years. In February 2012 earth had a near miss as the strongest CME seen since the Carrington Incident missed earth by a week.

The strongest modern era GMD to hit earth occurred on March 13, 1989 during Solar Cycle 22's maximum. It immediately caused short-wave radio interference. The Northern Lights were reported in Southern Florida and Cuba. Several satellites lost control, and the Shuttle Discovery experienced mysterious electrical problems. The large GMD caused a blackout across all of Quebec, Canada. There were hundreds of power grid problems in the U.S. though no blackouts due to low

[56] United States. Phillips, Tony. "Near Miss: The Solar Superstorm of July 2012." NASA. July 23, 2014. Accessed November 17, 2017. https://science.nasa.gov/science-news/science-at-nasa/2014/23jul_superstorm.

[57] United States. Lovett, Richard. National Geographic News. *What if the Biggest Solar Storm on Record Happened Today?* March 2011. Accessed August 2019. https://www.nationalgeographic.com/news/2011/3/110302-solar-flares-sun-storms-earth-danger-carrington-event-science/

demands on the grid in the early morning hours.[58] This incident registered a disturbance storm time (Dst) of 600 nT (nanoTesla). The Dst during the 1859 Carrington Incident was estimated to be between 800 and 1750 nT. As a point of reference, the Northern Lights around the Arctic Circle have an average Dst of 50 nT.

2.6.4 Impacts – Cascading Incidents

Civil Unrest

A large scale and destructive GMD could easily generate all the contributing factors identified for violent conflict or civil unrest to occur (Figure 4-4). With reliable news limited or absent, tensions and anger can rise. Little information is known on how a GMD could trigger this impact. An incident has not been witnessed since the advent of modern technology, but it is reasonable to assume civil unrest could quickly spring from such a situation.

History of Impact in Eugene-Springfield

There is no known history of a civil unrest incidents due to a geomagnetic disturbance.

Risk of Impact

A large GMD has the potential of causing widespread confusion and panic, especially if it impacts the entire country. A large-scale GMD incident combined with very limited mitigation activities and the extreme dependency on modern technology means the risk of civil unrest is high.

Dam or Levee Failure

Scientists are studying GMDs and their effects on modern technology. Large solar flare incidents have the potential of causing devastating damage to unprotected electronics. It is plausible a GMD could cause damage to electronic dam control and operation systems.

More information on dams or levees is in Appendix H.

History of Impact in Eugene-Springfield

There is no known history of dam or levee failure due to a geomagnetic disturbance.

Risk of Impact

[58] Odenwald, Sten. "The Day the Sun Brought Darkness." NASA. Updated August 2017. Accessed November 2017. http://www.nasa.gov/topics/earth/features/sun_darkness.html

Based on the predicted probability and potential damage from a large GMD, Eugene-Springfield's risk from this impact is moderate.

Epidemics

Epidemics could also be an impact of a GMD based on its size, severity, and the recovery time for damages. The probability of an epidemic, however, is extremely hard to predict due to the vast number of variables involved. If Earth was to receive a direct hit from a large GMD in which medical and pharmaceutical manufacturing facilities are non-operational for an extended period, an increase of epidemics should be expected. If this were to happen, containment and palliative care of sick individuals may be the only option until health care services are fully restored. Water and wastewater services could also be affected, increasing the likelihood of an epidemic.

History of Impact in Eugene-Springfield

There is no known history of epidemics due to a geomagnetic disturbance.

Risk of Impact

Due to the possibility of a large GMD occurring and incapacitating electronic devices, which the medical community relies upon, the risk from this impact is moderate.

Hazardous Materials

Hazardous material spills due to the impact of a GMD are plausible. Many facilities containing hazardous substances depend upon electronics technology for their control and operation systems. Improperly or non-shielded electronics may be affected by a GMD.

More information on HazMat spills and releases is in Appendix I.

History of Impact in Eugene-Springfield

There is no known history of a hazardous material incident due to a geomagnetic disturbance.

Risk of Impact

The risk of a GMD induced HazMat incident is moderate due to the electrical requirements for storage of hazardous materials and the probability of a large GMD occurring.

2.6.5 Probability of Future Occurrence

Current research suggests, the probability of a significant GMD effecting the Eugene-Springfield area is high. In 2012, the probability of a Carrington size GMD hitting Earth in the next ten years was estimated to be 12%.[59]

2.6.6 Vulnerability and Capacity Assessment

Due to the potential size and severity of a GMD, the damages from such an incident could be wide ranging and severe. Eugene and Springfield's vulnerability to a GMD incident is high while capacity to deal with such an incident is low.

2.6.7 Risk Assessment

Based on the probability of future occurrence, vulnerability, and capacity to deal with a national-scale geomagnetic disturbance, the Eugene-Springfield area's risk to this hazard is categorized as very high.

A summary of Impact Risks is in Table 2-7.

Table 2-7 Geomagnetic Disturbance - Impact Risks

Cascading Incident	Ranking
Civil Unrest	High
Dam or Levee Failure	Moderate
Epidemic	Moderate
Hazardous Materials	Moderate

2.6.8 Existing Hazard Mitigation Activities

Geomagnetic disturbances are a new addition to the 2020 NHMP update. Hazard specific mitigation activities have yet to occur.

2.7 Landslide

In December 2018, the Oregon Department of Geology and Mineral Industries (DOGAMI) released a new analysis of landslides in the Eugene-Springfield area titled IMS-60, Landslide Hazard and Risk Study of Eugene-Springfield and Lane County, Oregon (IMS-60)[60]. Based upon the results of this study, the Steering Committee determined the probability of a landslide is high in Eugene and Springfield and vulnerability to landslide is low in both cities.

[59] Riley, P. On the probability of occurrence of extreme space weather events. *Space Weather* **10**, S02012, https://doi.org/10.1029/2011SW000734 (2012). Accessed August 2, 2019

[60] Oregon Dept. of Geology and Mineral Industries, IMS-60. https://www.oregongeology.org/pubs/ims/p-ims-060.htm. Accessed August 5, 2019

2.7.1 Causes and Characteristics of the Hazard

The term "landslide" refers to a variety of slope instabilities resulting in the downward and outward movement of slope-forming materials including rocks, soils, and artificial fill. The IMS-60 Study evaluated two categories of landslide types:

- Shallow Landslides: failure plane is 15 feet or less below ground surface;
- Deep Landslides: failure plane is greater than 15 feet below ground surface.

The IMS-60 Study found some areas are more susceptible to shallow landslides, whereas other areas are more susceptible to deep landslides, and some are susceptible to both. Maps showing the areas susceptible to shallow and deep landslides are included in Section 3.

The Eugene-Springfield area is susceptible to four types of landslides (Figure 2-7) which may occur as either shallow or deep landslides:

- Rockfalls are abrupt movements of masses of material (rocks and soils) detached from steep slopes or cliffs. Movement occurs by free-fall, bouncing, and/or rolling. Falls are strongly influenced by gravity, weathering, undercutting, and/or erosion.
- Rotational slides are those in which the rupture surface is curved concavely upwards and the slide movement is rotational about an axis parallel to the slope. Rotational slides usually have a steep scarp at the upslope end and a bulging "toe" comprised of the slope material at the bottom of the slide (Figure 2-8). Roads constructed by cut and fill along the side of a slope are prone to slumping on the fill side of the road. Rotational slides may creep slowly or move large distances suddenly.
- Translational slides are those in which the moving material slides along a flat surface. Translational slides occur on surfaces of weaknesses, such as faults and bedding planes or at the contact between firm rock and overlying loose soils. Translational slides may creep slowly or move large distances suddenly.
- Flows are plastic or liquid in nature and the slide material breaks up and flows during movement. This type of landslide occurs when a landslide moves downslope as a semi-fluid mass, scouring or partially scouring rock and soil from the slope along its path. A flow landslide is typically rapid-moving and tends to increase in volume as it moves downslope as it scours out its channel.

Though immediate damage is limited to where the slide occurs, landslides can have far reaching repercussions if infrastructure or water ways are involved. Historic landslides (within the past 150 years) in Eugene-Springfield tend to be smaller slides or slumps near waterways or slides related to development activity. The potential for larger slides exists primarily in the south hills of Eugene and Springfield.

Rockfall incidents are primarily limited to quarry sites where rock has been exposed (e.g., the west face of Skinner's Butte).

The primary factors affecting or increasing the likelihood of landslides in Eugene-Springfield are:

- Natural conditions and processes including the geology of the site, rainfall, water action, seismic activity, and volcanic activity.
- Excavation and grading on slopes for homes, roads, and other structures.
- Natural or human-caused drainage and groundwater alterations can trigger landslides. Human activities such as broken or leaking water or sewer lines, water retention facilities, irrigation, stream alterations, ineffective stormwater management, and excess runoff due to increased impervious surfaces.
- Change or removal of vegetation on very steep slopes due to timber harvesting, land clearing, and wildfire.
- The water content of soils/rock is a major factor in determining the likelihood of sliding for any given slide-prone location. Thus, most landslides happen during rainy months, when soils are saturated with water. Winter storms with intense rainfalls are a common trigger for landslides in the Eugene-Springfield area.

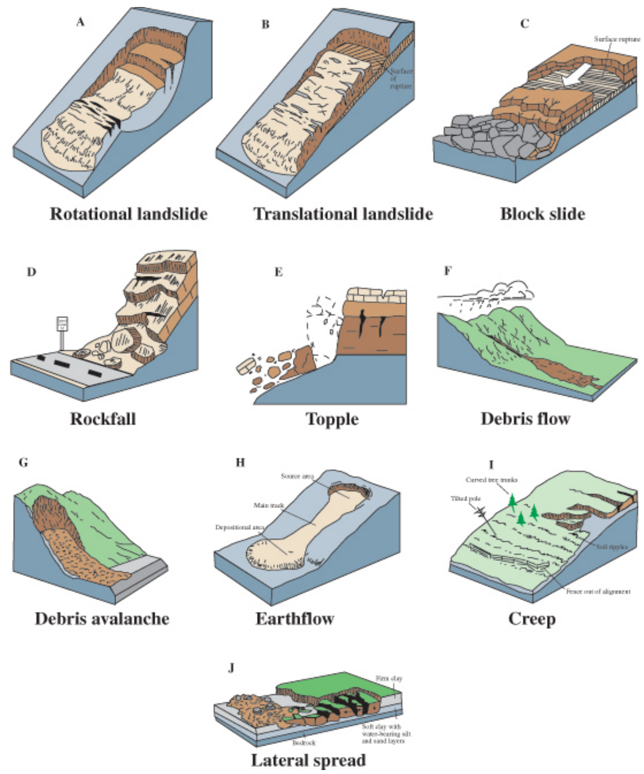

Figure 2-7. Source: USGS – Types of Landslides. 2004.
https://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html

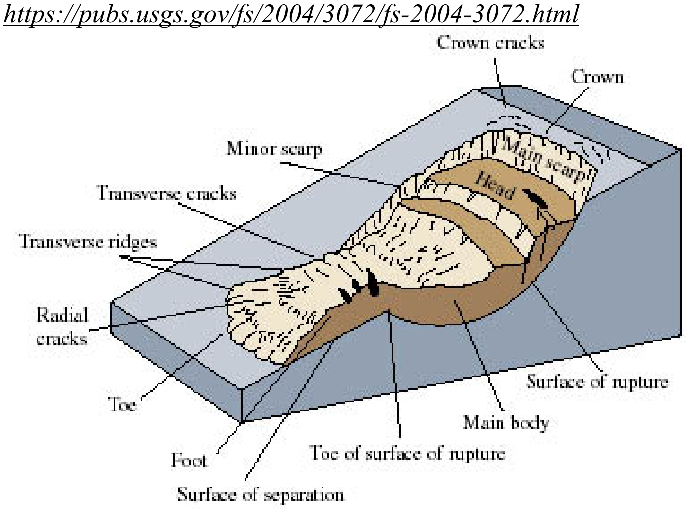

Figure 2-8. *Source USGS* – Common Landslide Anatomy. 2004.
https://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html

2.7.2 Climate Change

While the full extent of the effect of climate change on landslides is unknown, existing research suggests it will influence this hazard. Precipitation is expected to decrease, occurring as less frequent, but heavier downpours. [61] Shifting peak snowmelt periods will change how and when soil levels have reached saturation. With soil saturation being a significant factor for landslides, we expect to see changes in this hazard, if climate predictions are correct.

2.7.3 History of the Hazard in Eugene-Springfield

The IMS-60 Study included updating the inventory of historic (<150 years) and prehistoric (>150 years) landslides in the Eugene-Springfield area utilizing LIDAR and records provided by the Cities and Lane County. The inventory identified over 700 existing landslides covering about 6% of the 230 square mile study area, more than 3 times the previous number of inventoried landslides.

Table 2-8 provides a summary of the landslide inventories for the communities included in the IMS-60 Study. The Special Paper 42 (SP-42) Inventory landslides were identified using LIDAR methods and the Historic Landslide Point Inventory represents landslide records from 1979 to 2016.

Table 2-8 Summary of Landslide Inventories for each Community (IMS-60 Table 4-1)

Community	SP-42 Inventory*	Historic Landslide Point Inventory
Lane County**	575	38
City of Springfield (East) City of Springfield (West)	20 2	7 4
City of Coburg	0	0
City of Eugene Neighborhoods		
Eugene North	1	1
Eugene South	63	24
Eugene Southwest	0	0
Eugene West	0	1
City of Eugene Totals	64	26

Table 2-8 Source *IMS-60 Table 4-1*

* Some landslides overlap community boundaries, so totals will not equal total landslides in study area.

**Unincorporated Lane County included in study.

[61] United States. Melillo, Jerry M., Terese Richmond, and G.W. Yohe. U.S. Global Change Research Program. *Climate Change Impacts in the United States: The Third National Climate Assessment*. 2014. 487-513.

2.7.4 Impacts – Cascading Incidents

Civil Unrest

Civil unrest is not a known significant impact of a landslide.

Dam or Levee Failure

As discussed in section 2.3.4, landslides do have the potential to cause dam failure due to overtopping. This is more likely to occur when the reservoir behind the dam is at full capacity. The Army Corp of Engineers takes this into account during design and operations, so failure due to this impact is very low.

More information on dams and levees is in Appendix H.

History of Impact in Eugene-Springfield

Landslide induced dam or levee failure has not occurred in the Eugene or Springfield area. Additionally, such incidents are extremely rare. Out of the 90 dam failures reviewed, between 1802 and 2015, only one was due to a landslide. The Vajont Dam (Italy) was overtopped by a wave produced by a massive landslide in 1963. This incident destroyed five villages, killing 2,000 people. Poor construction and operation were thought to have worsened the impact to the dam.[62]

Risk of Impact

Based on historical occurrences, the condition of local dams and levees, and the probability of a significant landslide into a large body of water contained by such structures, the risk from this impact has been determined to be low.

Epidemics

Though the odds of landslide induced epidemics is unknown, a landslide could cause this impact. Search and rescuers may be exposed to contaminated biological waste. Additionally, a slide may contaminate water supplies, though this should be detected relatively quickly thus limiting transmission.

History of Impact in Eugene-Springfield

There has been no landslide-induced epidemics in the Eugene-Springfield area.

Risk of Impact

[62] Bressan, David. "Expecting A Disaster: The 1963 Landslide of the Vajont Dam." Forbes. October 10, 2017. Accessed November 30, 2017. https://www.forbes.com/sites/davidbressan/2017/10/09/expecting-a-disaster-the-1963-landslide-of-the-vajont-dam/#34fc306f11f8

Though no noted historical occurrences of a large-scale landslide induced epidemic has been documented, there is a possibility it may occur. Unless water sources are contaminated, an outbreak would be limited to responders and, potentially, those with whom they come into contact. Due to this, some mitigation would be necessary to prevent the spread of viral or bacterial contaminants. The risk of this impact occurring is low.

Hazardous Materials

A hazardous material spill or release can occur any time there is a landslide in a developed area. Commonly, spills are seen when household chemicals, fuel tanks, and wastewater components are involved. Larger spills can occur when a landslide damages hazardous material infrastructure such as holding tanks or power supplies.

More information on HazMat spills and releases is in Appendix I.

History of Impact in Eugene-Springfield

There has been no known significant landslide induced hazardous materials spills or releases in the Eugene-Springfield area.

Risk of Impact

Due to historical occurrences and the number and location of hazardous materials within the area, the risk of this impact occurring has been deemed to be low.

2.7.5 Probability of Future Occurrences

The probability of a landslide occurring in the Eugene-Springfield area depends upon several factors, including steepness of slope, slope composition (i.e. soil type), local geology, vegetative cover, human activity, and water. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides. Most landslides occur during the rainy months of the year. The Steering Committee rated the probability of a landslide occurrence as high. A high rating means one incident is likely in a 10 to 35-year period.

2.7.6 Vulnerability and Capacity Assessment

Landslides can occur during any season in the Eugene-Springfield area. Given local development patterns, residential and public land use is most likely to be impacted by landslides. In Oregon, residential development is explicitly prohibited or restricted in areas with steep slopes. Specifically, Chapter 197 of the Oregon Revised Statute in the Oregon Administrative Rules provides for needed housing "…suitable, available and necessary for residential uses." Lands "(c) [having] slopes of 25 percent or greater" are not considered "suitable and available" under the buildable land definition.

A summary of the results of the IMS-60 Study (Table 2-9) show the applicable zone and associated estimated population and building and land value for each zone identified in the study. As such, residential vulnerability to landslides is low.

Table 2-9 Summary of Exposure of Select Assets to Landslides (Adapted from IMS-60 Tables 4-4 and 4-5)

Landslide Zone	Estimated Population	Estimated Building & Land Value
Existing Landslides	4,615	$1.13B
Shallow Landslides – Highly Susceptible	4,649	$4.92B
Deep Landslides – Highly Susceptible	5,232	$0.87B

Table 2-9 Source: DOGAMI IMS-60 Landslide Hazard and Risk Study. (Adapted from IMS-60 Tables 4-4 and 4-5) 2018

One additional analysis provided in the IMS-60 Study is the risk of earthquake-induced landslides. The study indicates about 1.5% of the building damage, within the overall study area, may be caused by landslides triggered by a Cascadia Subduction Zone (CSZ) earthquake. By contrast, nearly 20% of the building damage in the East Springfield study area following a CSZ earthquake may be from landslides.[63]

The Eugene-Springfield Steering Committee rated the Cities' vulnerability to landslides as low, meaning less than 10% of the population and/or regional assets would be affected by a landslide incident. Additionally, due to available resources and the generally limited scale of a landslide, the area's overall capacity to deal with such an incident is moderate.

2.7.7 Risk Assessment

The IMS-60 Study identified four primary conclusions about the risk of landslides in the Eugene-Springfield area:

- Large, deep landslides are a primary threat in the study area, and asset exposure to these landslides is significant. More than 4,500 residents and

[63] United States. DOGAMI. *Landslide Hazard and Risk Study of Eugene-Springfield and Lane County, Oregon.* 2018. Accessed August 2019. https://www.oregongeology.org/pubs/ims/IMS-60/IMS_60_report.pdf

2,500 buildings, and a combined building and land value of about $950 million would be affected.

- 8,350 buildings are located in the high shallow landslide susceptibility zone, with close to $5 billion worth of land and buildings exposed.
- Annual historic landslide losses range from $99,000-$306,000; in extreme years (such as 1996), this increases to several million.
- Damage and losses from landslides alone, induced by a local crustal or a Cascadia Subduction Zone earthquake, may result in an estimated 2,770 buildings being moderately to completely damaged and close to 600 residents in need of shelter. In most communities, <5% of earthquake damage would come from landslides. However, in some communities, potential landslides triggered by the earthquakes could cause a 20% increase in damage and losses.

Based upon these conclusions, DOGAMI considers the overall risk of landslide in the study area to be moderate. The Steering Committee concurs.

A summary of Impact Risks is in Table 2-10.

Table 2-10 Landslide - Impact Risks

Cascading Incident	Ranking
Civil Unrest	No Known
Dam or Levee Failure	Low
Epidemic	Low
Hazardous Materials	Low

2.7.8 Existing Hazard Mitigation Activities

In Eugene and Springfield, mitigation of the landslide hazard is accomplished through land use and development regulations. Both require geotechnical analysis of steep slopes prior to development to determine whether a development is appropriate for the area.

2.8 Volcano

The probability of volcanic activity impacting Eugene-Springfield is low. Vulnerability to volcanic activity is moderate for the Eugene-Springfield area.

2.8.1 Causes and Characteristics of the Hazard

The Cascade Range, which runs from British Columbia through Washington, Oregon, and into northern California, contains more than a dozen major volcanoes and hundreds of smaller volcanic features. In the past 200 years, seven of the

Cascade volcanoes have erupted, including Mt. Baker, Glacier Peak, Mt. Rainier, Mount St. Helens, Mt. Hood, Mt. Shasta, and Mt. Lassen.

Over the past 4,000 years, Oregon has experienced three eruptions of Mt. Hood, four eruptions in the Sisters area, and two eruptions in the Newberry Volcano area. Minor eruptions have taken place near Mt. Jefferson, at Blue Lake Crater in the Sand Mountain Field (Santiam Pass) near Mt. Washington, and near Belknap Crater. During this period, the most active volcano in the Cascades has been Mount St. Helens with over 14 eruptions.

Volcanic eruptions often involve several distinct types of hazards to people and property, as evidenced by the Mount St. Helens eruption in 1980. Major volcanic hazards include lava flows, blast effects, pyroclastic flows, ash falls, lahars, landslides, and debris flows. Some of these hazards (e.g., lava flows) only affect areas very near to the volcano. Other hazards may affect areas 10 to 20 miles away. Ash falls may affect areas hundreds of miles downwind of the eruption site. The primary volcanic hazards of concern for Eugene-Springfield are:

- **Ash falls** result when explosive eruptions blast rock fragments into the air. Such blasts may include tephra (solid and molten rock fragments). The largest rock fragments (sometimes called “bombs”) generally fall within two miles of the eruption vent. Smaller ash fragments (less than about 0.1 inch) typically rise into the area forming a huge eruption column. In very large eruptions, ash falls may total many feet in depth near the vent and extend for hundreds or even thousands of miles downwind.

- **Lahars** are common during eruptions of volcanoes with heavy loading of ice and snow or glaciers. These flows of mud, rock, and water can rush down channels at 20 to 40 miles an hour and can extend for more than 50 miles. For some volcanoes, lahars are a major hazard because highly populated areas are located on lahar flows from previous eruptions.

2.8.2 Climate Change

Climate change may impact the effect of a volcanic eruption in many ways. The most plausible, and perhaps most significant, is the severity of a lahar. Warming temperatures are causing a steady decline in mountain snowpack. This directly correlates to the amount of snow and ice available to form a lahar during an eruption. Significant long-term climate change implications for volcanic eruptions will, more than likely, not be known for some time.

2.8.3 History of the Hazard

The history of volcanic activity in the Cascades is contained in its geologic record and the age of the volcanoes vary considerably. Figure 2-9 shows the history of volcanic incidents in the Cascades. Scientists utilize a range of techniques to identify areas subject to volcanic hazards. For more information on volcano hazard identification in Oregon, refer to the Oregon Natural Hazards Mitigation Plan.

Several of the 20 active volcanoes in Oregon are located along the crest of the Cascades near the eastern boundary of Lane County. These volcanoes include the Three Sisters and Mount Jefferson. The active volcanoes posing the greatest threat to the Eugene-Springfield area are the Three Sisters, which are approximately 50 miles to the east. Lava flow, pyroclastic flows, debris flows, and avalanches from an eruption in the Three Sisters will be limited to the immediate area of the eruption and will not impact Eugene and Springfield. However, hazard zone maps for the Three Sisters show landslides, debris flows, and lahars from an eruption could enter the McKenzie River and its tributaries. This could cause flooding on the McKenzie possibly extending to the Thurston area on the east side of the Eugene-Springfield metro area (Figure 2-10).

Lahars can occur both during an eruption and when a volcano is quiet. The water creating a lahar can come from melting snow and ice (especially water from a glacier melted by a pyroclastic flow or surge), intense rainfall, or the breakout of a summit crater lake. Some lahars contain so much rock debris (60 to 90% by weight) they look like fast-moving rivers of wet concrete. Historically, lahars are one of the deadliest volcano hazards. Close to their source, these flows are powerful enough to rip up and carry trees, houses, and huge boulders miles downstream. Farther downstream, they can entomb everything in their path in mud. In Eugene-Springfield, lahar impact areas are expected to be similar to the FEMA- mapped floodplains of the McKenzie River.

Lahars running through the McKenzie River could also lead to temporary damming of the River or high turbidity in the water. These impacts could cause degradation of water quality and operational problems at water treatment plants. For the City of Eugene, which currently relies on the McKenzie River as its sole source of drinking water, the Eugene Water and Electric Board (EWEB) has developed procedures to manage high-turbidity incidents and is actively seeking to diversify its sources of drinking water, as described in Annex A. Minimal lahar impact is expected to the groundwater sources used by Springfield Utility Board (SUB) and Rainbow Water District along the McKenzie and Willamette Rivers.

Ash fall could extend to the Eugene-Springfield area from an eruption in the Three Sisters, as well as from other eruptions including Mount St. Helens. In all but the most extreme incidents, ash falls in the Eugene-Springfield Metro Area are likely to be very minor, with an inch or less of ash accumulation likely. There is the possibility heavy ash fall into streams and rivers upstream from public water supply intakes from a major eruption in the Cascades could affect public water supplies.

In Oregon, awareness of the potential for volcanic eruptions was greatly increased by the 1980 eruption of Mount St. Helens in Washington, which killed 57 people. During this eruption, a debris avalanche moved 3.3 billion cubic yards of material

14 miles down the North Fork Toutle River, and the lateral blast effects covered 230 square miles and devasted an area 19 miles from west to east of the crater. The ash cloud spread across the United States in three days and circled the Earth in 15 days. Major ash falls occurred as far away as central Montana, and ash fell visibly as far asway as the Great Plains. A lahar eroded material from the North Fork Toutle River, increasing in size as it travelled downstream destroying bridges and homes. It eventually flowed into the Cowlitz River about 50 miles downstream of the volcano.[64]

There are no known damages, due to volcanoes, for Eugene or Springfield in recorded history.

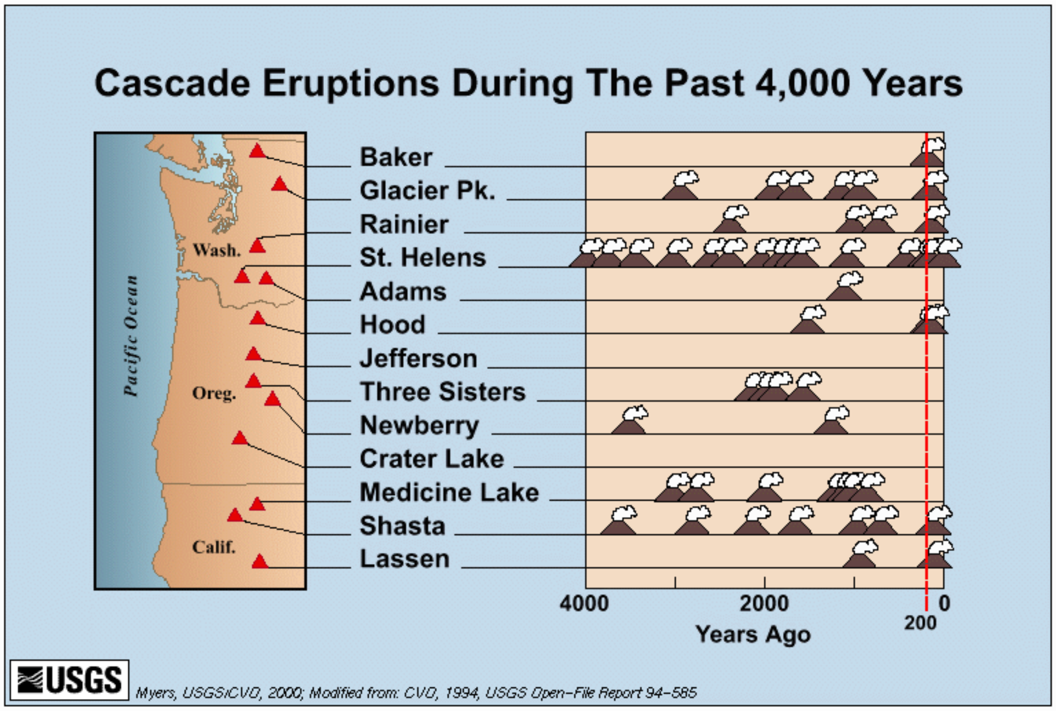

Figure 2-9. Source: W.E. Scott et al., 1997 - *http://vulcan.wr.usgs.gov/Volcanoes/Cascades/EruptiveHistory/cascades_eruptions_4000yrs.html*

[64] United State. USGS. *1980 Cataclysmic Eruption.* https://volcanoes.usgs.gov/volcanoes/st_helens/st_helens_geo_hist_99.html Accessed August 2019.

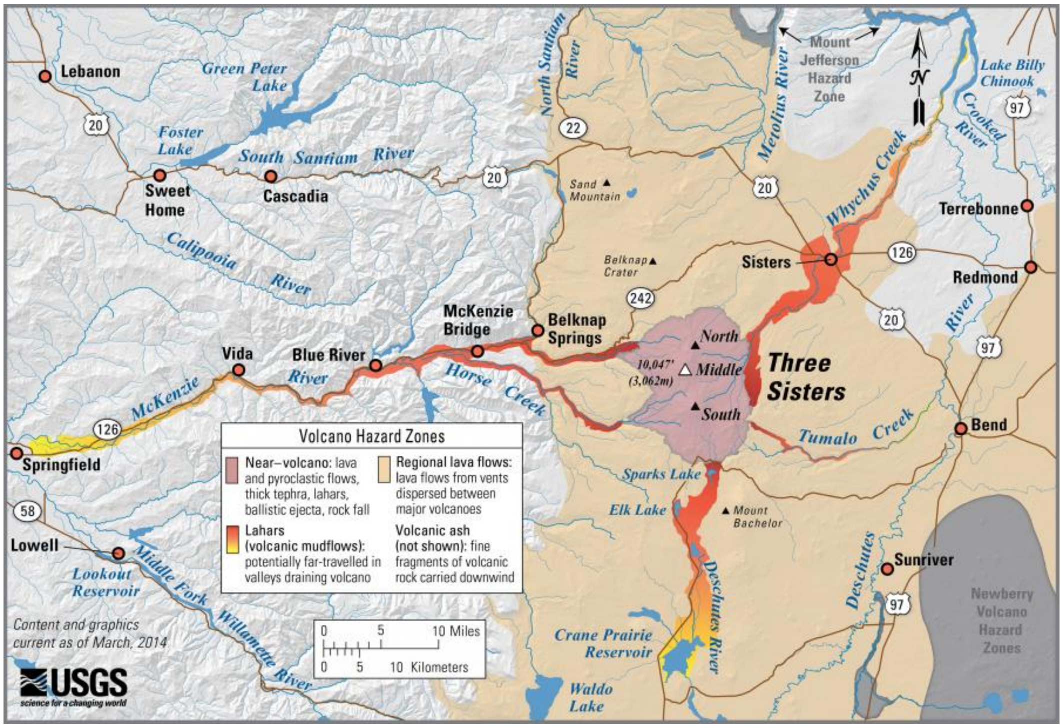

Figure 2-10. Source: USGS 2014 – Three Sisters, Oregon simplified hazards map showing potential impact area for ground-based hazards during a volcanic incident. https://volcanoes.usgs.gov/volcanoes/three_sisters/three_sisters_hazard_98.html

2.8.4 Impacts – Cascading Incidents

Civil Unrest

Civil unrest is not a significant impact of a volcanic incident for the Eugene or Springfield area.

Dam or Levee Failure

Dam failure is not a significant impact of a volcanic incident for the Eugene or Springfield area since all major dams or levees are outside of the predicted lahar flow. Additionally, there are no historical records of such an incident occurring.

Epidemics

The risk of communicable diseases after a volcanic incident is deemed moderate for person to person, water born, and food born modes of transmission. The data is largely collected from undeveloped countries in which volcanic incidents displaced large populations. Due to the limited implications of a volcanic incident for the Eugene-Springfield area the risk of epidemics arising from such an incident is also limited. The most significant threat would be if the McKenzie River's use as a drinking water source were no longer viable.

History of Impact in Eugene-Springfield

There have been no volcano induced epidemics in the Eugene-Springfield area.

Risk of Impact

Though worldwide risk of an epidemics arising after a volcanic eruption is moderate, the healthcare system and demographics of an area must be considered. Due to these facts the Eugene-Springfield area's risk is low.

Hazardous Materials

Volcano induced hazardous material spills or releases are not a significant impact for the Eugene or Springfield area.

2.8.5 Probability of Future Occurrence

The 2015 Oregon Natural Hazards Mitigation Plan indicates the annual probability of the South and Middle Sister entering a new period of eruptive activity is estimated from 1 in several thousand to 1 in 10,000. However, the ability to calculate the probability of a volcanic eruption is limited due to the fragmented nature of the geologic history for these volcanoes.

Uplift was discovered on South Sister in 2001 when geologists and volcanologists observed an area roughly 10 miles in diameter rise by roughly 4 inches at the center. The center of this area was approximately 3 miles from the summit of the South Sister volcano. Uplift continued at roughly 1 inch per year until 2004, when it decreased to one half inch per year. As of 2017, the rate of inflation decreased to 0.2 inches per year.[65] While this uplift is significant, it does not indicate an eruption is imminent.

Although the presence of active volcanoes in the Cascades threatens the area, Eugene and Springfield estimate the probability of a new volcanic occurrence as low. A low rating means one incident is likely within a 75 to 100-year period.

2.8.6 Vulnerability and Capacity Assessment

The Steering Committee rated the vulnerability to a volcanic incident as moderate, meaning 10% to 69% of the population and/or regional assets could be impacted by a volcanic incident. This moderate rating is due to the fact the repercussions of an eruption for Eugene would be limited to ash fall, and a decrease in water quality from the McKenzie River. Due to the expected slow onset, advanced warning, and

[65] USGS, Cascades Volcano Observatory. Long-Term Monitoring Tracks Subtle Surface Changes at some Cascade Range Volcanoes – Uplift at South Sister, December 05, 2017. https://volcanoes.usgs.gov/observatories/cvo/cvo_news_archive.html

available resources, Eugene-Springfield's capacity to respond to a volcanic incident is high.

2.8.7 Risk Assessment

Based on the vulnerability, probability, and capacity scores determined by the Steering Committee this hazard poses a low risk to the Cities. Volcanic eruptions can occur any time in the Eugene-Springfield area, but the average recurrence interval is about 1,500 years making this hazard rather rare compared to others within this plan. Despite the rarity, we know such incidents have affected the area and will affect it in the future.
A summary of Volcanic Impact Risks is in Table 2-11.

Table 2-11 Volcano - Impact Risks

Cascading Incident	Ranking
Civil Unrest	No Known
Dam or Levee Failure	No Known
Epidemic	Low
Hazardous Materials	No Known

2.8.8 Existing Hazard Mitigation Activities

There are no hazard specific mitigation activities for a volcanic eruption. Several existing multi-hazard mitigation items may also mitigate the effects of a volcanic incident.

2.9 Wildfire

The probability of wildfire is high in Eugene-Springfield while vulnerability is moderate in both cities.

2.9.1 Causes and Characteristics of Wildfires

Fire is an essential part of Oregon's ecosystem, but it is also a serious threat to life and property particularly where urban areas encroach upon forested, open range, or grassland areas. Wildfires occur when fire consumes large vegetated areas, in some cases requiring responder suppression.

In this region, changes in historic vegetation, climate, and fire occurrence are resulting in changes to the patterns and character of fire. In short, the risks and potential impacts of wildfire are increasing.

The Eugene-Springfield area is bordered by grassland, agricultural land, and forest. The wildfire hazard is primarily located in the south hills of both Eugene and Springfield where forested areas interface directly with homes, businesses, and infrastructure. Other areas, like northeast Springfield, have large areas with high vegetative fuel loads located close to developed and developing areas.

Relative Fire Hazard maps are in Section 3.

Areas in Eugene and Springfield are vulnerable to wildfire, depending on the following factors:

- Amount of vegetative fuel loads on the property, and the degree of continuity of fuel load (i.e. number of significant firebreaks). If properties are surrounded by large amounts of fuel without significant firebreaks, vulnerability to wildfire is greater. Risk may be particularly high if the fuel load is grass, brush, and smaller trees. These types of vegetation have low moisture levels in short-duration drought periods.
- Degree of slope. Steeper slopes can allow fire to spread more rapidly than on flatter terrain.
- Limitations in fire suppression capacity can increase vulnerability to wildfire incidents in Eugene and Springfield. Fire suppression capacity is affected by limited water supplies, personnel, apparatus, steep slopes, and long response times.
- Access for firefighting apparatus and resident evacuation. Limited access and egress increase vulnerability.
- Construction materials for infrastructure in the path of fire.
- Maintenance of firebreaks and defensible space around structures.

Oregon Wildfires

Large scale wildfires in Oregon include the Long Draw fire and the Miller Homestead fire. The Long Draw and Miller homestead fires of 2002 were started by lightning and dry thunderstorms. The Long Draw fire burned over 500,000 acres in southeast Oregon and was the worst fire the State had seen in 150 years.[66] The Bureau of Land Management owned most of the land. However, forty, mainly agricultural, property owners were affected.[67] The Miller Homestead fire alone caused over $(2012)8 million in damage.[68]

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[66] Blackwood, Jeff D. Long Draw/Miller Homestead Fire Review. April 2013. http://www.blm.gov/or/news/files/long-draw.pdf

[67] Oregon.gov. Governor Kitzhaber announces funds to help repair fences, re-seed land, and retail rural jobs in Southeastern Oregon. http://www.oregon.gov/gov/media_room/pages/press_releases/press_060613.aspx

[68] Bureau of Land Management. BLM Oregon Post-Fire Recovery Plan. August 23, 2012. http://www.blm.gov/or/districts/burns/plans/files/MilleESRPlan_1.pdf. http://www.denverpost.com/colorado/ci_23518579/officials-511-homes-burned-black-forest-fire

In July 2017, the Chetco Bar fire in southwest Oregon burned over 191,000 acres. The fire threatened the town of Brookings but was contained before mandatory evacuation of the city occurred. During August 2017 a series of fires collectively known as the Horse Creek Complex fire began east of Springfield in the Deschutes and Willamette National Forests, burning over 42,480 acres and causing several evacuation orders. Evacuation orders were also issued during the Eagle Creek fire in the Columbia Gorge beginning in September 2017. The fire burned over 50,000 acres and jumped the Columbia River into the State of Washington.

Fires in Other Parts of the West

The Black Forest fire occurred in Colorado in 2013. This fire damaged 595 homes; 498 of which were destroyed.[69] It cost nearly $(2013)8.5 million to contain the fire.[70] The Carlton Complex fire occurred in Washington in 2014, damaged over 300 homes, and cost the State over $(2014)23.3 million in damages, bringing the total damages from wildfires in Washington to over $(2014)50 million.[71]

Wildfires are not just a rural phenomenon. The impact on urban areas from wildfire can be significant. In 1990, Bend's Awbrey Hall fire destroyed 21 homes, caused $(1990)9 million in damage, and cost over $(1990)2 million to suppress. In 1991, the Oakland Hills firestorm in Oakland, California killed 25 people, injured 150 others, destroyed 3,791 dwelling units, and resulted in roughly $(1991)1.5 billion in economic losses. The 1996 Skeleton fire in Bend burned over 17,000 acres and damaged or destroyed 30 homes and structures. The Camp Fire in California in 2018 is the sixth-deadliest wildfire in the U.S., with at least 85 casualties and over 19,300 structures destroyed.[72]

For the purpose of this plan wildfire was categorized into the following three types:

- Interface fire occurs where wildland and developed areas come together at the wildland-urban interface with both vegetation and structural development combining to provide fuel.
- Wildland fires main fuel source is natural vegetation. Often referred to as forest or rangeland fires, they occur in national forests and parks, private timberland, and on rangeland. A wildland fire can become an interface fire if it encroaches on developed areas.

[69] 12 FEMA. Colorado Black Forest Wildfire. http://www.fema.gov/media-library-data/c25715894278ad44c82ddd9d0c7e3243/PDA_Report_FEMA-4134-DR-CO.pdf
[70] The Denver Post. Officials: 511 homes burned in Black Forest Fire. June 2013. http://www.denverpost.com/colorado/ci_23518579/officials-511-homes-burned-black-forest-fire
[71] The Oregonian. Washington Wildfire-Fighting Costs Soar past $50 Million for Season. July 27, 2014. http://www.oregonlive.com/pacific-northwest-news/index.ssf/2014/07/washington_wildfire-fighting_c.html
[72] United States. InciWeb Plumas National Forest. *Camp Fire Incident Overview.* https://inciweb.nwcg.gov/incident/6250/ June 2019. Accessed August 2019.

- Firestorms are incidents of such extreme intensity they create and sustains their own wind system.[73] Firestorms often occur during dry, windy weather and generally burn until conditions change, or the available fuel is consumed.

Ignition of a wildfire may occur naturally from lightning or from human causes such as debris burns, arson, careless smoking, recreational activities, and industrial accidents. Once started, four main conditions affect the fire's behavior: fuel, topography, weather, and urban development.

- Fire needs fuel. Fuel is classified by volume and type. As a western state, Oregon is prone to wildfires due to its prevalent conifer, brush, and rangeland fuel types.
- Topography influences the movement of air and directs a fire's course. Slope and hillsides are key factors in fire behavior. Unfortunately, hillsides with steep topographic characteristics are also desirable areas for residential development.
- Weather is the most variable factor affecting wildfire behavior. High-risk areas in Oregon share a hot, dry season in late summer and early fall with high temperatures and low humidity.
- The degree of urban development influences the amount of fuel available.

2.9.2 Climate Change

Global climate change is expected to increase the length and severity of summer drought along with an increase in summer high and low temperatures. By 2030, climate change is expected to result in:

- Average annual temperature increases of 2-4°F;
- Reduced precipitation in spring, summer and fall; and
- An increase in extreme heat incidents.

These changes will likely result in an increase in wildfire frequency and intensity as well as the probability of future wildfires in the Eugene-Springfield area.

2.9.3 History of the Hazard

While some small wildfires have been recorded by the Eugene and Springfield fire departments, there is no history of large wildfires in the immediate area.

[73] Science Daily. *Reference Terms.* https://www.sciencedaily.com/terms/firestorm.htm Accessed August 2019.

2.9.4 Impacts – Cascading Incidents

Civil Unrest

Civil unrest is not a known significant impact of wildfires.

Epidemics

Epidemics are not a known significant impact of wildfires.

Dam or Levee Failure

Dam or levee failures are not a known significant impact of wildfires.

Hazardous Materials

Hazardous material spills or releases are not a known significant impact of wildfires.

2.9.5 Probability of Future Occurrence

The Steering Committee identified the probability of a wildfire occurring in the Eugene-Springfield area as high given the high fuel load in nearby forested areas, hilly topography, and dry summers. A high probability means one incident is likely to occur within a 0 to 35-year period. As previously noted, climate change is expected to make wildfires more likely as well.

2.9.6 Vulnerability and Capacity Assessment

Given the amount of residential development in the south hills of Eugene, the Steering Committee rated the vulnerability to wildfire as moderate, meaning a wildfire may impact 10% to 69% of the population and/or regional assets.

The 2014 Climate and Hazard Vulnerability Assessment confirmed these ratings. Specifically, the assessment found, while wildfire incidents have the potential to cause severe loss and damage in localized areas, the wildfire hazard is not likely to result in systemic failures across multiple sectors or significant damage to critical systems.

Capacity to respond to and recover from a forest fire is moderate for both Eugene and Springfield. This is due to the amount of available resources as well as an established conflagration process within the State of Oregon instituted through the Office of the State Fire Marshal.

2.9.7 Risk Assessment

The 2008 update to the Lane County Community Wildfire Protection Plan's (CWPP) risk assessment identifies specific neighborhoods in Eugene and Springfield as areas at risk. The areas of concern include the south hills neighborhoods in Eugene, the southwest Eugene/Spencer Creek area, Thurston Hills in Springfield, and the Harbor Drive/South 2nd area in Springfield. Based on the vulnerability, probability, and capacity ratings determined by the Steering Committee, the Eugene-Springfield area's wildfire risk is high.

Table 2-12 shows the percentage of each community at risk-by-risk category.

For a summary of Impact Risks see Table 2-13.

Table 2-12 CWPP Communities at Risk Summary for Eugene-Springfield

Community at Risk	Total Acreage	Percentage of Community at Risk		
		High	Medium	Low
Eugene	37,747	2.1	17.7	80.2
Springfield	9,445	3.9	15.8	80.2

Table 2-13 Wildfire - Impact Risks

Cascading Incident	Ranking
Civil Unrest	No Known
Dam or Levee Failure	No Known
Epidemic	No Known
Hazardous Materials	No Known

2.9.8 Existing Mitigation Activities

In 2010, the Springfield and Eugene Fire Departments began operating under an intergovernmental agreement to share the services of key administrative positions in both departments. In 2014, the two departments functionally merged into one department. This merger has facilitated better sharing and utilization of resources and improved communication. For example, Eugene Springfield Fire offers educational campaigns to inform residents about actions they can take to reduce wildfire hazards on their property. In addition, Eugene Springfield Fire completed an Urban Interface Fire Plan in 2016 addressing specific wildfire hazards for the metro area.

The City of Eugene's Parks and Open Space Division of the Department of Public Works conducts wildfire hazard mitigation activities yearly. Objectives of this work are to:

1. Implement landscape-scale fuels reduction treatments to reduce the risk of damaging wildfires in the Wildland Urban Interface of the South Hills of Eugene and the West Eugene Wetlands to create a more fire resilient landscape;
2. Provide the framework for reducing the risks and consequences of wildland fire to the community. Promote public awareness of wildfire hazard, engage participation, and enhance partnerships through education, outreach, and coordination of diverse and representative groups of the City of Eugene's population; and
3. Implement and maintain greater coordination among local, State, and Federal land management agencies and private landowners to effectively prioritize hazardous fuels treatments.

Efforts include, but are not limited to:

Picture 2-5. Before (left) and after (right) thinning at Wild Iris Ridge park, showing decrease in stem density following thinning.

- July 30, 2015 – July 29, 2016: Thinned 18 acres at Wild Iris Ridge Park, a City-owned property located adjacent to residential developments and rural residential houses (Picture 2-5). Designed, produced, and placed large-format kiosk posters at 11 trailheads. Delivered 9,983 educational mailers targeting residences and businesses close to project areas deemed at high risk from wildland-urban interface fires. Distributed over 2,000 pocket-sized 'trading cards' with project information and web addresses where interested parties can obtain more information concerning local wildfire mitigation efforts. Along with the Eugene-Springfield Fire Department, produced a 30 second PSA which ran 140 times on five different radio stations. Conducted three in-person outreach events reaching more than 175 people.
- July 30, 2016 – July 29, 2017: Thinned 23 acres at the City's Suzanne Arlie Park to protect critical infrastructure crossing the property. Placed large-format posters at 8 trailhead kiosks. Designed and built two new kiosks (Picture 2-6). Installed one of the two new kiosks with the other one installed during the July 30, 2017 thru July 29, 2018 reporting period. Distributed 1,505 pocket-sized 'trading cards' with project information and

web addresses where interested parties can obtain more information concerning local wildfire mitigation efforts. Mailed 379 letters to residents and businesses surrounding Skinner Butte Park as well as hosted an evening public tour of the project.

Picture 2-6. New kiosk at Wild Iris Ridge Park and first kiosk the western portion of the Ridgeline Park System, reaching a new area of the community with outreach information.

- July 30, 2017 – July 29, 2018: Thinned 6 acres by hand at Skinner Butte (Picture 2-7) and thinned 29 acres at Arlie Park. Placed "Team Up for Fire Safety" posters at 7 trailhead kiosks. Placed large-format poster at Skinner Butte's kiosk which receives 50-100 visitors per day during the summer. Installed one new kiosk built during the July 30, 2016 thru July 29, 2017 reporting period. Conducted a "Cascadia Prairie-Oak Cooperative Field Tour" for 25 ecologists, restoration practitioners, and land managers from regional government agencies and non-profit organizations. This daylong event covered mutual goals of habitat improvement and fuels reduction in oak and prairie habitats of western Oregon, the use of prescribed fire to prevent establishment of new woody vegetation, and forestry techniques used for thinning shrubs and trees. From an outreach perspective, the Skinner Butte project was highly visible and offered the opportunity to spread wildfire risk and awareness information to a new segment of the community – a more urban population comprised of residences, businesses, and incidental site users from across the City.

Picture 2-7. Before (left) and after (right) thinning at Skinner Butte, showing removal of dense, invasive shrubs. Note trail marker post in both photos.

2.10 Windstorm

The probability of a windstorm in the Eugene-Springfield area is high while vulnerability to a windstorm is moderate. Windstorms are storms with damaging "straight-line" winds. The term "straight-line" is used to differentiate from wind damage caused by tornadoes.

2.10.1 Causes and Characteristics of the Hazard

Windstorms are relatively common for the Eugene-Springfield area. These storms occur any time of the year but are more typical during winter months. Destructive winds are generally from the southwest and associated with cyclone storms which move in from the Pacific Ocean. Winds from the west are generally slowed by the Coast Mountain Range before reaching the Willamette valley.

Windstorm damage generally consists of fallen trees and power outages. Damage may be much worse if the ground is heavily saturated with water increasing the likelihood of trees falling. Typically, these storms have sustained winds more than 50 mph.[74]

2.10.2 Climate Change

It is unknown how climate change may affect the severity or frequency of windstorms in the Eugene-Springfield area.

2.10.3 History of the Hazard in Eugene-Springfield

Oregon's most destructive windstorm was the Columbus Day Storm in October 1962. Wind speeds of 116 mph were recorded in the Willamette Valley. Eighty-four

[74] United States. NOAA The National Severs Storms Laboratory. *Severe Weather 101-Damaging Winds.* https://www.nssl.noaa.gov/education/svrwx101/wind/. Accessed August 2019.

homes were destroyed and five thousand were severely damaged. Estimates put the damage at approximately $(1962)230 million to $280 million for California, Oregon and Washington combined. Those figures in translate to $1.8 Billion to $2.2 Billion in 2014 Dollars. Oregon's share exceeded $(1962) 200 million.[75] Other notable incidents are identified in table 2-14.

Table 2-14 Significant Eugene-Springfield Windstorms Since 1990

Date	Location	Comments
January 7-8, 1990	Statewide	Peak gusts up to 58 mph in Eugene
December 1995	Statewide	Peak gusts up to 49 mph in Eugene and up to 62 mph in the Willamette Valley in general. Saturated soils compounded damage. (FEMA-1107-DR-Oregon)
February 7, 2002	Lane County	Peak gusts up to 70 mph in Eugene. Damages of public properties were greater than $(2002)6 million. (FEMA-1405-DR-Oregon)
February 3-4, 2006	Western Oregon	Peak gusts of 46 mph in Eugene. 3500 without power in Lane County and $(2006)300,000 in damages.
May, 2006	Lane County	$(2006)5,000 in property damage in Eugene, and Approximately 13,000 without power.
March 13, 2011	Lane County	Peak gusts of 60 mph in Eugene. 25,000 residence without power in Lane County. Trees toppled and buildings damaged.
December 10, 2015	Lane County	Peak gusts of 47 mph in Eugene and Creswell due to a thunderstorm. Widespread electrical outages and $(2015)260,000 in damages.
January 16, 2016	Lane County	Peak gusts of 63 mph winds from a thunderstorm. Several down trees, damaged roofs, electrical outages, and $(2016)15,000 in damages reported.

Significant windstorm incidents. Compiled from FEMA Disasters. https://www.fema.gov/disasters

[75] https://en.wikipedia.org/wiki/Columbus_Day_Storm_of_1962. Accessed August 7, 2019.

2.10.4 Impacts – Cascading Incidents

Civil Unrest

In the Eugene-Springfield area, civil unrest is not a known impact of windstorms.

Dam or Levee Failure

Dam or levee failure is not a known impact of windstorms.

Epidemics

Epidemics are not a known impact of windstorms.

Hazardous Materials

Hazardous Material spills or releases may occur when debris impacts holding tanks, pipelines, or equipment vital to operating a facility.

History of Impact in Eugene-Springfield

There have been no known HazMat spills or releases due to a windstorm in the Eugene-Springfield area.

Risk of Impact

Based on historical incidents the risk from this impact is low.

2.10.5 Probability of Future Occurrence

Windstorms have a three-year recurrence interval in Lane County. These storms cause limited damage.[76] A 25-year recurrence windstorm has average wind speeds of 47 to 61 mph. A 50-year incident has wind speeds between 62-75 mph, and a 100-year incident, for the Willamette Valley, is considered a storm with average speeds over 75 mph. As indicated by the Beaufort Scale, storms with average wind speeds in excess of 47 mph can cause significant damage (Figure 2-11).

[76] NOAA. Storm Interval Calculation based on the significant windstorm record (Table 2-14).

Beaufort	1-min Wind speed	Effects on land
0 Calm	0 - 1 mph	Calm. Smoke rises vertically.
1 Light air	1 - 3 mph	Smoke drift indicates wind direction and wind vanes cease moving.
2 Light breeze	3 - 7 mph	Wind felt on exposed skin. Leaves rustle and wind vanes begin to move.
3 Gentle breeze	7 - 12 mph	Leaves and small twigs constantly moving, light flags extended.
4 Moderate breeze	12 - 17 mph	Dust and loose paper raised. Small branches begin to move.
5 Fresh breeze	17 - 24 mph	Branches of a moderate size move. Small trees in leaf begin to sway.
6 Strong breeze	24 - 30 mph	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic bins tip over.
7 Near gale	30 - 38 mph	Whole trees in motion. Effort needed to walk against the wind.
8 Gale	38 - 46 mph	Some twigs broken from trees. Cars veer on road. Progress on foot is seriously impeded.
9 Severe gale	46 - 54 mph	Some branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over.
10 Storm	54 - 63 mph	Trees are broken off or uprooted, saplings bent and deformed. Poorly attached asphalt shingles and shingles in poor condition peel off roofs.
11 Violent storm	63 - 73 mph	Widespread damage to vegetation. Many roofing surfaces are damaged; asphalt tiles that have curled up and/or fractured due to age may break away completely.
12 Hurricane	73 - 99 mph	Very widespread damage to vegetation. Some windows may break; mobile homes and poorly constructed sheds and barns are damaged. Debris may be hurled about.

Figure 2-11 Source*:* Ben Lee-Rodgers, 2017- *Beaufort Scale*
http://nw3weather.co.uk/BeaufortScale.php

2.10.6 Vulnerability and Capacity Assessment

Property damage concerns are significant with windstorms. These incidents could affect almost every Eugene-Springfield resident which classifies the Cities' vulnerability to this hazard as moderate. The area's capacity to respond to, and recover from, a windstorm is also moderate. This is largely due to the frequency in which these storms occur as well as the resources available to respond to them.

2.10.7 Risk Assessment

Based on the probability of future windstorms, the area's vulnerability, and capacity to deal with them, the Eugene-Springfield NHMP Steering Committee determined the overall risk from this hazard is high.

For a summary of windstorm impact risks see table 2-15.

Table 2-15 Windstorm- Impact Risks	
Cascading Incidents	**Ranking**
Civil Unrest	No Known
Dam or Levee Failure	No Known
Epidemic	No Known
Hazardous Materials	Low

2.10.8 Existing Mitigation Activities

The Cities of Eugene and Springfield along with EWEB and SUB routinely trim trees to prevent power outages due to falling limbs and trees. Additionally, funding is being actively pursued to equip all Eugene fire stations with backup generators.

2.11 Winter Storm

The probability of, and vulnerability to, winter storms in Eugene and Springfield is high. In previous Eugene-Springfield NHMPs extreme weather, windstorms, and heavy rain were included under winter storms. This update addresses extreme weather, windstorms, and the repercussions of heavy rain (flooding and landslides) with dedicated assessments within Section 2. Winter storms are storms where below freezing temperatures and precipitation combine to produce adverse conditions. These storms could include snow, ice, extreme cold, and/or frost heave.

2.11.1 Causes and Characteristics of the Hazard

Extreme Cold

Extreme cold periods vary in severity based on temperature and duration. Long durations and/or extreme lows increase the severity of a cold wave incident. Extreme cold incidents can be life-threatening for those exposed to the elements. These conditions can worsen when mixed with wind creating dangerous “wind chill” (Figure 2-12).

Frost Heave

Frost heave occurs when soil swells upwards due to ice forming within the ground. Generally, its effects are mild in the Eugene-Springfield area. When subzero temperatures occur, and the ground is saturated with water, more damaging frost heave incidents can occur. Primary damage from frost heave is seen when structures such as utility poles and storage tanks tilt or topple due to destabilization of the supporting ground.

Snow and Ice

The most likely effects of snow and ice incidents are road closures limiting access to and from the Eugene-Springfield area. Closures especially affect roads to higher elevations, such as the highways into the Cascades or Coast Range. Winter storms with wet heavy snow and ice storms may also result in significant power outages from downed transmission lines and/or poles.

Wind Chill Chart

Wind (mph)	Temperature (°F)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T = Air Temperature (°F) V = Wind Speed (mph)

Effective 11/01/01

Figure 2-12. Source: National Weather Service – *Wind Chill Chart*

2.11.2 Climate Change

As previously discussed in section 2.2.2 (Drought: Climate Change), average annual temperatures along with high and low temperatures are expected to rise in the coming decades. In addition, the total precipitation is predicted to decrease. These conditions will produce fewer winter storms for the Eugene-Springfield area, although there may be an increase in severe winter storms due to the fluctuating climatic conditions as discussed in section 2.5.2 (Flood: Climate Change).

2.11.3 History of the Hazard in Eugene-Springfield

For the Eugene-Springfield area, most winters result in little snowfall. Major snow falls of 10 inches or more typically occur every 10 to 20 years. Significant winter storms have a reoccurrence rate of 2.9 years.[77]

[77] United States. Eugene, Oregon. NOAA. *Eugene Ice Storm Benefit Cost Analysis 2016.*

Major winter storms affecting the Willamette Valley occurred in 1884, 1892, 1909, 1916, 1919, 1937, 1950, 1969, 1989, 2002, 2004, 2008, 2010, 2012, 2013, 2014, 2016, and 2019. January 1950 snowfalls were especially high, with 54" in Albany and 36" in Eugene. In January 1969, Eugene received 47" of snow. In December 2008, January 2012, February 2014, December 2016, and February 2019 significant snow and ice disrupted electrical service and transportation systems throughout the Willamette Valley. All five (Table 2-16) of these storms resulted in Federal Disaster Declarations for Lane County.

Average annual snowfall gauged by the Eugene Airport weather station is 6.4". Since the weather station was established in 1939, the maximum monthly snowfall has been 47.1" (January 1969), with the maximum seasonal snowfall also at 47.1" (1969).

Significant winter storm incidents affecting the area since 1990 are listed in Table 2-16.

Table 2-16 Significant Eugene-Springfield Winter Storm Incidents Since 1990

Date	Location	Comments
February 11-16, 1990	Statewide	Heavy Snow: Average of 8 inches across the Willamette Valley
December 16-17, 1992	Western Oregon	Heavy Snow
February 18-19, 1993	Northwestern Oregon	Heavy Snow: 6 to 12 inches fell in the Willamette Valley
Winter 1998-1999	Statewide	Series of Snowstorms: One of the snowiest winters in Oregon history
March 12, 2002		Snow
December 2003- January 2004		Snow
NOTE: the following incidents were compiled from the list of Eugene Public Works Emergency Command Center activations between 2009 and 2014 and crossed referenced with State and County NHMPs as well as news outlets to ensure accuracy		
December 2008- January 2009	Southern Willamette Valley	Heavy Snow/Ice Incident.
November 23-24, 2010	Cascades and Foothills in Lane County	Heavy Snow
December 27-29, 2010	Cascades and Foothills in Lane County	Ice Incident: Road icing
March 13, 2011		Rain storm: Downed trees
January 17 to 21, 2012		Snow and Ice incident. 2,000 power outages. **Federal Disaster Declaration (DR-4055)**

Table 2-16 Significant Eugene-Springfield Winter Storm Incidents Since 1990

Date	Location	Comments
March 21-24, 2012	Southern Willamette Valley	Heavy Snow: Eugene received eight inches in eight hours. Reports of trees down, power lines down, local roads closed. $(2012)317,612 in damages to the City of Eugene and several power outages.
January 10, 2013	Lane County	De-icing incident: Freezing Temps
December 4-13, 2013	Central & Southern Willamette Valley	Heavy Snow & Extreme Cold: 8-9 inches of snow recorded in Creswell. De-iced
February 6-24, 2014	Northwest Oregon	Heavy Snow & Freezing Rain: Reports of up to 0.75 inches of ice in Eugene. $(2014)1.7 million in damages to the City of Eugene and roughly 10,000 power outages lasting up to six days. **Federal Disaster Declaration (DR-4169)**
December 15-22, 2016	Lane County	Ice Storm. $(2016)1.6 million in damages to the City of Eugene and roughly 20,000 power outages lasted several days. **Federal Disaster Declaration (DR-4269)**
February 25 – March 1, 2019	Lane County	Heavy Snow: 9 inches in and around the Eugene area with 12 inches reported in the South Hills of Eugene. **Federal Disaster Declaration (DR-4432)**

2.11.4 Impacts – Cascading Incidents

Civil Unrest

Civil unrest is not a known significant impact of winter storms.

Dam or Levee Failure

Winter storms can cause dam or levee failures when ice and snow compound flooding incidents, clog drainage, or disrupt power to control or operating systems. Such incidents cause failures due to overtopping or erosion.

History of Impact in Eugene-Springfield

Dam or levee failure has not been an impact from a winter storm in the Eugene or Springfield area.

Historically, two dams have failed during winter storms in the United States. In 1890 heavy snow, flooding, and poor design contributed to the failure of the Walnut Grove Dam (AZ) killing 100 people. The Meadow Pond Dam (NH) failed in 1996 due to heavy icing, compounded by poor design and construction, killing one person.

Risk of Impact

Based on historical occurrences, and the condition of the dams and levees in and around Eugene and Springfield, the risk of this impact occurring is low (Appendix H).

Epidemics

Epidemics are not a known significant impact of winter storms.

Hazardous Materials

There is a moderate risk of winter storms causing hazardous material spills or releases. Adverse winter driving conditions make transportation of hazardous materials via trains or roads dangerous. Freezing temperatures and frost heave may severely damage tanks and piping, as well.

History of Impact in Eugene-Springfield

There have been no significant HazMat incidents in the Eugene or Springfield area due to winter weather. Nationally, winter weather related-natech incidents have resulted in over $6 million in damages and account for roughly 25,000,000 barrels spilt by the US oil and gas industry.[78] These incidents tend to be small in scope (less than 500 barrels), and companies take protective measures to preempt them, but they are a possibility.

Risk of Impact

Based on the frequency and volume of previous HazMat incidents induced by winter storms, this impact poses a moderate risk to the Eugene-Springfield area.

2.11.5 Probability of Future Occurrence

The Oregon NHMP Hazard Profile for the region indicates the probability of winter storms in the area is high. Significant winter storms have a recurrence rate of 2.9[79] years while major snowstorms reoccur every 10 to 20 years. This means, on average, two or more severe winter storms occur each decade.

[78] Italy. Girgin, Serkan, Elisabeth Krausmann. European Commission Joint Research Centre. *Lessons learned from oil pipeline natech accidents and recommendations for natech scenario development.*2015. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/lessons-learned-oil-pipeline-natech-accidents-and-recommendations-natech-scenario
[79] Wilde, Tyree, NOAA, 2017. DR-4269 Benefit Cost Analysis for City of Eugene.

Eugene-Springfield rates the probability for local winter storms as high, which indicates at least one incident is likely within a 0 to 35-year period.

2.11.6 Vulnerability Assessment and Capacity

Findings from the 2014 Climate and Hazards Vulnerability Assessment confirmed severe winter storms in Eugene-Springfield have the potential to cause region-wide cascading system failures. Specifically, severe winter storms disrupt electricity and transpiration sectors, two of the three sectors all others depend upon. This is especially true if the snow and ice accumulations are significant and the storm lasts more than a couple of days.

The Steering Committee rates winter storm vulnerability as high, indicating a winter storm would impact more than 70% of the region's population. With the electric and transportations sectors particularly vulnerable to winter storms, almost every citizen in Eugene and Springfield is impacted.

The Eugene-Springfield area's capacity to deal with such incidents is moderate. Historically, it takes a very significant winter storm to drain the area's resources.

2.11.7 Risk Assessment

Based on the probability of future occurrences, vulnerability, and capacity to respond to, and recover from, winter storms, the Eugene and Springfield's risk to this hazard is categorized as being high. One factor limiting the area's capacity to respond to these incidents is the large number of the storms. Historically, these incidents tend to involve multiple counties and, at times, the entire State, if not multiple states, which limits mutual aid resources.

For a summary of winter weather impact risks see table 2-17.

Table 2-17 Winter Storm- Impact Ricks

Cascading Incident	Rating
Civil Unrest	No Known
Dam or Levee Failure	Low
Epidemic	No Known
Hazardous Materials	Moderate

2.11.8 Existing Hazard Mitigation Activities

Eugene and Springfield are participating in winter storm mitigation activities.

- Development Codes: Both jurisdictions require utilities in all new subdivision developments to be installed underground. This assists in the prevention of damaged power and communication lines during an incident.
- Tree-Trimming: The Eugene Water & Electric Board and the Springfield Utility Board engage in tree-trimming around power lines.
- Building Codes: Eugene and Springfield Building Codes adhere to the Oregon Structural Specialty Code guidelines for new development.
- In 2017, after DR-4269, Eugene and Springfield each purchased another storage tank for deicer fluid.

2.12 Conclusions

The results of the natural hazards identified by the Project Team are compiled below in Risk Assessment Matrix for the City of Eugene and the City of Springfield. Table 2-18 was used in the development of table 2-19.

In both tables the following applies to the rating levels:

- High = 3
- Moderate = 2
- Low = 1
- No Known = 0

Table 2-19 uses the following formula to calculate Risk Total

- (Vulnerability x Probability)/Capacity = Risk Total

Risk Total is rated using the following index:

- <1.5 = Low
- 1.5-2.9 = Moderate
- 3-4.5 = High
- >4.5 = Very High

Table 2-18 Summary of Cascading Incidents- By Hazard					
Hazard	**Civil Unrest**	**Dam/Levee Failure**	**Epidemic**	**Hazardous Materials**	**Cascading Incident Rating**
Geomagnetic Disturbance (GMD)	High	Moderate	Moderate	Moderate	9
Earthquake	Moderate	Low	Moderate	High	8
Flood	Low	Low	Moderate	Moderate	6
Landslide	No Known	Low	Low	Low	3
Winter Storm	No Known	Low	No Known	Moderate	3
Extreme Weather	Low	No Known	No Known	Low	2
Volcano	No Known	No Known	Low	No Known	1
Windstorm	No Known	No Known	No Known	Low	1
Drought	No Known	No Known	No Known	No Known	0
Wildfire	No Known	No Known	No Known	No Known	0
Cascading Incident Rating	7	6	8	12	

Table 2-19 Risk Assessment Matrix

Hazard	Vulnerability	Probability	Capacity	Risk Total	Risk Rating
Geomagnetic Disturbance (GMD)	3	3	1	9	Very High
Earthquake	3	2	1	6	Very High
Winter storm	3	3	2	4.5	High
Drought	3	3	3	3	High
Wildfire	2	3	2	3	High
Windstorm	2	3	2	3	High
Flood Riverine	2	2	2	2	Moderate
Landslide	1	3	2	1.5	Moderate
Flood Stormwater	1	3	3	1	Low
Extreme Weather	1	2	3	0.7	Low
Volcano	2	1	3	0.7	Low

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3 Maps

3.1 Eugene-Springfield Hazard Maps

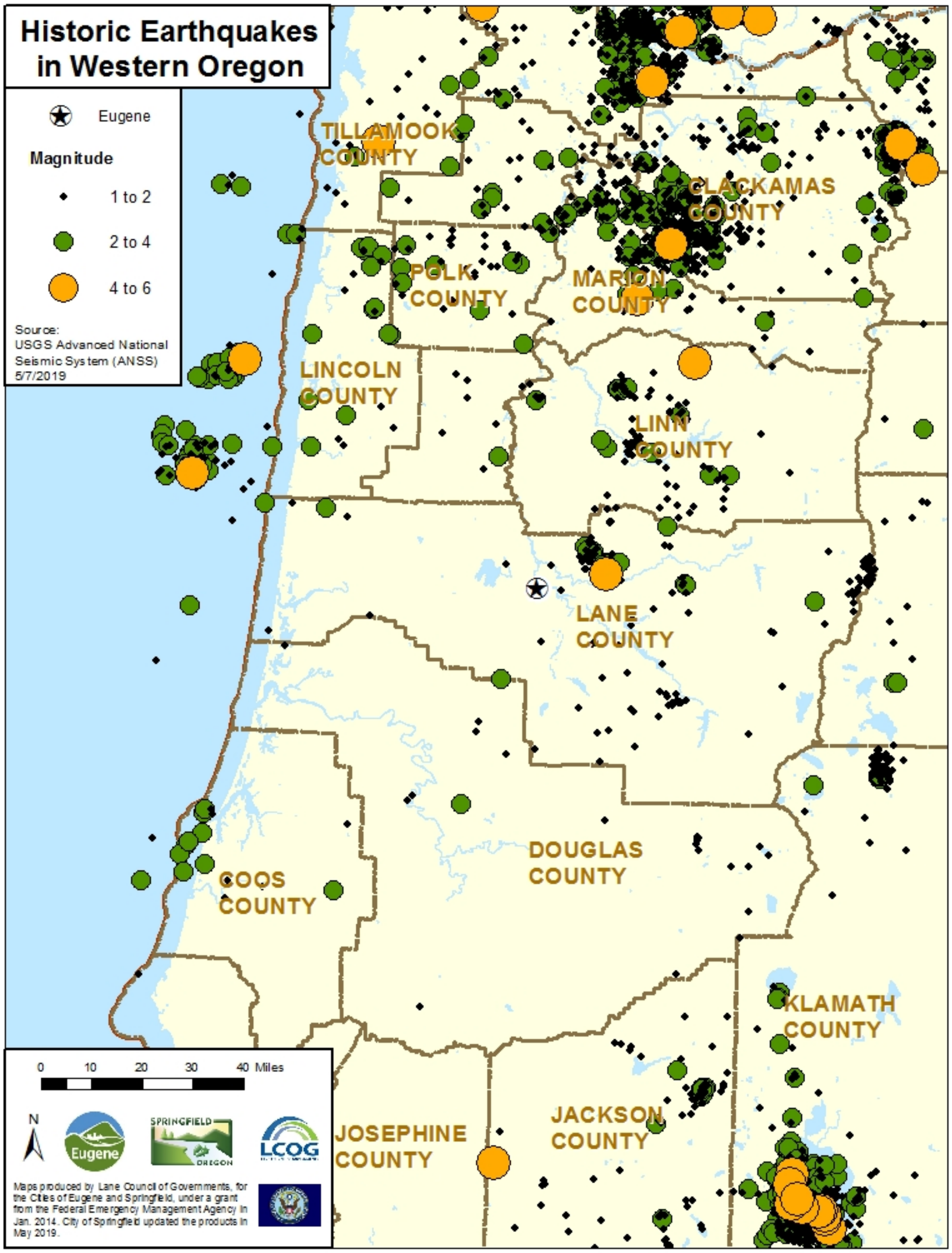
The maps in this section describe the location and intensity of individual hazards including earthquake, flood, urban wildfire, and landslide. The maps were originally prepared by Lane Council of Governments using federal funds and were updated for this Plan by the City of Springfield.

A description of the map and source data is contained within each map.
A complete description of the history, probability, and risk of each hazard is discussed within Section 2, Hazard Descriptions.

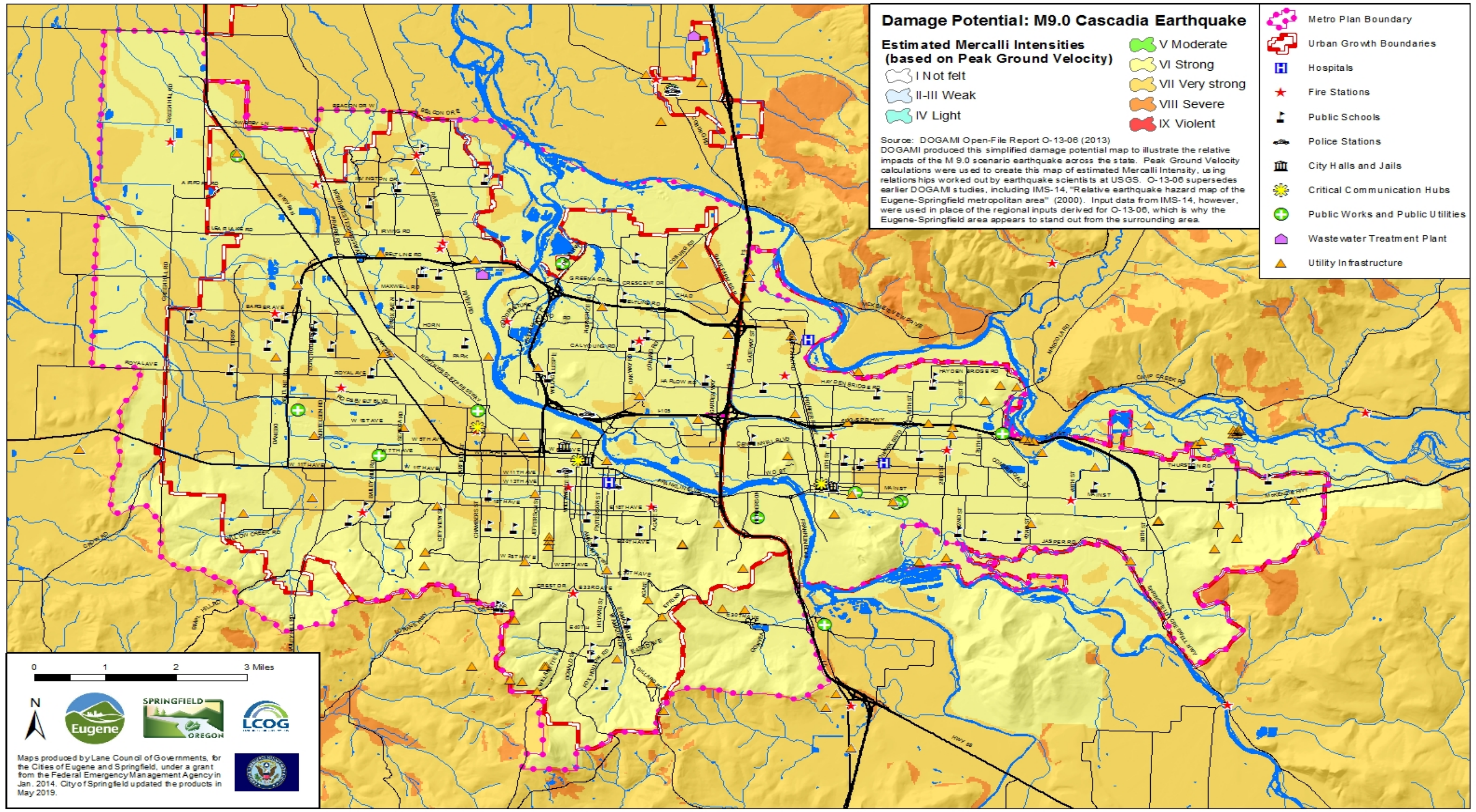
The following maps are included:

- Historic Earthquakes in Western Oregon
- Earthquake Damage Potential
- Relative Fire Hazard
- Flood Hazard Areas
- Chronic Urban Flooding
- Landslide Inventory
- Shallow Landslide Susceptibility
- Deep Landslide Susceptibility
- Liquefaction Susceptibility
- Metro Land Use Zones
- Metro Transportation System

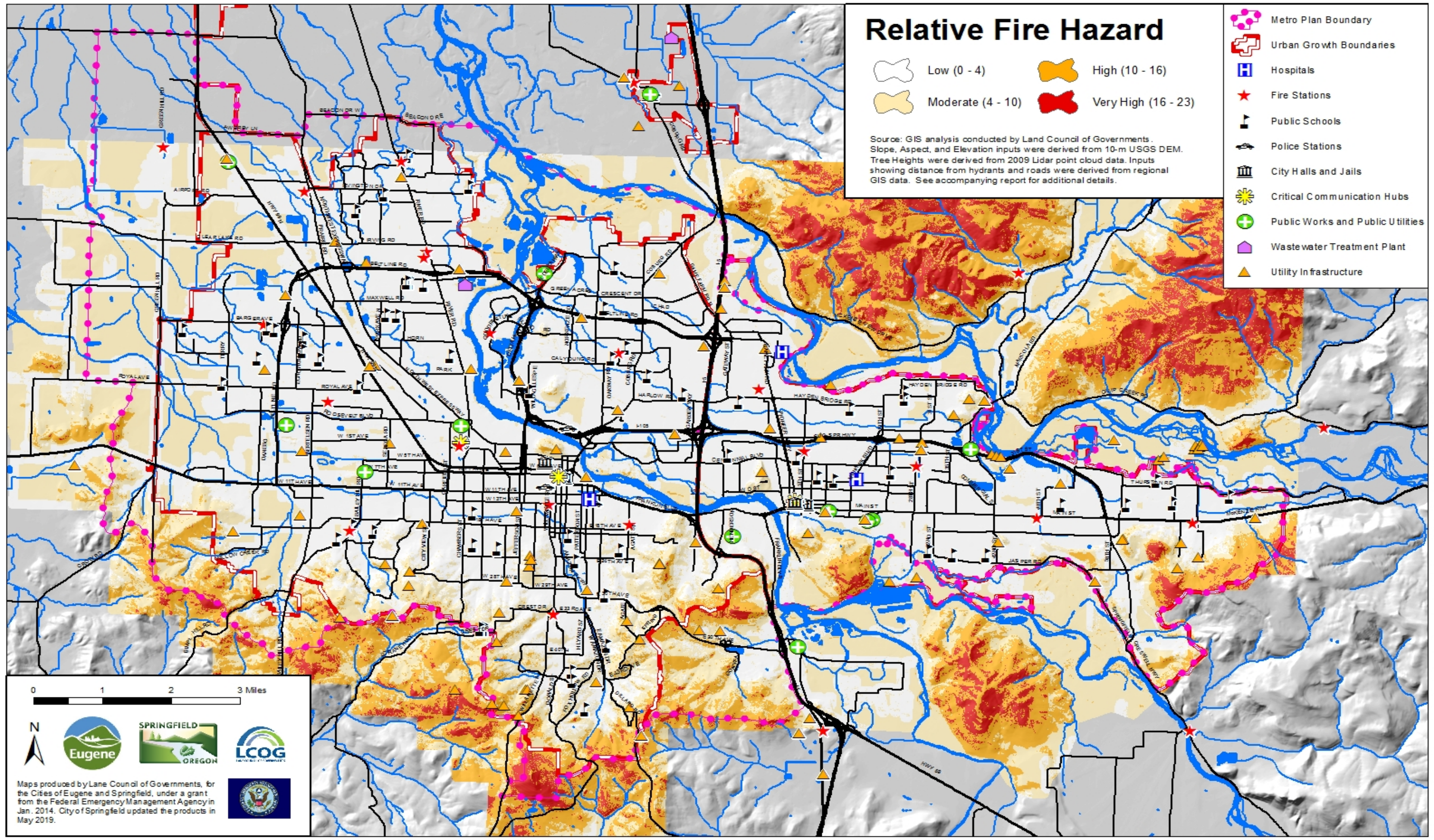
3.1.1 Historic Earthquakes in Western Oregon



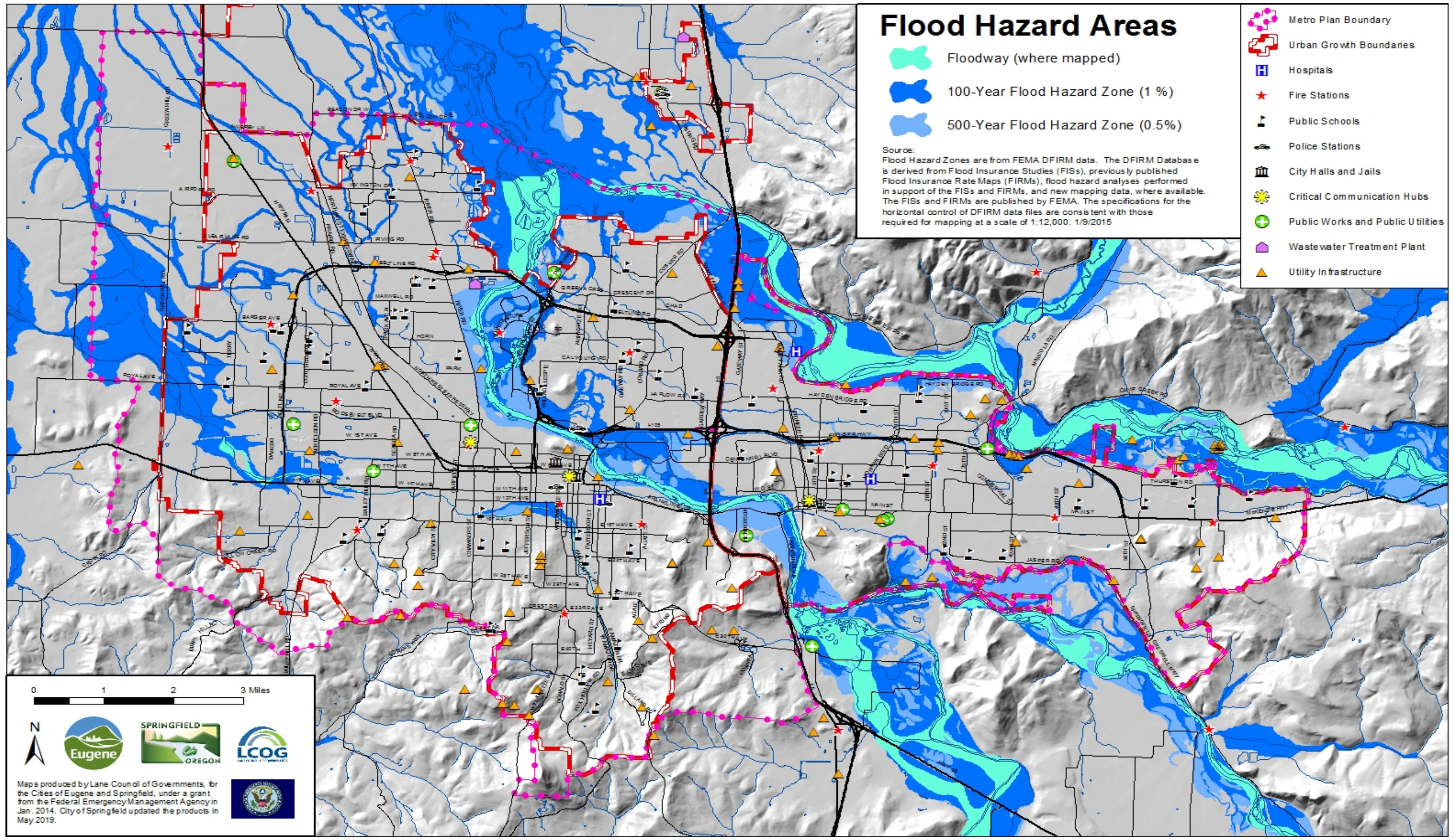
3.1.2 Earthquake Damage Potential



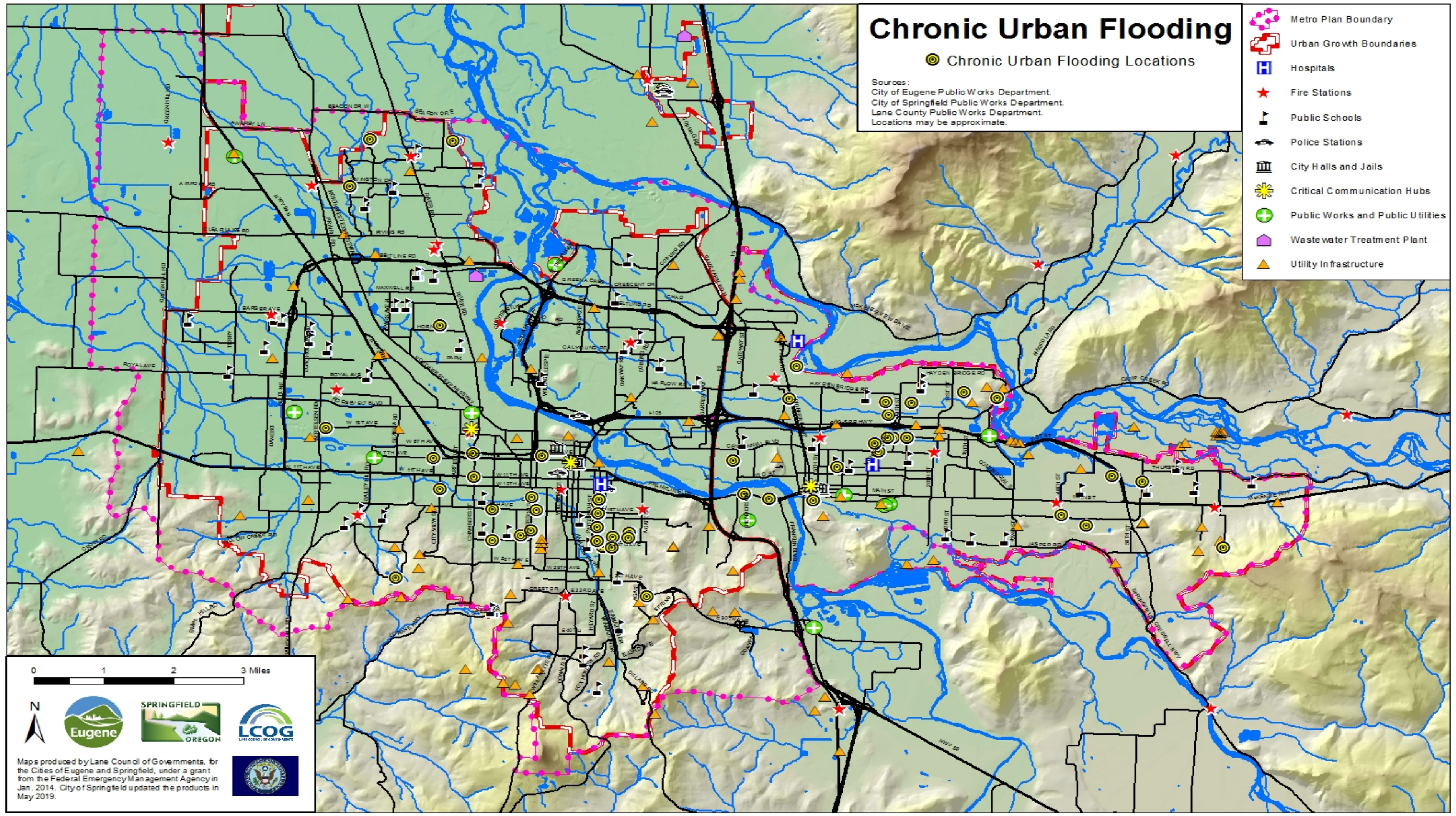
3.1.3 Relative Fire Hazard



3.1.4 Flood Hazard Areas

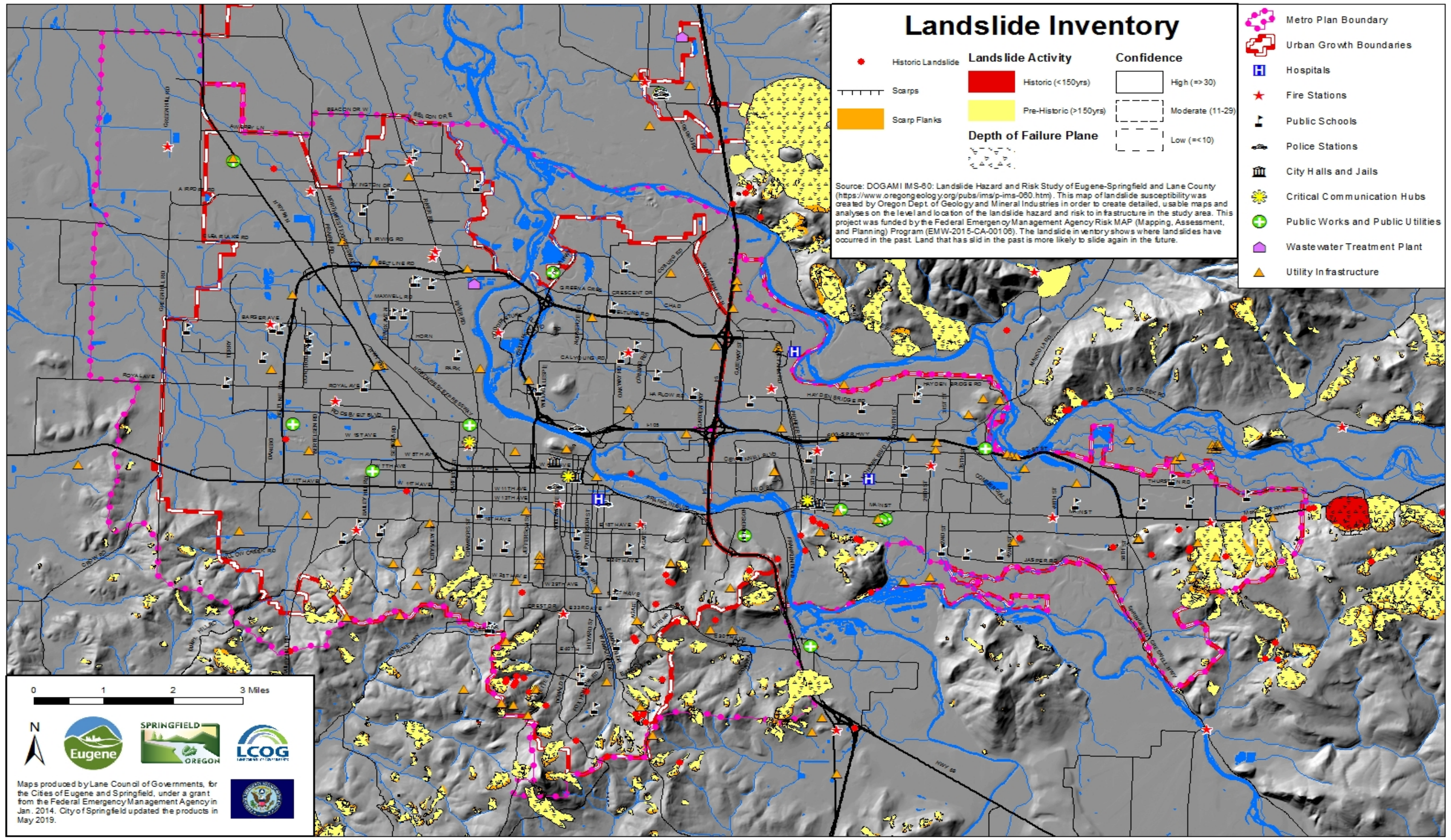


3.1.5 Chronic Urban Flooding

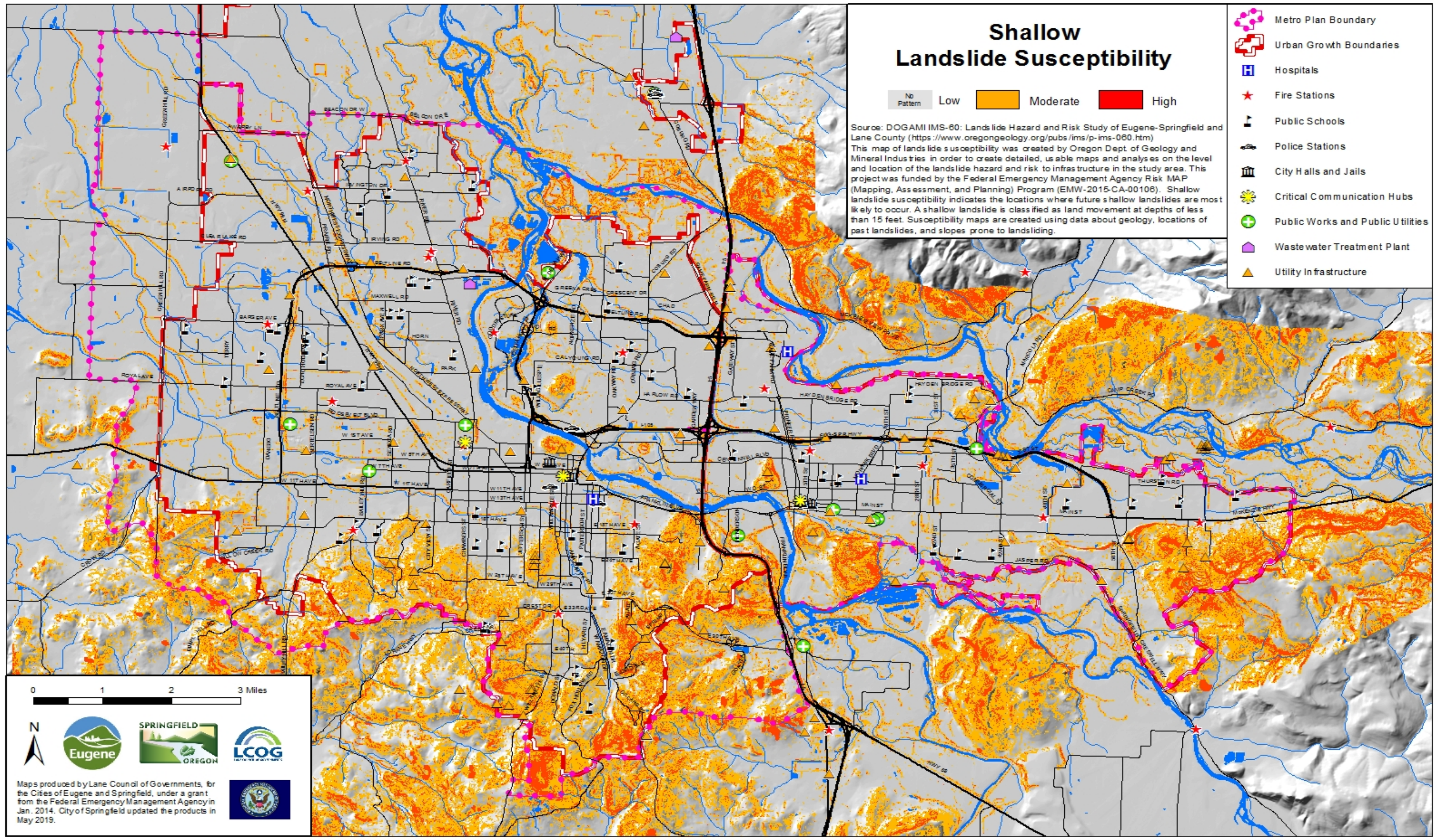


3. Maps

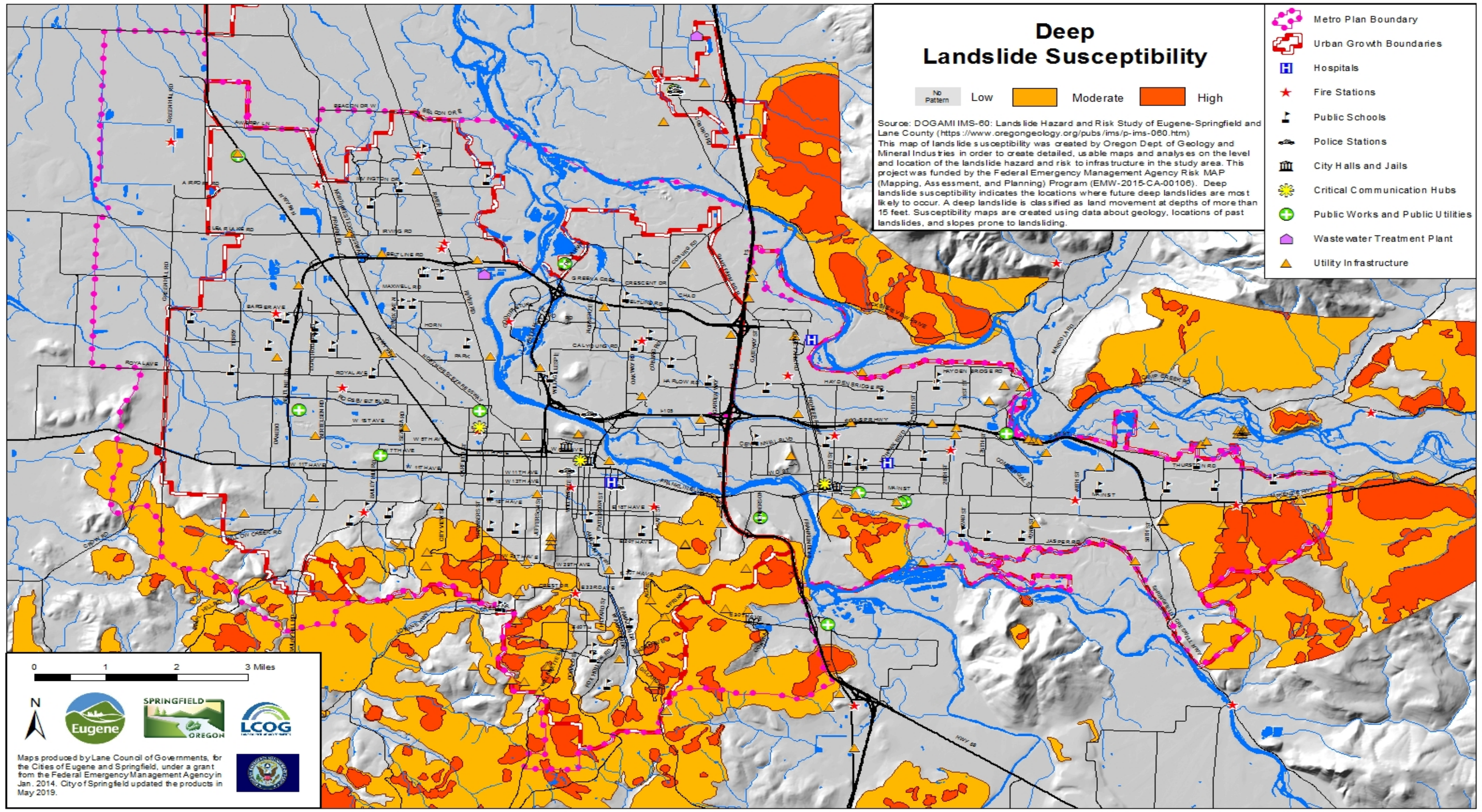
3.1.6 Landslide Inventory



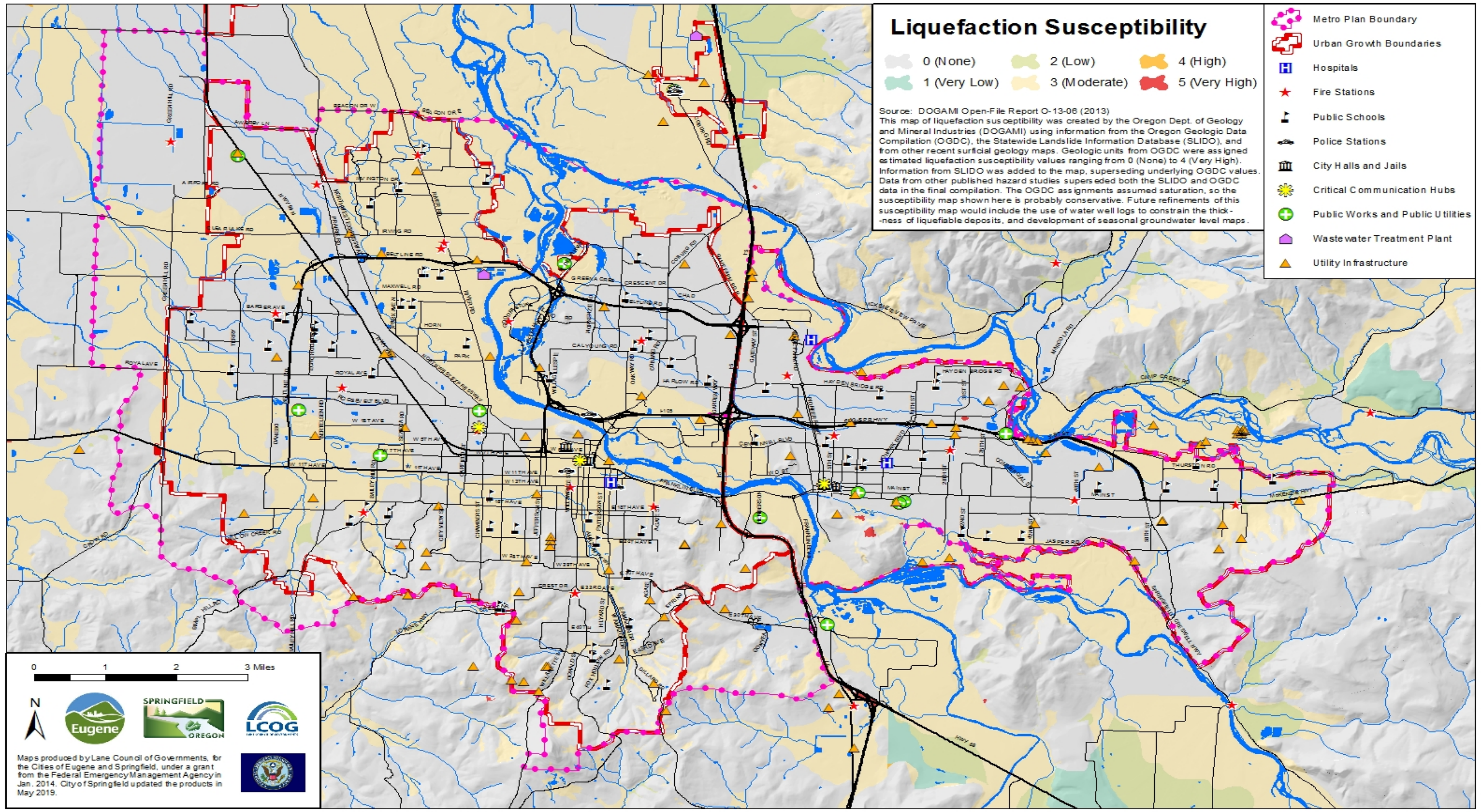
3.1.7 Shallow Landslide Susceptibility



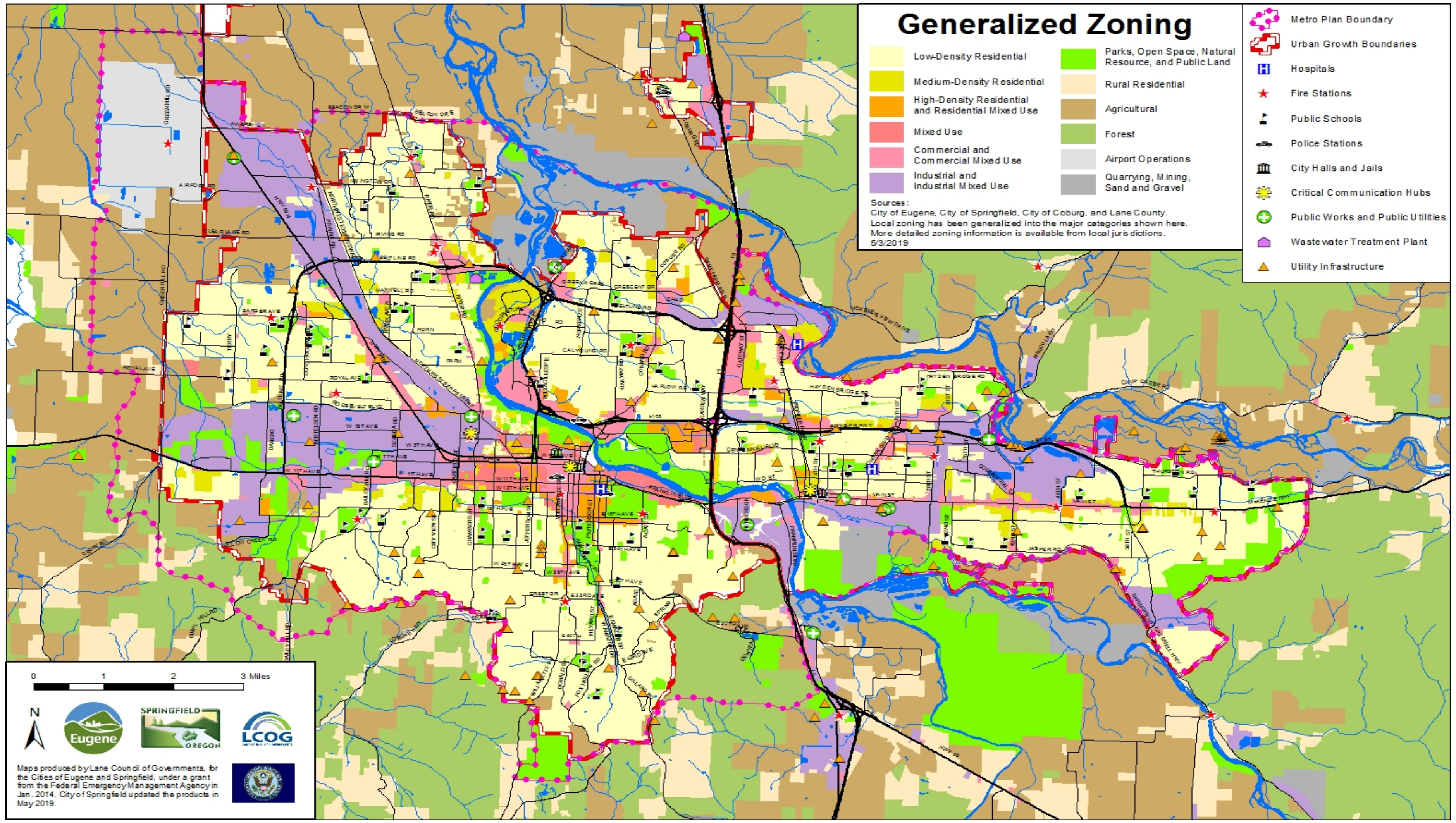
3.1.8 Deep Landslide Susceptibility



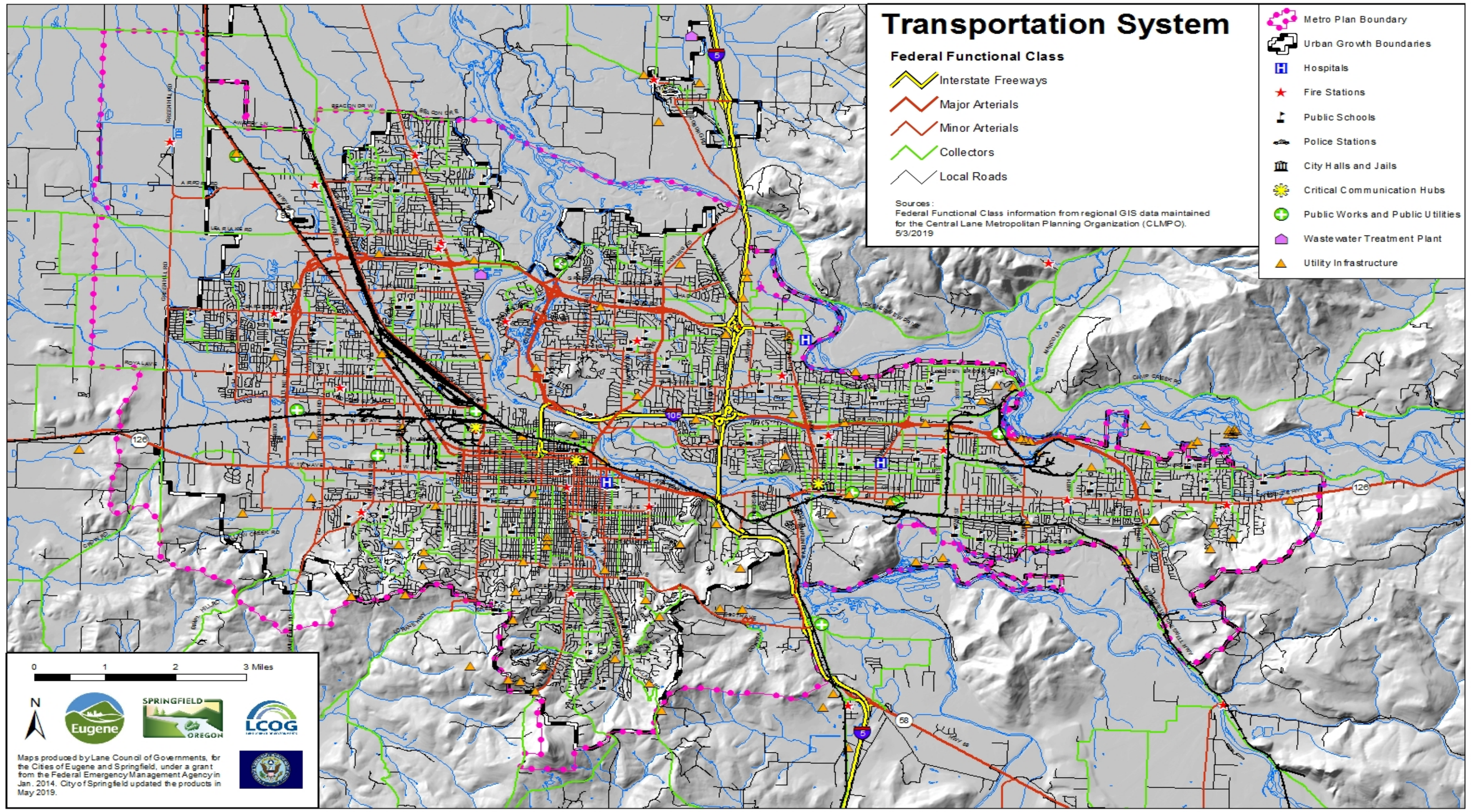
3.1.9 Liquefaction Susceptibility



3.1.10 Metro Land Use Zones



3.1.11 Metro Transportation System



3.2 Vulnerable Population Maps

The maps in this section describe the populations vulnerable to natural hazards and climate change for the Cities of Eugene and Springfield. These maps are a product of the Lane Livability Consortium, a metro area collaboration funded by a grant from the US Department of Housing and Urban Development (HUD).

A description of the map and source data is contained within each map.

A complete description, research, and references for the source data is in Section 4.6 Social Vulnerability.

The following maps are included:

- Children 17 and Under
- Population Experiencing a Disability
- Female Headed Households
- Households Without Access to a Vehicle
- Income and Poverty: Economic Vulnerability
- Latino and Minority Households
- Manufactured Homes
- Households in Poverty
- Residents Living in Rental Housing
- Seniors 80 and Older

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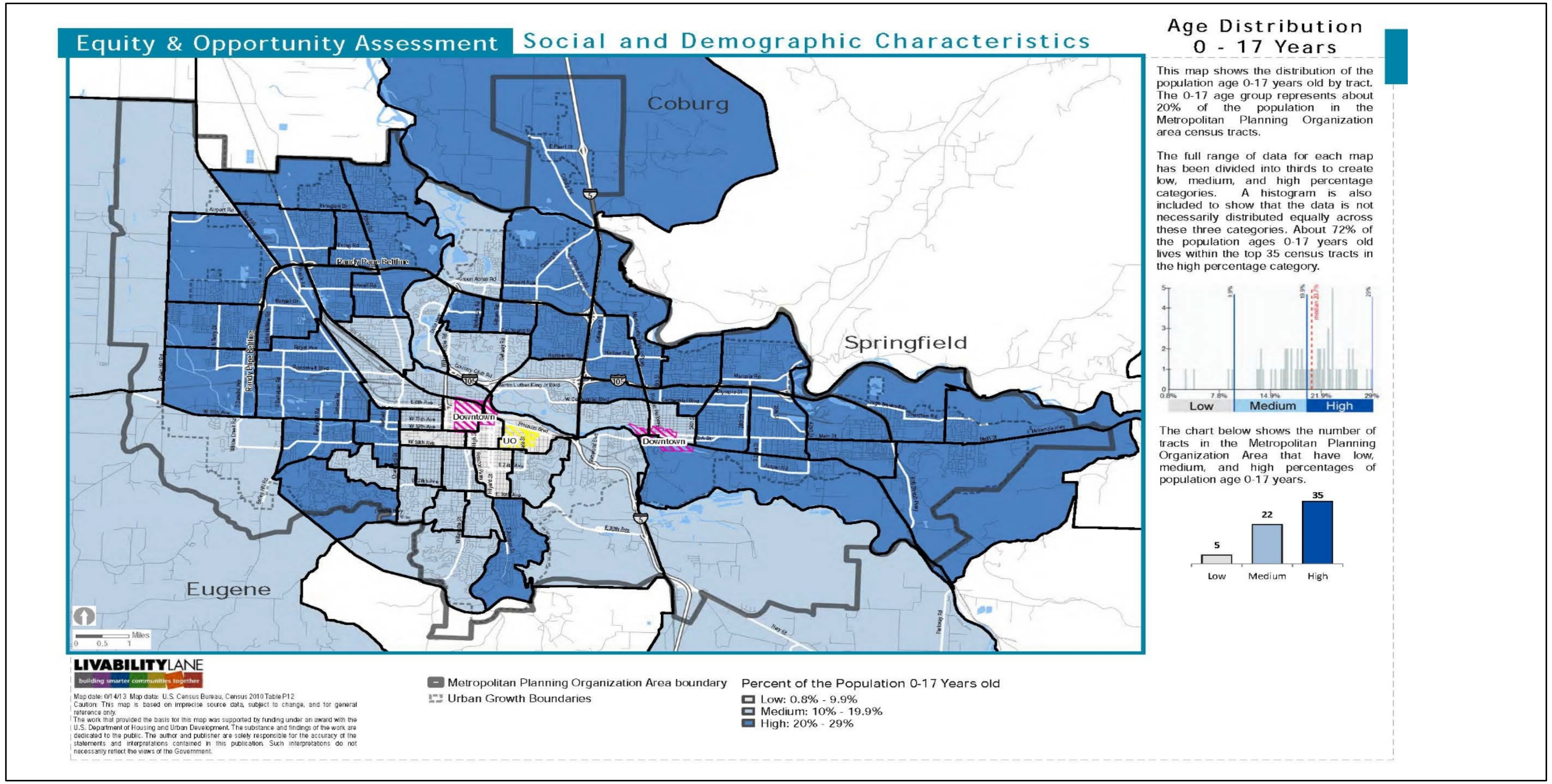
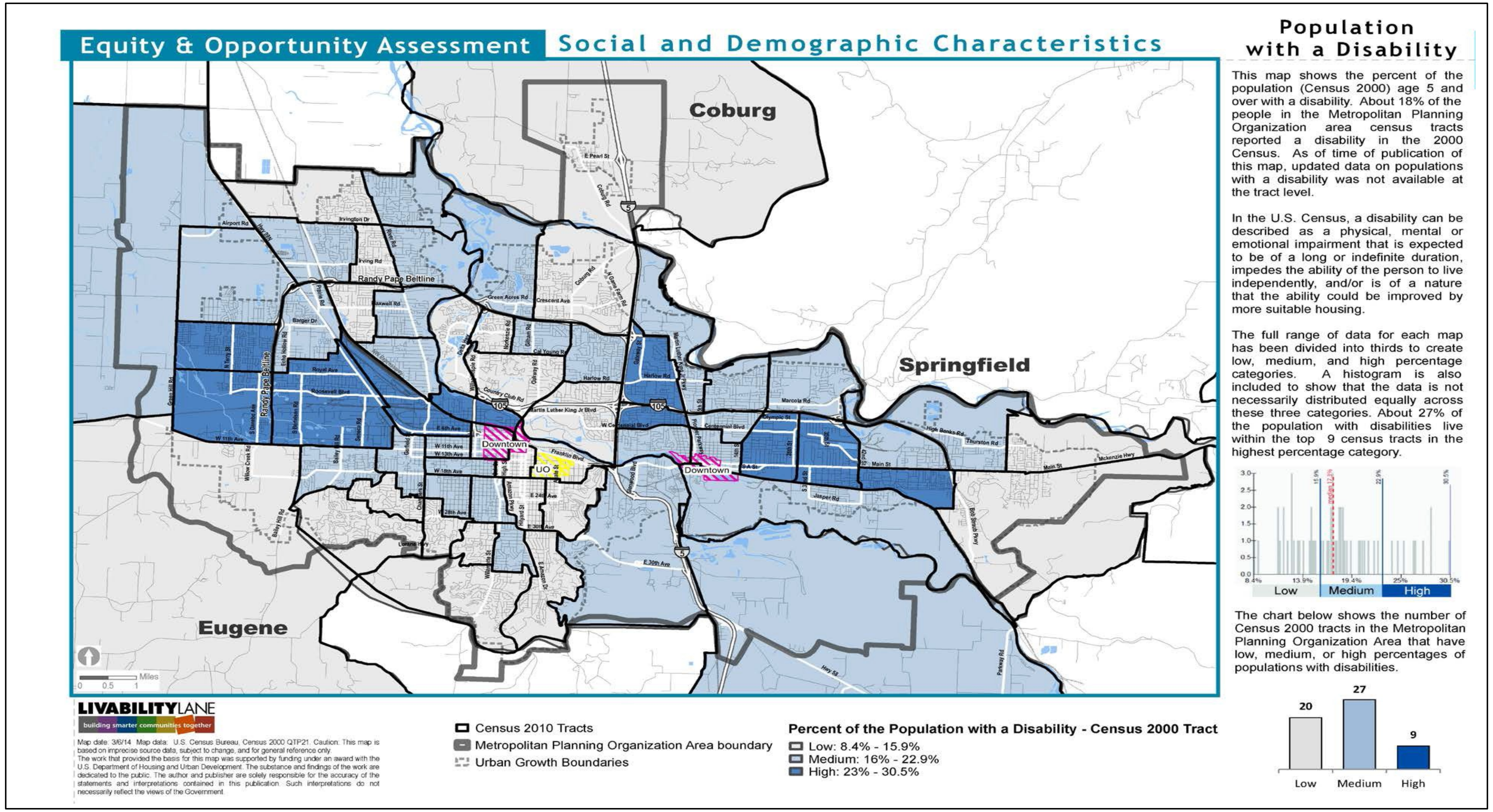
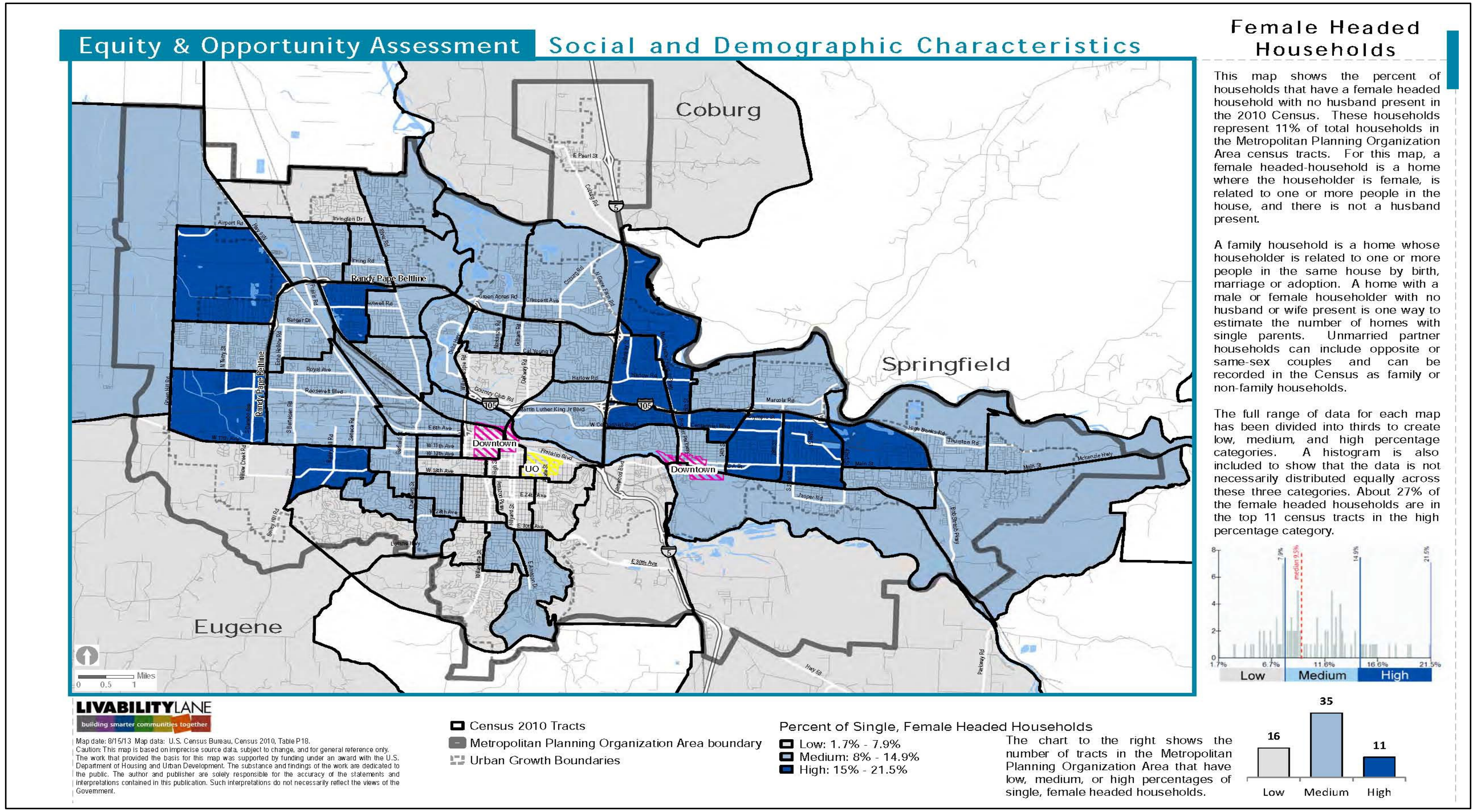
3.2.1 Children 17 and Under



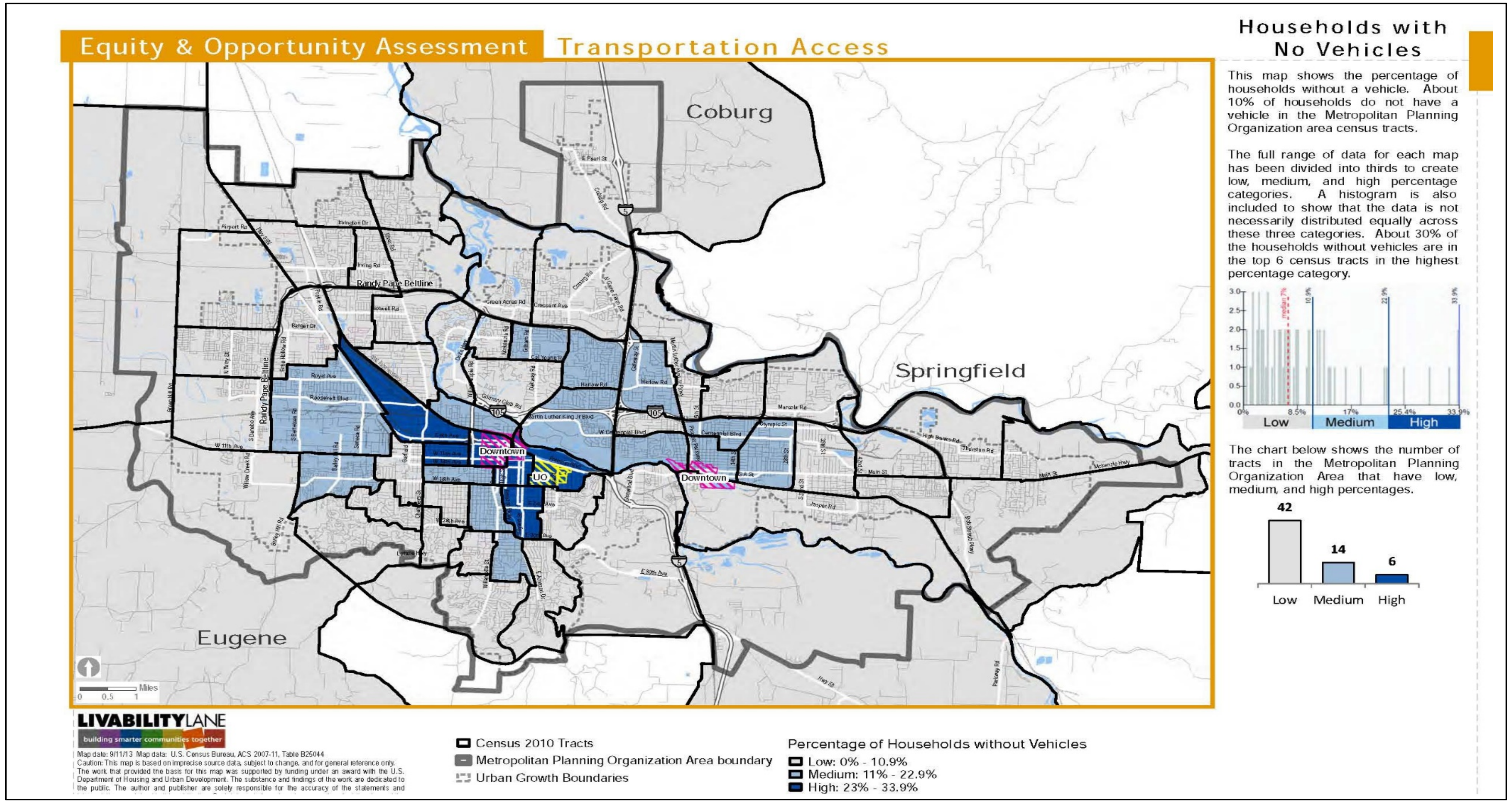
3.2.2 Population Experiencing a Disability



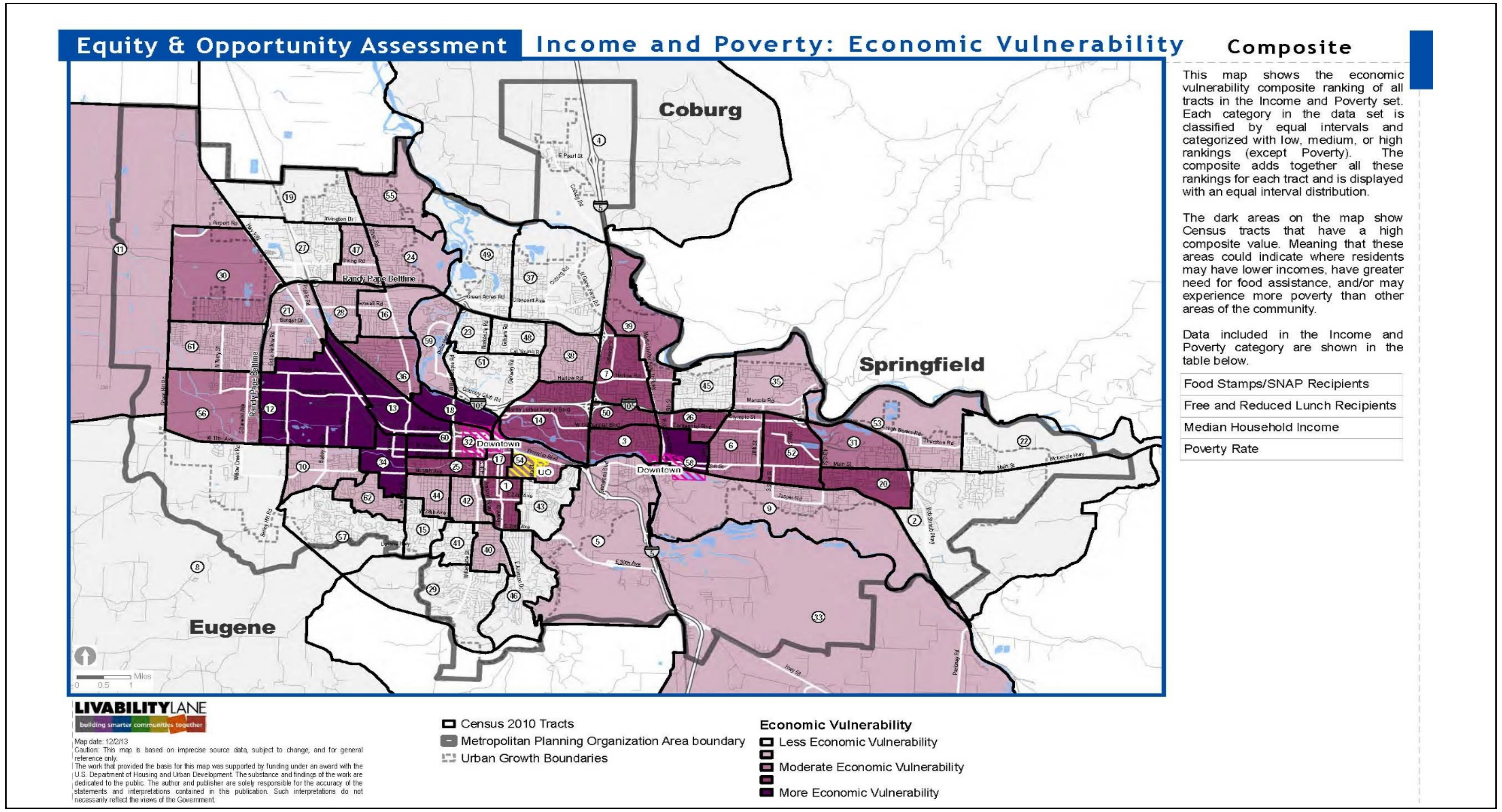
3.2.3 Female Headed Households



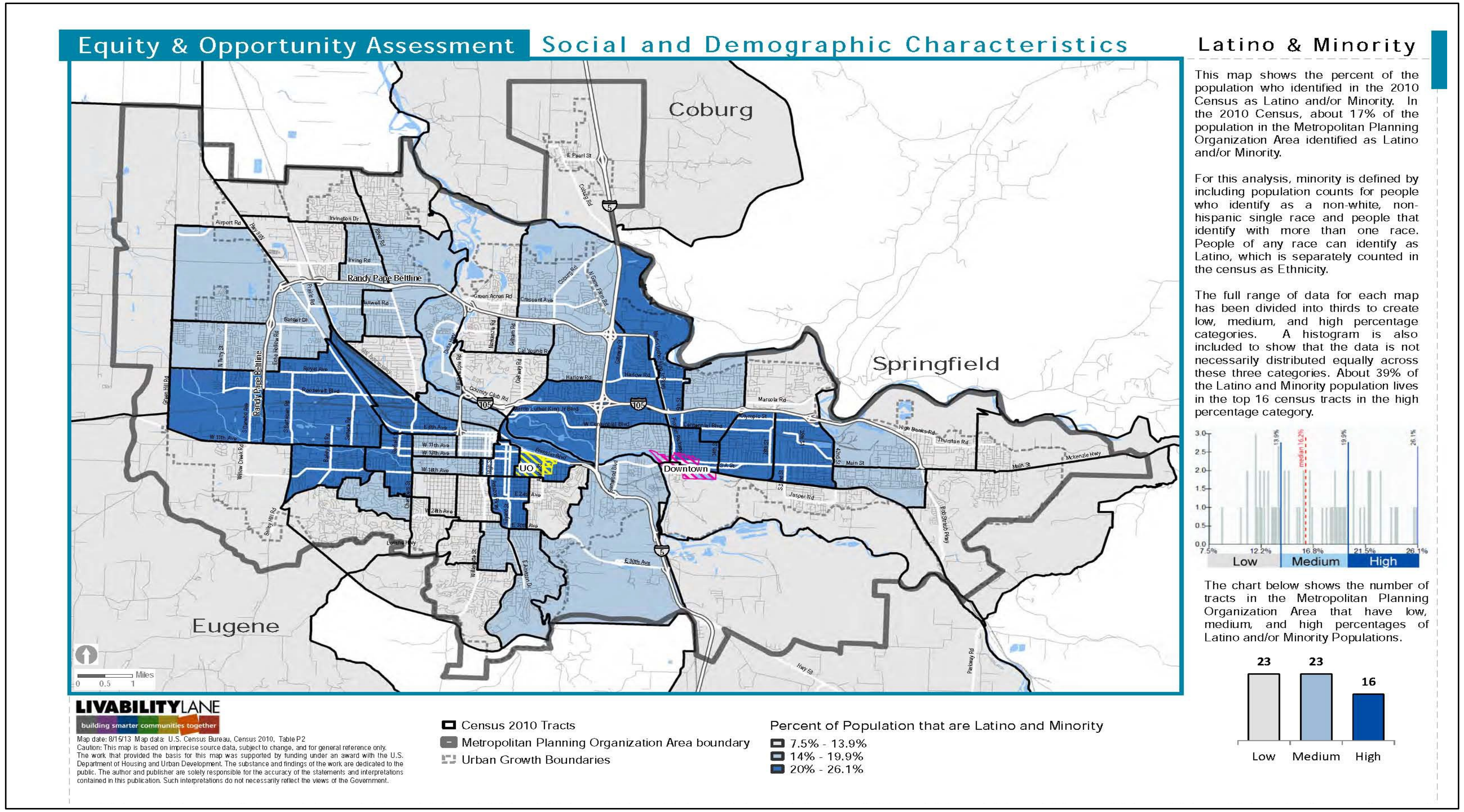
3.2.4 Households Without Access to a Vehicle



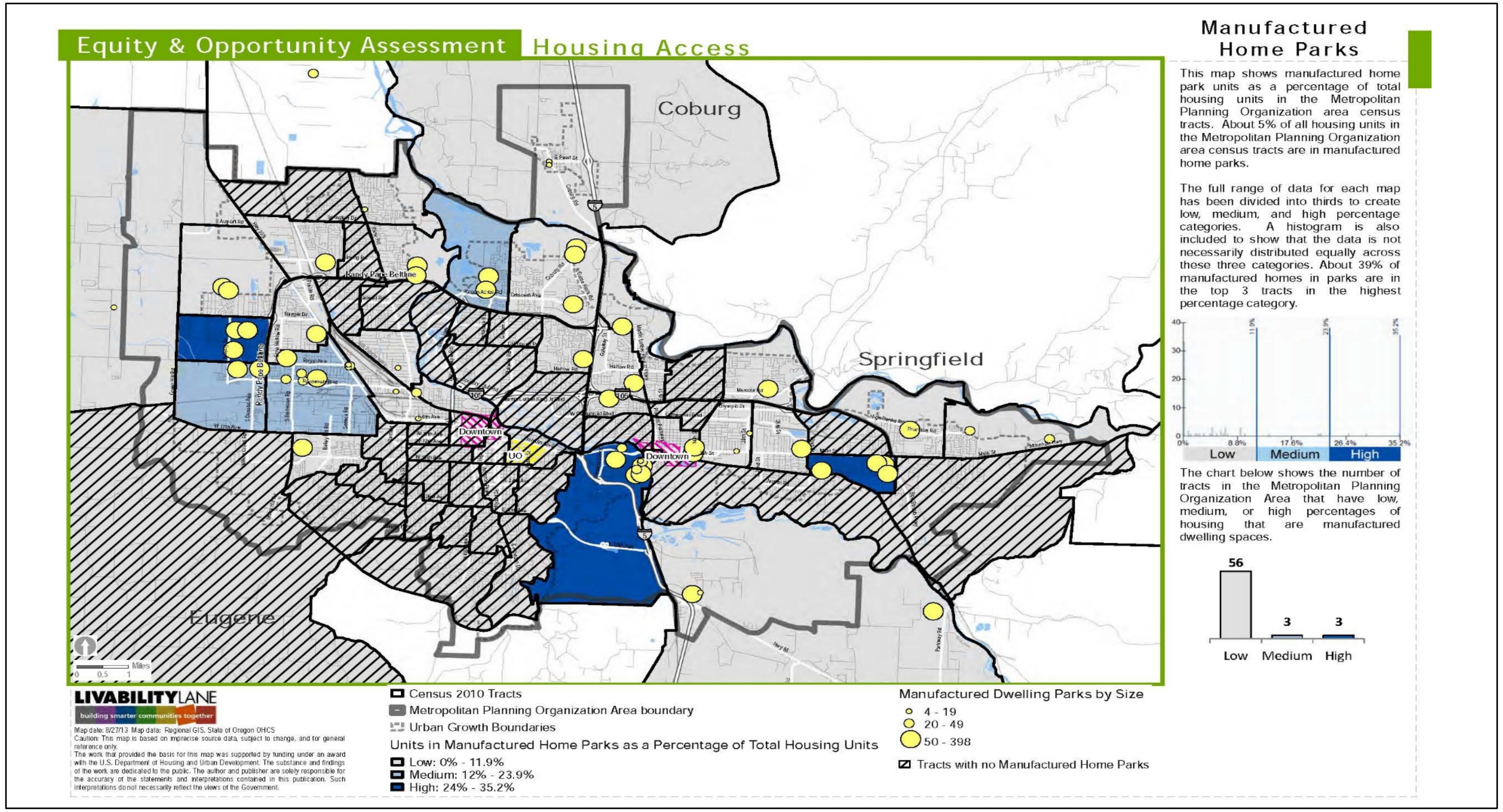
3.2.5 Income and Poverty: Economic Vulnerability



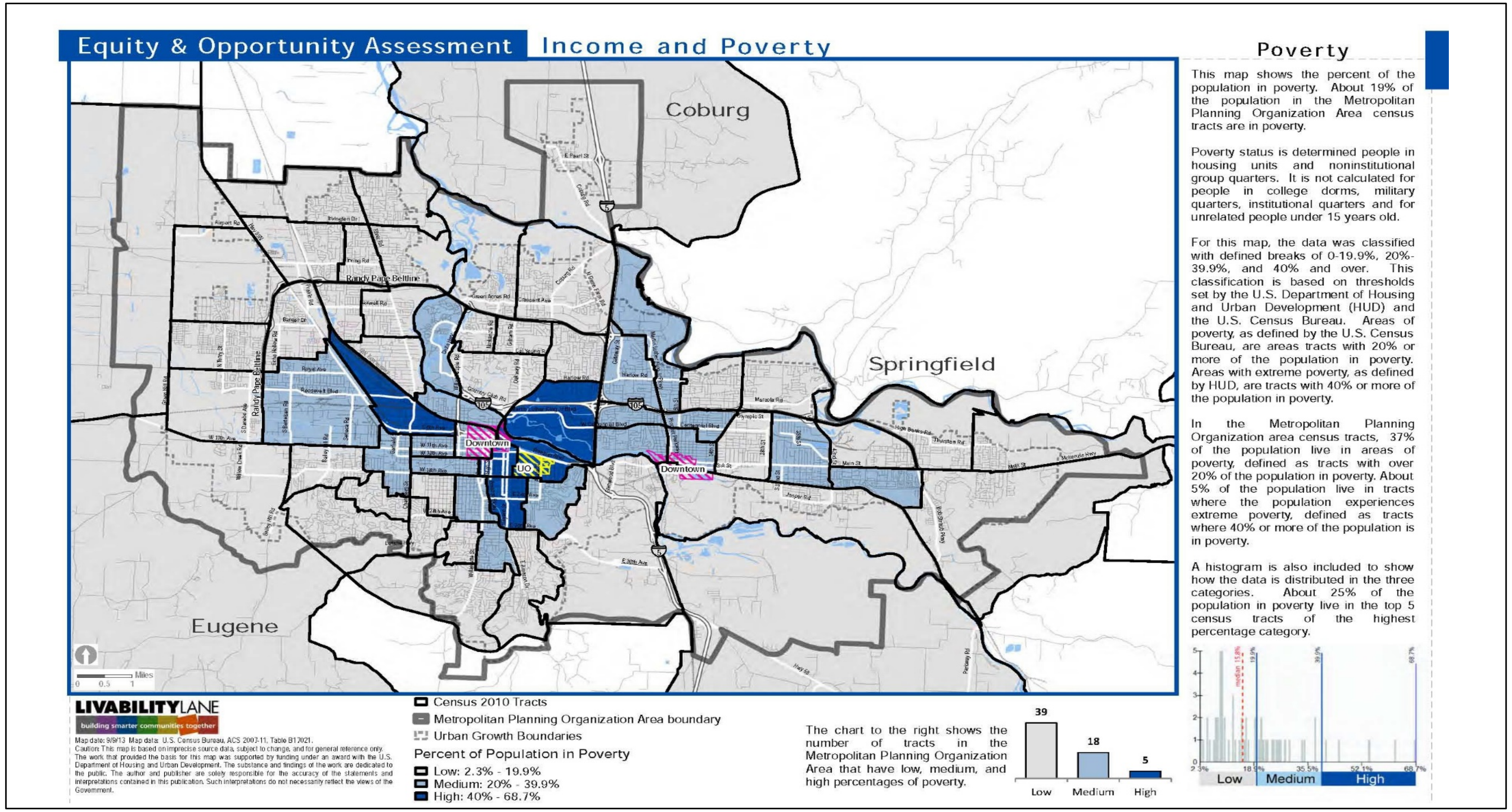
3.2.6 Latino and Minority Households



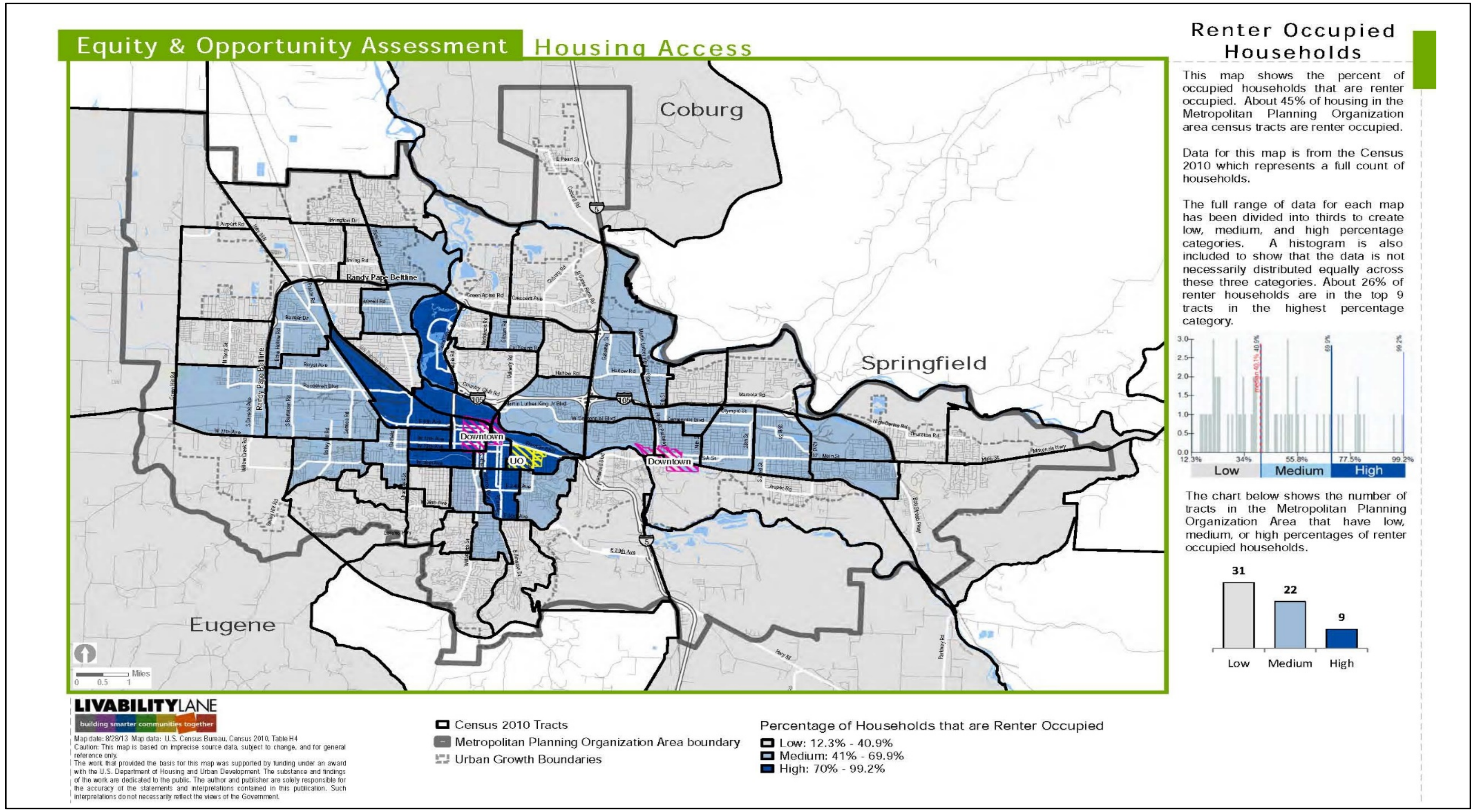
3.2.7 Manufactured Homes



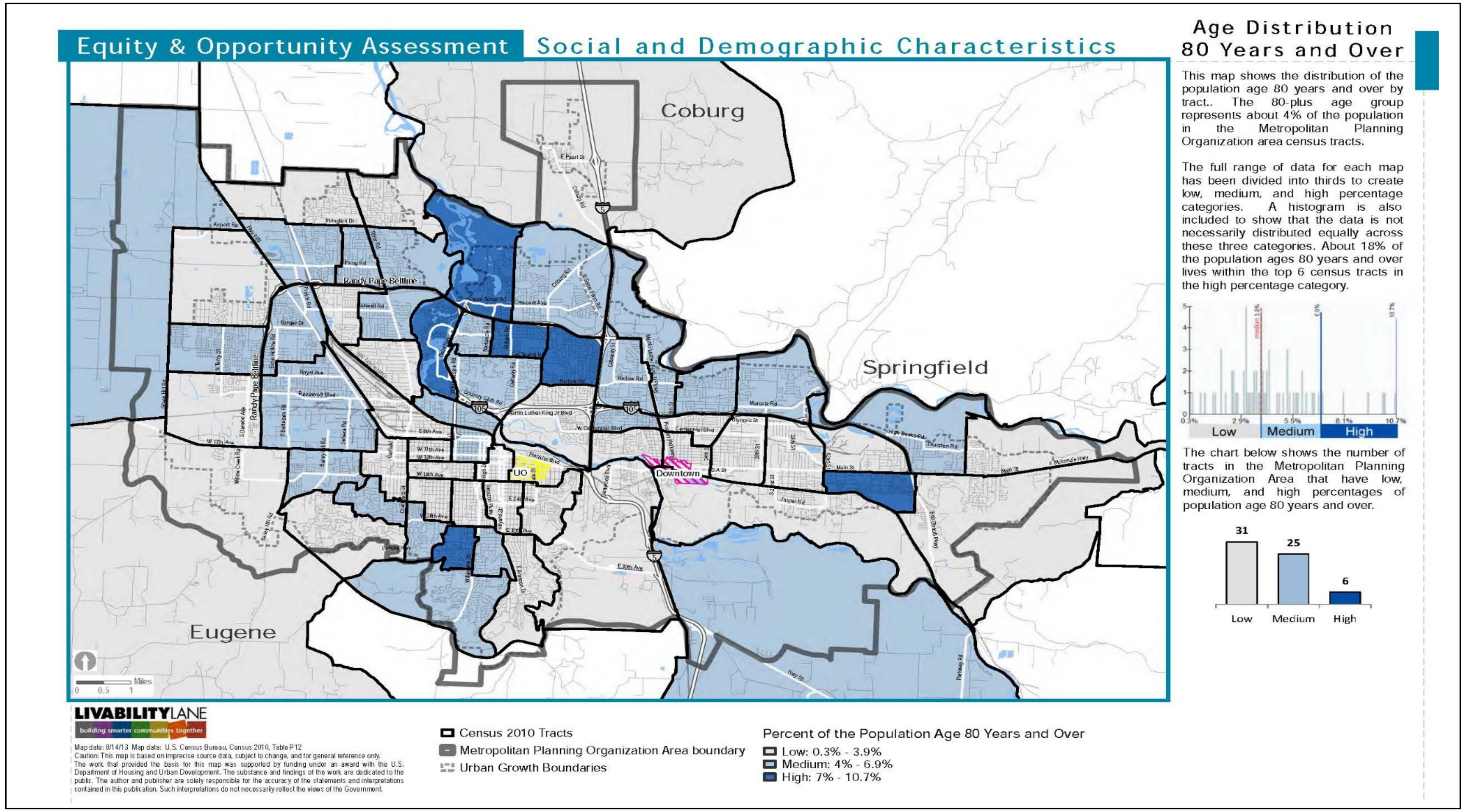
3.2.8 Households in Poverty



3.2.9 Residents Living in Rental Housing



3.2.10 Seniors 80 and Older



4 Risk and Vulnerability

4.1 Overview of Section 4

This section explains the processes and research data used to develop the mitigation actions in the 2020 NHMP.

Section 4.2 Provides an overview and description of the risk assessment process.

Section 4.3 Identifies the methodology for the development of probability, vulnerability, and capacity assessments found in Section 2 of the Eugene-Springfield Area Multi-jurisdictional 2020 NHMP

Section 4.4 Is a summary of the 2014 Regional Climate and Hazards Vulnerability Assessment.

Section 4.5 Includes the 2014 Sector research and system analysis process and conclusions.

Section 4.6 Includes the 2014 Population studies of social venerability, process, and conclusions.

Section 4.7 Contains the recent mitigation work stemming from the 2014 Eugene-Springfield Multi-jurisdictional NHMP.

Section 4.8 Explores the probability studies of impacts for cascading incidents.

Section 4.9 Discusses the prioritization of Mitigation Action Items.

4.2 Assessing Risk

The foundation of any Natural Hazards Mitigation Plan is the vulnerability and risk assessment.[80] Risk assessments provide information about the areas where the hazards may occur, the value of existing land and property in those areas, and an analysis of the potential risk to life, property, and the environment resulting from natural hazard events (Figure 4.1).

[80] United States. Department of Homeland Security. FEMA. *Local Mitigation Planning Handbook*. Washington, D.C.: FEMA, 2013. 5-1-20.

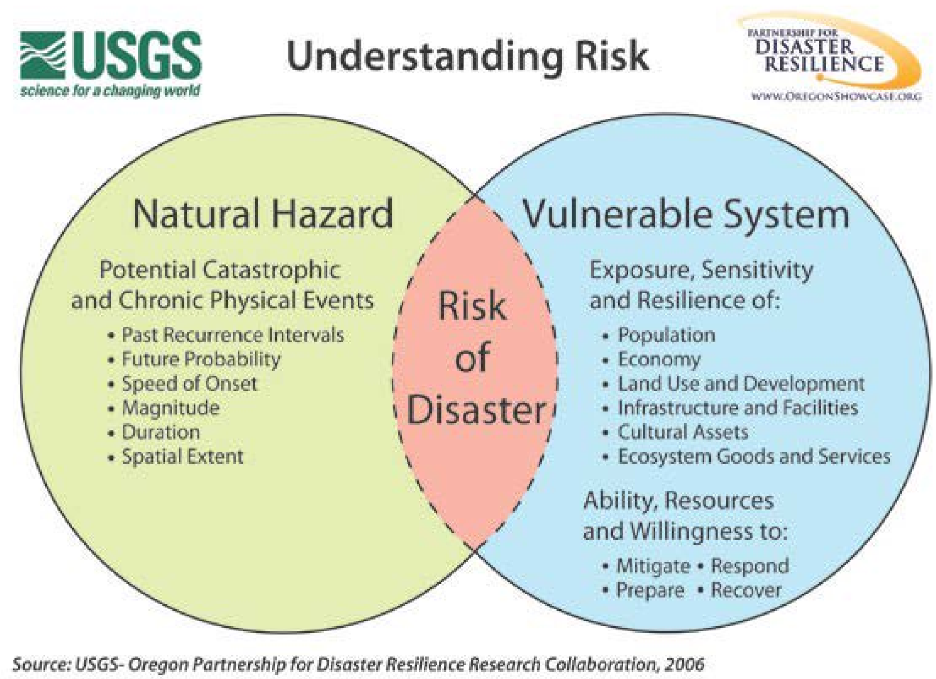


Figure 4-1. Source: USGS – The Partnership for Disaster Resilience Research Collaborative, 2006

This section explains what risk assessments are, provides a summary of the Eugene-Springfield Regional Climate and Hazards Vulnerability Assessment conducted in 2013, and a description of the additional vulnerability and risk assessment efforts incorporated into this plan.

4.2.1 What is a Risk Assessment?

A risk assessment consists of three phases (or levels): hazard identification, vulnerability assessment, and risk analysis (Figure 4-2). Risk assessments help to inform the local mitigation strategy. This assessment can be used to establish emergency preparedness and response priorities, for land use and comprehensive planning, and for decision making by elected officials, local departments, businesses, and organizations in the community.

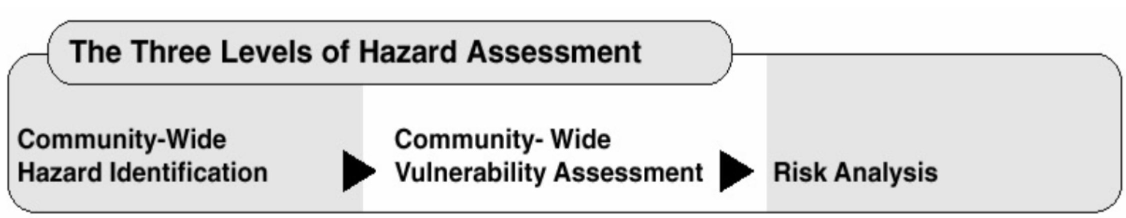


Figure 4-2. The Three Phases of a Risk Assessment. Source: Planning for Natural Hazards: Oregon Technical Resource Guide, 1998

The first phase, hazard identification, involves identifying the geographic extent of a hazard, its intensity, and its probability of occurrence. This level of assessment typically involves mapping of assets and hazards and is covered in Section 2, Hazard Descriptions, and Section 3.1, Hazard Maps. The outputs from this phase can be used for land use planning, management, and regulation; public awareness; defining areas for further study; and identifying properties or structures appropriate for acquisition or relocation.[81]

The second phase, vulnerability assessment, combines the information from the identified hazards with an evaluation of the existing (or planned) infrastructure and the population exposed to a hazard. It attempts to predict how the identified hazards could affect various infrastructure and population groups. This phase can also assist in identifying necessary changes to building codes or development of regulations, property acquisition programs, policies concerning critical and public facilities, taxation strategies for mitigating risk, and informational programs for members of the public who are at risk.[82] Section 4.4 describes the 2014 Regional Climate and Hazard Vulnerability Assessment.

The third phase, risk analysis, involves estimating the damage, injuries, and costs likely to occur in the geographic area for each identified hazard. Section 4.3 describes this phase.

This three-phase approach is conducted sequentially because each phase builds upon data from previous phases. However, gathering data for a risk assessment need not occur sequentially.

4.2.2 Components of Risk Analysis

Risk assessment for natural hazards includes three waited components. Each component is important to assessing risk and is described below.

> *Vulnerability* estimates are based on the percentage of the population or assets negatively affected by the natural hazard. Assets are any infrastructure or properties within jurisdictional boundaries or owned by one of the Plan Holders.
>
> *Probability* estimates are based on the frequency of previous events.
>
> *Capacity* is the community's ability to respond to, and recover from, a natural hazard event. Estimates for this variable are based on the potential number of outside resources needed to respond to, and recover from, a specific natural hazard event. Capacity is a new variable added in the 2020 Eugene-Springfield NHMP Risk Matrix.

[81] Burby, Raymond J. *Cooperating with Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Communities*. Washington, D.C.: Joseph Henry Press, 1999. 126.
[82] Ibid.

The following section further describes each of the components and the methodology for the assessment.

4.3 Probability, Vulnerability, and Capacity Assessment Process

This Section explains the methodology used to arrive at the conclusions found in Section 2 of this plan. It does not represent the analysis used to determine the risk for specific natural hazards threatening the Eugene-Springfield area.

The processes used by the Project Team to arrive at the conclusions of probability of future occurrence of natural hazards and the overall vulnerability and capacity to respond to each identified hazard was critical to prioritizing risk for the Eugene-Springfield area.

Table 4.1 provides the relative ratings used to assess the vulnerability to, probability of, and capacity of Eugene and Springfield to respond to, and recover from each natural hazard.

Table 4-1 Hazard Analysis Methodology

Vulnerability	
High	More than 70% of population or assets affected
Moderate	10% - 69% of population or assets affected
Low	Less than 9% of population or assets affected
Probability	
High	One incident likely within 0-35 years
Moderate	One incident likely within 35-75 years
Low	One incident likely within 75-100 years
Capacity	
High	No outside resources needed
Moderate	Less than 49 outside resources needed
Low	More than 50 outside resources needed

4.3.1 Natural Hazards

The natural hazards affecting the Cities of Eugene and Springfield, EWEB, Rainbow Water District, and SUB include, but are not limited to, droughts, earthquakes, extreme weather, floods, GMD, landslides, volcanoes, wildfires, and wind and winter storms. This plan also addresses civil unrest, dam or levee failures, epidemics, and hazardous material spills; four anthropogenic hazards closely connected to natural hazards. Referred to as cascading incidents, these hazards can occur independently, or because of natural hazards.

This plan does not address algal blooms, asteroids or meteors, and pandemics because:

- The risk is very low with extremely costly and limited mitigation activities available, thus mitigating the natural hazard is not warranted or is not practical; and/or
- The Cities of Eugene and Springfield do not have authority to mitigate the natural hazard.

Algal Bloom – Since the Cities get water from the McKenzie River, which is fed from reservoirs far outside their jurisdictional boundaries, or wells, the influence of natural systems and the operational aspects of the built system make this risk very low.

Asteroid or Meteor - Mitigating asteroid or meteor strikes is beyond the financial capacity of the Cities. Mitigation is largely left to the federal government.

Pandemic - Lane County Public Health Department is the primary agency responsible for mitigating pandemics.

4.3.2 Risk Matrix

Below is the Summary Risk Assessment Matrix (Table 4-2) providing an overview of each hazard and the associated vulnerability, probability, and capacity in the Eugene-Springfield area. See also Table 2-19 Risk Assessment Matrix.

Table 4-2 Summary Risk Assessment Matrix

Hazard	Vulnerability	Probability	Capacity	Risk Rating
Geomagnetic Disturbances (GMD)	High	High	Low	Very High
Earthquake	High	Moderate	Low	Very High
Winter Storm	High	High	Moderate	High
Drought	High	High	High	High
Wildfire	Moderate	High	Moderate	High
Windstorm	Moderate	High	Moderate	High
Flood Riverine	Moderate	Moderate	Moderate	Moderate
Landslide	Low	High	Moderate	Moderate
Flood Stormwater	Low	High	High	Low
Extreme Weather	Low	Moderate	High	Low
Volcano	Moderate	Low	High	Low

4.4 Summary 2014 Climate and Hazards Vulnerability Assessment

The following is a high-level overview of the Eugene-Springfield Climate and Hazards Vulnerability Assessment (Vulnerability Assessment) completed in 2014.
Using the findings of the assessment the 2020 NHMP Project Team looked at how each natural hazard may, or may not, be affected by climate change. Included in this research was our fossil fuel dependency. The 2020 Project Team used a long-range lens developed by the 2014 research to assist and influence development of mitigation action items needed to align with the hazards we face today. The lens considered future conditions to ensure mitigation actions taken now will not be obsolete or counterproductive in the next several decades.

Working from a standardized list of questions, the Vulnerability Assessment Team collected information about the adaptive capacity and sensitivity of each system to specific hazards.[83] The summary of findings below provides a description of key themes from across all surveyed community sectors.

These sector summaries include sector descriptions, an assessment of adaptive capacity, critical vulnerabilities, hazard specific sensitivities, and key sector interdependencies. The assessment does not reflect all hazards for all sectors.

4.4.1 Vulnerability Assessment - Hazards

The Vulnerability Assessment reflects sensitivities to earthquakes, floods, wildfires, winter storms, climate changes, and rising fuel prices. While flood and wildfire events have the potential to cause severe loss, damage, inconvenience, and drain emergency response resources in localized areas these hazards are not likely to result in systemic failures across multiple sectors. Both large earthquake and severe winter storm events have the potential to cause region-wide system failures and other cascading incidents.

Much of the region's adaptive capacity stems from our ability to draw resources, personnel, and expertise from nearby communities, particularly during an emergency. This capacity is severely restricted during region-wide events such as a Cascadia Subduction Zone earthquake or severe winter storms such as the big snow incidents of 1969.

4.4.2 Earthquake-Specific Findings

According to the Oregon Resilience Plan 2013, all sectors (except for natural systems)

[83] United States. Oregon. City of Eugene. *Regional Climate and Hazards Vulnerability Assessment.* December 2014. Accessed August 2019. https://www.eugene-or.gov/DocumentCenter/View/20644/2014-EugeneSpringfield-Climate-and-Hazards-Vulnerability-Assessment?bidId=

are extremely vulnerable to a Cascadia Subduction Zone (CSZ) earthquake.[84] Exceedingly limited staff availability in the aftermath of a severe earthquake will create problems and challenges difficult to predict or solve in advance. Every sector will experience substantial failures and interruptions. Some possible impacts from a large earthquake can be anticipated and others may not. Unanticipated impacts and the sheer magnitude of a large earthquake will challenge local, State, and Federal preparedness and response efforts. Very few residents have first-hand experience with a major subduction zone earthquake, making the potential experience and results difficult for the population to fully prepare for and survive without significant resources from outside of the area.

Since the completion of the Vulnerability Assessment and the 2014 NHMP, both Eugene and Springfield conducted seismic evaluations on some critical infrastructure of concern.

4.5 Vulnerability Assessment – Process

In 2013 staff from the City of Eugene and the City of Springfield, with support from Oregon Partnership for Disaster Resilience (OPDR), convened meetings with representatives from each of the crucial sectors. The team met for six hours with each sector. Working from a standard list of questions, the team collected information about the adaptive capacity and sensitivity to specific hazards. The sector summaries below are the result of these interviews and reflect the conversations and thinking of the participants. The Participant List in Section 4.2.6 of the 2014 Regional Climate and Hazards Vulnerability Assessment catalogs those system managers who provided their expertise.[85]

The 2014 Assessment became the foundation of the 2014 Eugene-Springfield Natural Hazard Mitigation Plan and allowed staff to identify gaps in information. The Vulnerability Assessment continues to be the foundation of the 2020 Eugene-Springfield NHMP. The Risk Matrix (Table 4-2) has been, and will continue to be, modified as additional studies are completed to ensure this document is accurate.

The following sections describe the methodology and results of the 2014 Vulnerability Assessment in more detail. Figure 4-3 shows the process flow leading to ascertaining the results.

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[84] United States. Oregon Seismic Safety Policy Advisory Commission. *The Oregon Resilience Plant: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami.* February 28, 2013. https://www.oregon.gov/oem/documents/oregon_resilience_plan_final.pdf.

[85] United States. City of Eugene. *Regional Climate and Hazards Vulnerability Assessment.* December 2014. Accessed August 2019. https://www.eugene-or.gov/DocumentCenter/View/20644/2014-EugeneSpringfield-Climate-and-Hazards-Vulnerability-Assessment?bidId=

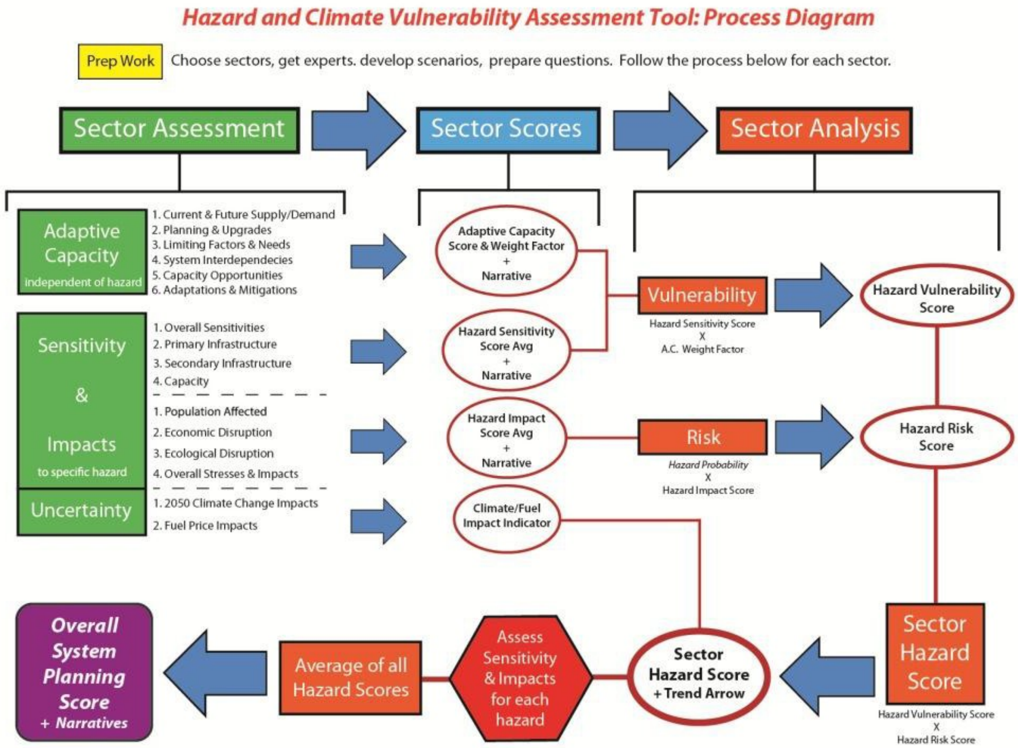

Figure 4-3. Process Diagram. Source: Oregon Partnership for Disaster Resilience

4.5.1 Crucial Sector Summaries

The crucial sector summaries from 2014 Regional Climate and Hazard Vulnerability assessment within the Eugene-Springfield metro area are:

- Drinking Water
- Health Care and Public Health
- Electricity
- Transportation
- Food
- Housing
- Communication
- Stormwater
- Wastewater
- Natural Systems
- Public Safety

4.5.2 Hazards

The sector summaries describe sensitivities to earthquakes, floods, wildfires, and winter storms, as well as, climate change, and rising fuel prices. Because of limited meeting time with system experts, the assessment does not reflect all hazards for all sectors. The flood scenario used does not include dam failure and associated inundation. It reflects river flooding due to precipitation and snow melt as well as some impacts of urban street flooding.

4.5.3 Geographic Boundaries

The geographic extent for this assessment was the area within both Cities' urban growth boundary. Due to the regional nature of some systems and hazards, several of the summaries briefly discuss areas beyond this boundary.

4.5.4 High Level Findings

Below is a list of high-level findings from the 2014 Assessment. This does not represent all lessons learned or all relevant information collected during the assessment. It is a short collection of the common themes from across multiple sectors.[86]

Overall

A. There exists a unique culture of collaboration and information sharing within our community. Overall, this increases our adaptive capacity in several areas. Information sharing is particularly visible within the health, public safety, electricity, and transportation sectors. There is a noticeable willingness to share information within other sectors as well, including both food and communications.

B. Participants voiced the value in hazard planning and exercises. Multiple participants in multiple sectors indicated they valued the assessment, and many stated their support for continuing this discussion and engaging in multi-sector planning and exercises.

C. Many sectors are heavily dependent on resources and decisions made outside of the Eugene-Springfield area, most notably the food, electricity, and fossil fuel sectors.

D. There are three sectors fundamental to the operation, maintenance, and restoration of all other sectors; those are electricity, fossil fuels, and transportation.

E. For several sector managers, finding and keeping qualified staff is an important concern over the next decade with few obvious solutions.

F. There is a high level of interdependence among sectors. Nearly every sector relies on several other sectors to function, with stormwater and natural systems being the least dependent on other sectors.

[86] United States. City of Eugene. Emergency Management. *Climate and Hazards Vulnerability Assessment.* December 2014. Accessed April 2019. https://www.eugene-or.gov/DocumentCenter/View/20644/2014-EugeneSpringfield-Climate-and-Hazards-Vulnerability-Assessment?bidId=.

Hazard Specific Findings

While flood and wildfire events have the potential to cause severe loss and damage in localized areas, as well as, inconvenience for many and a drain on emergency response resources, these hazards are not likely to result in systemic failures across multiple sectors.

Much of our regional adaptive capacity stems from our ability to draw resources, personnel, and expertise from nearby communities, particularly during an emergency. This capacity is severely restricted during region-wide events. Severe earthquake, winter storm, and, to a lesser degree, flooding events have the potential to cause region-wide cascading system failures.

Earthquake – Specific Findings

The impacts resulting from a 9.0 Cascadia earthquake[87] will be staggering. Results from the Vulnerability Assessment determined:

- Except for Natural Systems, all sectors are extremely sensitive to an earthquake of this magnitude.
- Very little has been done to prepare any systems, infrastructure, or personnel to handle the initial impact and ongoing response and recovery a Cascadia earthquake would require.
- Exceedingly limited staff availability in the aftermath of a severe earthquake will create problems and challenges difficult to predict or solve.
- Every sector will experience substantial failures and interruptions unfamiliar to the area and therefore difficult (though possible) to plan for.
- Very few locals have first-hand experience with a major earthquake, making it difficult to describe the potential experience and aftermath.

Winter Storm – Specific Findings

- Severe winter storms disrupt electricity and transportation, two of the three sectors all others depend upon; especially if the storm lasts more than a couple of days and has significant snow and/or ice accumulation.

Other Factors Considered

Dam Failure – Specific Findings

[87] See the Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. Report to the 77th Legislative Assembly.

- While not the focus of this phase of the regional vulnerability assessment, participants repeatedly articulated a broad concern about the potential consequences of a dam failure.

Climate Change – Specific Findings

- Sectors most likely to experience negative impacts associated with climate change are natural systems, drinking water, and, to a lesser extent, food, electricity, and public health.
- Several sector managers in the drinking water, public health, and natural systems sectors are actively planning for the impacts of climate change. For the most part, other sectors are not.
- Most built community sectors don't appear to be at severe risk from projected climate-related impacts such as increasing temperatures, reduced snowpack, or changes in precipitation. However, the region's natural systems are highly sensitive to climate change and the resulting secondary impacts on community sectors and regional economy could become substantial.

Population

- While not a focus of this assessment, the added pressures from an increasing Willamette Valley population – adding 1.2 million people[88] in the valley over the next 25 years - will likely place further strain on fresh water resources. Stresses would be even greater if the population grows faster than projections suggest.

Fossil Fuels

- All but one group indicated their sectors rely heavily on fossil fuels and fossil fuel-derived products to operate. Health care, food, water, transportation, public safety, electricity, and housing appear most dependent.
- Natural systems is the only sector with a low dependency on fossil fuels to function
- There is not yet widespread planning for how sectors will manage the rising fuel prices anticipated in the coming decades. Most indicate added cost will be passed on to the customer. A notable exception is public safety, where sector managers indicated service levels would be reduced if there is no customer base or political will to absorb the increased costs.
- Nearly every group indicated the rate at which fuel prices increase makes all the difference. A slow increase in prices is manageable; a sharp increase in prices

[88] Environmental Migrants and the Future of The Willamette Valley: A Preliminary Exploration. USP 594: Planning in the Pacific Northwest Fall 2011

would strain sectors – some of them dramatically.

- Almost all backup power systems in Eugene and Springfield rely on diesel or natural gas transported by pipeline from Portland and beyond.
- There is an information gap regarding the fossil fuel sector. Because we were unsuccessful at convening representatives from this sector. There is a need for more information about how this sector operates. Due to this information gap the following studies were considered when conducting the 2014 Vulnerability Assessment.
  - As part of The Oregon Resilience Plan,[89] DOGAMI completed an Earthquake Risk Study for Oregon's Critical Energy Infrastructure Hub[90] containing useful information about the petroleum hub and its operability following an earthquake – with some implications for performance following other natural hazards.
  - The 2012 Oregon State Energy Assurance Plan[91] offers insights into the existing risks to energy infrastructure and systems statewide.

Based on these findings, the City of Eugene, in cooperation with several neighboring cities, applied for, and received a 2016 and 2017 Homeland Security Program Grant award via OEM to fund a Fossil Fuel Assessment Study for the majority of Lane County. This study is in progress and the results will be used to inform future NHMP updates.

4.5.5 Vulnerability Assessment – Scoring Summary

Introduction

This section describes the scoring results from the Eugene-Springfield 2014 Climate and Hazards Vulnerability Assessment. Ultimately, the results should help establish a course towards adaptive local and regional networks, and a more resilient community. These findings were used to inform the prioritization of infrastructure improvements and hazard mitigation strategies, as well as, for the development of natural hazard studies and climate adaptation strategies.

Adaptive Capacity

Adaptive capacity is a natural, built, or human system's ability to accommodate a new

[89] United States of America. Seismic Safety Policy Advisory Commission (OSSPAC). *The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the next Cascadia Earthquake and Tsunami*. Salem, OR, 2013.

[90] United States. Oregon Department of Geology and Mineral Industries. *Earthquake Risk Study for Oregon's Critical Infrastructure Hub*. By Yumei Wang, Steven F. Barlett, and Scott B. Miles. O-12-09. 2013.

[91] United States. Oregon Department of Energy. Oregon Public Utility Commission. *Oregon State Energy Assurance Plan*. 2012.

or changing environment, exploit beneficial opportunities, and/or survive moderate negative effects. In short, it reflects a sector's ability to adapt to changing circumstances. The adaptive capacity questions were asked in a series of six sections. The score of each section was averaged, and then all six section scores were again averaged to obtain an overall adaptive capacity score. Table 4-3 contains the scoring system used in the adaptive capacity scoring.

Table 4-3 Adaptive Capacity Ranking Systems

Score	Ranking
1.00 – 1.99	Very Low
2.0 – 2.74	Low
2.75 – 3.24	Medium
3.25 – 3.99	High
4.00 – 5.00	Very High

Table 4-4 contains the average adaptive capacity scores for each alphabetically listed sector. Nine out of eleven sectors have a rating of medium. The range of the averaged scores was 2.31- 3.21, on a scale of 1.0-5.0. Note, the digit in the hundredth place does not translate to a level of precision—it is used to further differentiate the scores, so they may be ranked.

Table 4-4 Average Adaptive Capacity Scores

Sector	Average Adaptive Capacity	Rating
Communication	3.21	Medium
Drinking Water	2.99	Medium
Electric	2.94	Medium
Food	2.80	Medium
Housing	2.31	Low
Natural Systems	2.76	Medium
Public Health	2.75	Medium
Public Safety	2.52	Low
Stormwater	3.04	Medium
Transportation	3.12	Medium
Waste Water	3.17	Medium

Comparison

After the adaptive capacity scores were calculated, OPDR looked for ways to compare sectors. The adaptive capacity eventually became a multiplier influencing the overall sector planning score. The three metrics for comparison are:

- The lowest averaged score,

- The lowest self-evaluation score, and
- The greatest discrepancy between the scores (i.e. the difference between the scores provided by system managers and the scores assigned by the project team based on the narrative.)

Table 4-5 contains the lowest overall averaged adaptive capacity scores.

Table 4-5 Three Lowest Averaged Adaptive Capacity Scores

Sector	Average Adaptive Capacity
Housing	2.31
Public Safety	2.51
Public Health	2.75

Table 4-6 highlights the three lowest adaptive capacity scores based on self- evaluation.

Table 4-6 Three Lowest Self-Evaluation Scores

Sector	Average Adaptive Capacity
Housing	1.92
Food	2.08
Public Safety	2.33

Table 4-7 shows the systems with the greatest discrepancies between the average score and the self-evaluation score provided by system managers. Here a bigger percent difference indicates the system managers felt their sector was in better condition than the average scores would suggest.

Table 4-7 Three Systems with the Greatest Discrepancies Between Averaged and Self-Evaluated Adaptive Capacity Scores

Sector	Percent Differences in Estimated vs Average Adaptive Capacity
Natural Systems	-48%
Public Health	-15%
Transportation	-12%

Sensitivity and Impacts

The second half of the assessment measured the sectors' sensitivity to three hazards and their impacts. Earthquakes and floods were assessed for all sectors, then either wildfires or winter storms was assessed depending on which hazard was expected to be most detrimental to the system. Table 4-8 list the sectors hazard sensitivity scores. Table 4-9 list the sectors sensitivity to the impact from each hazard.

Table 4-8 Hazard Sensitivities				
Sector	Earthquake	Flood	Wildfire	Winter Storm
Drinking Water	4.67	2.00	4.14	
Public Health	4.25	3.63		
Waste Water	4.00	3.13		
Electric	4.13	2.38	2.75	
Transportation	4.25	2.88		
Stormwater	3.50	3.50	2.63	
Food	3.75	1.67		
Housing	3.67	2.67	2.50	
Communications	4.50	1.75		
Natural Systems	3.50	2.50	3.00	
Public Safety	4.50	3.55		3.83

Table 4-9 Hazard Impacts				
Sector	Earthquake	Flood	Wildfire	Winter Storm
Communications	3.75	1.50		
Drinking Water	4.40			
Electric	3.80	1.90	2.00	
Food	2.33	1.67		2.33
Housing	3.71	2.00	1.36	
Natural Systems	2.39	2.11	2.67	
Public Health	4.17	2.67		
Stormwater	4.18	3.36	1.64	
Transportation	5.00	2.00		5.00
Waste Water	4.00	2.75		2.25

Overall System Analysis

The adaptive capacity scores are combined with the hazard sensitivity and impact sensitivity scores to obtain an overall system planning score. Table 4-10 contains the overall system planning scores, ranked from highest to lowest. Drinking water, transportation and public safety received the highest total scores based on this assessment, suggesting they should be considered for prioritization for hazard mitigation activities in Eugene and Springfield. The absolute numbers do not imply greater or lesser significance. Rather, the numbers should be used to provide a method to rank sectors in comparison with each other.

Table 4-10 System Planning Scores	
Sector	**System Planning Score**
Drinking Water	61.6
Transportation	47.0
Public Safety	42.2
Public Health	41.1
Waste Water	31.7
Stormwater	30.7
Electric	25.7
Communications	24.5
Housing	22.4
Natural Systems	21.7
Food	19.7

Conclusion

When considering sectors to address for hazard mitigation, emergency managers, planners, system managers, and public officials should bear in mind the results of this assessment. Importantly, the housing and public safety sectors experience relatively low adaptive capacity compared to other sectors. Overall, the drinking water, transportation, and public safety sectors are in greatest need of attention.

4.6 Social Vulnerability

The following tables (Tables 4-11 and 4-12) summarize peer-reviewed research indicating what variables are most important when considering populations vulnerable to both natural hazards and climate change. These populations are particularly important for natural hazards planning as they are often disproportionately affected by hazard events. Therefore, it is important planners pay attention to the locations and characteristics of these populations.

The associated maps (Section 3.2.1 - 3.2.10) of the Eugene-Springfield metro region are available within Section 3 of the 2020 Eugene-Springfield NHMP. These maps are a product of the Lane Livability Consortium, a metro area collaboration funded by a grant from the US Department of Housing and Urban Development (HUD).

Table 4-11 Natural Hazard Social Vulnerability Factors		
Number	**Indicator**	**References (listed below)**
1	Age	1, 2,3,4,5
2	Income	1,2,6
3	Residence	2,6
4	Tenure	2, 7
5	Employment	8
6	English Skills	7, 8

7	Household Type	4,5,7,8
8	Disability	2,8
9	Home Insurance	
10	Health Insurance	
11	Debt and savings	
12	Car	1,5,8
13	Gender	2,5,9
14	Injuries (hazard specific)	10
15	Residence Damage (hazard specific)	10

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Table 4-11. Natural Hazard Social Vulnerability Factors. Source: Dwyer, A., Zoppou, C., Nielsen, O., Day, S., Roberts, S., 2004. Quantifying Social Vulnerability: A methodology for identifying those at risk to natural hazards. *Geoscience Australia Record 2004/14*. Table title: *The thirteen socio-economic indicators and two hazard indicators used in this study to establish the vulnerability of a person within a household to natural hazard impacts.*

Table 4-12 Climate Change Social Vulnerability Factors

Category	Vulnerability Factor(s)/Vulnerable Population	References
Socio-economic	Low Income	1,2, 3, 4, 5
	People of color (ethnic minorities)	3, 5, 7
	Women	5
Age	Elderly	5
	Children	5
Housing Conditions	Home renters	4
	Flammable roof, vegetation within 10 meters of home	8, 9
Isolation	Language ability/linguistic isolation	10
	Isolation from public agencies for fear of interacting with public agencies	10
	Geographic isolation	11
Other	No health insurance	12
	No vehicle	13
	Disabled (or family member disabled)	5, 13
	Institutionalized populations	11, 14

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Table 4-12. Climate Change Social Vulnerability Factors. Source: Social Vulnerability to Climate Change in California. A white paper from the California Energy Commission’s California Climate Change Center. Prepared by Pacific Institute, July 2012

4.7 City of Eugene (Current Work)

Since the adoption of the Eugene-Springfield Multi-jurisdictional NHMP in 2014 many mitigation actions have occurred in both cities. The Project Team recognized and was influenced by the continued mitigation progress, support, and trends when determining the proposed 2020 mitigation action items. The following has occurred since in the past five years.

City of Eugene-owned buildings were evaluated utilizing either Federal Emergency Management Agency’s (FEMA) Rapid Visual Screening (RVS) or the American Society of Civil Engineers (ASCE) standard methodology.

For General Fund facilities, 536,014 square feet (ft^2) out of 743,572 ft^2, or approximately 72%, of the structures were evaluated. Additionally, 126,225 ft^2 of Public Works’, 48,000 ft^2 of Planning and Development Departments’, and 25,800 ft^2 of the Eugene Airport, which included the terminal and fire station, facilities were evaluated. Currently, Metropolitan Wastewater Management Commission facilities are being evaluated.

In the past five years 100% of Essential Facilities (Fire and Police) and non-Essential facilities identified as shelters according to an Intergovernmental Agreement (IGA) with the American Red Cross have been evaluated. Three fire stations were retrofitted to meet current seismic standards totaling 13,979 ft^2. No non-essential facilities have been retrofitted in the last five years. Three recreation facilities are slated to be expanded and renovated by 2022 and will be evaluated and upgraded to the 'Life Safety' level for seismic stability.

4.7.1 City of Springfield

The City of Springfield City Hall and several city-owned bridges were evaluated using ASCE standard methodologies. Some of the seismic retrofits to City Hall have been completed, while the remaining retrofits for this building and the bridges are delayed pending additional funding.

4.7.2 Winter Storm-Specific Findings

Severe winter storms disrupt two of the three sectors all others depend upon: electricity and transportation. The disruption is more pronounced if the storm lasts more than a few days and if snow or ice accumulation is significant. The City of Eugene, in conjunction with the National Weather Service, concluded the Central Lane County winter storm interval is one every 2.9 years.

4.7.3 Landslide-Specific Findings

Since the 2014 NHMP, DOGAMI conducted a thorough study using the latest technology to create detailed, usable maps, and analyses on the level and location of the landslide hazard and risk to infrastructure using FEMA Risk Mapping, Assessment, and Planning (Risk MAP) funds.[92] The Eugene-Springfield metropolitan area was the primary focus of the study.

Landslides can stand alone as a natural hazard or be a cascading event triggered by winter storms, heavy rain, earthquakes, or technological threats. Major findings from the study include:

- 700 existing landslides were identified, including historic landslide points, covering 6% of the study area;
- More than 4,500 residents live on existing deep-seated landslides; and
- Approximately $476 million worth of buildings are located on existing deep landslides.

[92] United States. Oregon Department of Geology and Mineral Industries. *Landslide Hazard and Risk Study of Eugene-Springfield and Lane County, Oregon*. By William J. Burns, Nancy C. Calhoun, Jon J. Franczyk, and Gustavo Monteverde. 2018.

The highest risk areas identified were the south hills of Eugene and southeast hills of Springfield. The report identified existing structures located on deep landslides as the primary landslide hazard in the study area. Report recommendations included:

- Increased public outreach for property owners to heighten awareness of the hazard and precautions needed, through mitigation, to reduce the risk posed by landslides;
- Incorporate landslide hazard maps and risk reduction strategies into community planning efforts; and
- Create a landslide emergency response plan to better prepare and react to a landslide occurrence.

Over the course of the next five years Emergency Management and Planning staff will analyze the study to determine areas and buildings at risk from landslides and propose comprehensive land use policies and construction standards accordingly.

4.7.4 Lifelines and Critical Bridge Evaluations

In 2017 the Oregon Department of Transportation (ODOT) has asked Lane County to complete these two tasks:

1. Review locations of seismically vulnerable bridges along the ODOT lifelines and identify alternate routes that can be used if an earthquake occurs before the necessary bridge work is completed. Assess the feasibility, seismic vulnerability and corrective cost of these alternate routes.

2. Identify local lifelines and assess corrective costs of any vulnerable bridges. Prioritize the replacement/rehab work to remove seismic vulnerabilities in a reasonable timeline. There will be priorities placed on bridges along these routes needing retrofitting or replacement. Some of these bridges can be avoided using alternate routes, saving money for other bridges that cannot be avoided. *(See the Lane County Bridge Resiliency in the Event of an Earthquake Study, by the Engineering and Construction Services Division 4/1/2017.)*

The Cities of Eugene and Springfield understand the main ODOT routes in our area are Hwy 58 to I-5; which will be critical lifelines during a Cascadia event. However, just as critical will be the need to get equipment, personnel, and supplies from these routes to the City's internal transportation routes, supplying our Points of Distribution and Staging Areas. To this end we selected the bridges for upgrades to the ODOT routes. The Cities of Eugene and Springfield can support each other in many ways, but without these critical lifeline bridges we are virtually cut off from one another. The most glaring example is the only two major hospitals that support the area reside in the City of Springfield. This alone will put more than 165,000 people without access to a major medical facility.

The following is the recommendation submitted to the State on April 1, 2017:

The conclusions of this report identify the Eugene and Springfield's minimum number of bridges needed to be operational after the Cascadia Seismic Event.

Methodology

Eugene and Springfield have identified detour routes around most bridge structures on their critical response routes. Detour routes are not presented in this report. This report addresses only the critical route bridges lacking realistic detour routes.

Several assumptions set the context of this memo:

1) ODOT has determined that HELP will come from Eastern Oregon via HWY 58;
2) Overcrossings over I-5 that may collapse onto I-5 will be driven around or pushed out of the way;
3) Beltline Interchange at I-5 is anticipated to be operational directly after the seismic event;
4) Riverbend Peace Health and McKenzie-Willamette Hospital will be operational and the triage point for mass casualties;
5) The Eugene Airport will be a critical lifeline for transportation, response personnel and equipment, medical personnel, pharmaceuticals, and water purification needed almost immediately (and long into the recovery effort) after the event;
6) There will be no help from Salem or Portland because they will be caught in the same event; yet Eugene-Springfield will be the gathering point for refugees from the coast and the south.
7) Eugene Springfield have a combined Fire and EMS department needing access across the Eugene, Springfield, and surrounding area.

Conclusion

Bridges that must be Operational after the Event
1) 08638: Beltline over Willamette River – Sufficiency rating= 74. Cost to upgrade = $2,000,000.
2) 08705: Debrick Slough WB On Ramp to Beltline – Suff [Sufficiency] rating = 64. Cost to upgrade = $450,000.

The following three bridges are critically needed to bring HELP from I-5/HWY 58 to the southern end of Springfield and Eugene. The Glenwood area is planned to be a freight off-load and redistribution point.
1) 016329: Glenwood Blvd over UPRR [Union Pacific Railroad] – Suff [Sufficiency] rating = 93. Cost to upgrade = $300,000.
2) W6099C: Franklin Blvd over HWY 1 W and UPRR [Union Pacific Railroad] – Suff [Sufficiency] rating = 55. Cost to upgrade =$2,000,000.
3) 08051: Main Street over Willamette River (Springfield) - Suff [Sufficiency] rating =

76. Cost to upgrade = $2,250,000.

There is one bridge in each City that provides a critical intercity link over a river or a HWY that needs to be operational to access a hospital or other vital resource:
1) 6648: Ferry Street Bridge over the Willamette (Eugene) – Suff [Sufficiency] rating = 31. Cost to upgrade $2,000,000.
2) 09596: Mohawk Blvd over HWY 126 (Springfield) - Suff [Sufficiency] rating = 64. Cost to upgrade = to be determined.

The 5 high priority bridges in the list above total $6,700,000. The phase 2 intercity bridges above are estimated at $2,000,000 plus.

4.8 Impacts – Cascading Incidents

When a natural occurrence causes a man-made technological disaster, it is referred to as a natech incident. Large-scale natech impacts are rare, so determining the exact likelihood of their occurrence is difficult. Nevertheless, they may occur, so careful consideration of how Eugene and Springfield's natural hazards could cause them is imperative to understanding the risks faced by the Cities. To accomplish this, data and incidents throughout modern history, across the United States, and in some cases around the world, were reviewed. For each hazard the likelihood of it causing one of the four cascading incidents was evaluated and categorized in Section 1 (Table 1-1 and 1-2). A summary of the natech evaluation process is included below and a review of the natech impacts for each natural hazard are in Section 2.

4.8.1 Civil Unrest

Research suggests natural disasters increase the risk of civil unrest by at least 30% especially when there is motive, incentive, and opportunity for such actions (Figure 4-4). The exact number of civil unrest incidents induced by a natural hazard is hard to determine due to different reporting methods, classifications, and societal compositions. For this plan, significant civil unrest is considered as any large-scale illegal incident to which law enforcement would have difficulty responding. This was weighed against the area's incentives, motives, opportunities, and history to determine the likelihood of such incidents occurring for each specific hazard.

NATURAL DISASTERS
hydro-meteorological, geological, 'other'

Type of Impact	*Type of Natural Disaster*	*MOTIVES*	*INCENTIVES*	*OPPORTUNITIES*
Proximate (immediate impact)	Rapid onset, mostly, but slow onset can also reach discrete crisis points	Widespread suffering Destruction of living space and means of survival Refugees and Internally Displaced Persons	Acute competition for scarce resources Incentives for elite resource grabs	State capacity stretched, or focus shifts creating 'space' for resistance Declining legitimacy of state if its response is inadequate or if it is partially to blame for disaster Capture of relief resources by combatants and insurgent groups
Structural (longer-term impact)	Slow onset and Rapid onset	Increased resource allocation inequality Increased poverty Population displacement Rising income inequality	Increased competition for scarce resources Incentives for elite resource grabs	Weakening of state (Reduce resources while constraining state capacity. Distribution of collective action resources shifts away from state)
		Grievances	***Calculations of potential gains from violent civil conflict***	***Distribution of collective action resources***

VIOLENT CIVIL CONFLICT

Figure 4-4 Source*:* International Studies Quarterly, 2008 - *Summary of Casual Argument Linking Natural Disasters and Violent Civil Conflict*

4.8.2 Dam or Levee Failure

This plan only considered dam failure a significant impact of a natural hazard. To evaluate the risk posed by this impact, 90 substantial dam failures since 1802 were evaluated (Appendix H). The review only included manmade dams and did not consider the failure of natural dams. The mode of failure was cross referenced to ensure natural hazards were, in fact, the cause.

Dam and levee failures are extremely uncommon. Due to the rarity of natural hazard induced dam failures, determining the odds of such an event is difficult. Less than one percent of dams fail and only a very small portion of those are caused by natural events.[93] Additionally, for most natural hazard-induced dam failures structural (design), operational, and/or construction problems compounded the natural hazard's impact on the dam or its components.

Levee failures were not evaluated due to the regulatory variances found throughout the country complicating accurate record keeping.

More information on dams and levees affecting the Eugene-Springfield area is in Appendix H.

4.8.3 Epidemics

An epidemic is the spread of an infectious disease affecting, or tending to affect, a disproportionally large number of individuals within a population, community, or region at the same time. Epidemics are not rare following a natural disaster, but typically manifest themselves in under developed countries. The cholera epidemic in 2010-2011 after the Haitian earthquake spread quickly affecting more than 500,000 people at a significant cost to the community. Worldwide risk assessments have been determined for many natural hazard-induced epidemics.[94] Identified risk factors and data from the worldwide risk assessment was reviewed to determine the Eugene-Springfield area's risk to such an event.

4.8.4 Hazardous Materials

In general, hazardous material releases and spills occur more frequently than dam or levee failures but are still difficult to identify due to security issues concerning release of information, different reporting standards and regulations, and differing classification of what constitutes a hazardous material. Despite the differences, industries, which handle hazardous materials and have strict reporting policies, can be used to better understand the odds of a natural hazard induced hazardous material spills or release from oil pipelines. See Figure 4-5 for the percentage of natechs by hazard.

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[93] "Dams' Safety Is at the Very Origin of the Foundation of ICOLD." Dams' Safety Is at the Very Origin of the Foundation of ICOLD. Accessed April 2016. https://www.icold-cigb.org/GB/dams/dams_safety.asp.

[94] Lemonick, David M. "Epidemics after natural disasters." *American Journal of Clinical Medicine* 8, no. 3 (2011): 144-152.

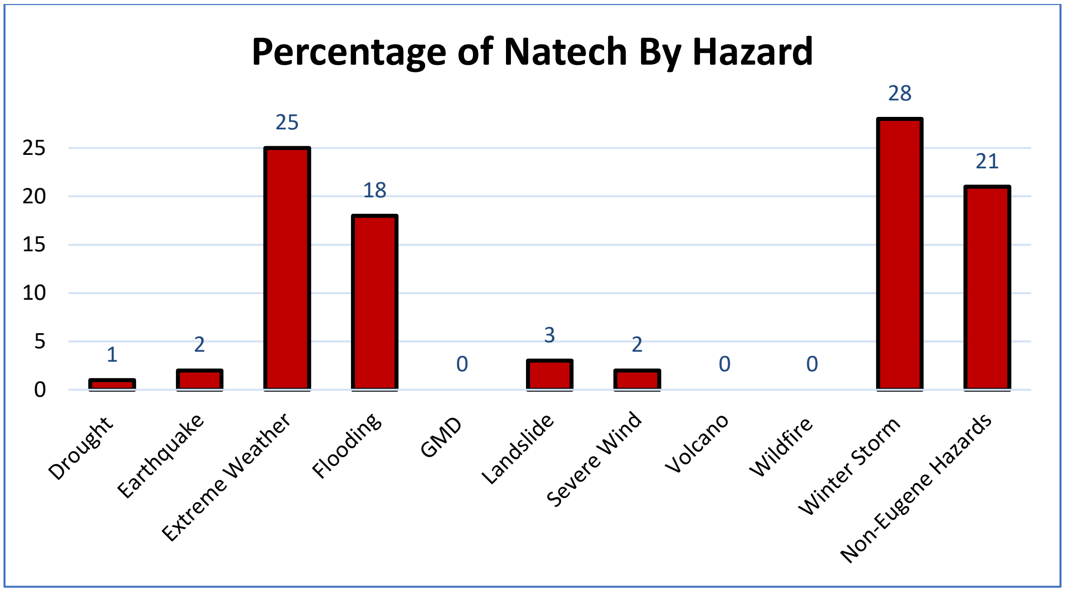

Figure 4-5 Source: Data from "Lessons learned from oil pipeline natech accidents and recommendations for natech scenario development" – *Percentage of natechs broken down by hazard. 2015.*

The Project Team reviewed indirect unintentional releases to determine the risks of hazardous materials natech events in Eugene or Springfield in Section 1 – Table 1- 2. It considered any natural hazard responsible for releasing 500 or more barrels of oil a significant impact. Additionally, hazards which could release large quantities of household hazardous materials were considered.

A JRC Science and Policy Report is helpful in determining the frequency of natural hazard induced HazMat incidents. The report analyzed the U.S. Department of Transportation's hazardous liquid transmission pipeline incident data from 1986-2012. The review included crude, hot, and white oil (paraffin, liquid petroleum, etc.) products in pipelines, terminals, tank farms, pumps, and metering stations. This report determined 5.5% of all oil industry spills in the United States were due to natural hazards.[95]

[95] Girgin, Serkan, and Elisabeth Krausmann. "Lessons learned from oil pipeline natech accidents and recommendations for natech scenario development." *JRC Science and Policy Report, EUR* 26913 (2015).

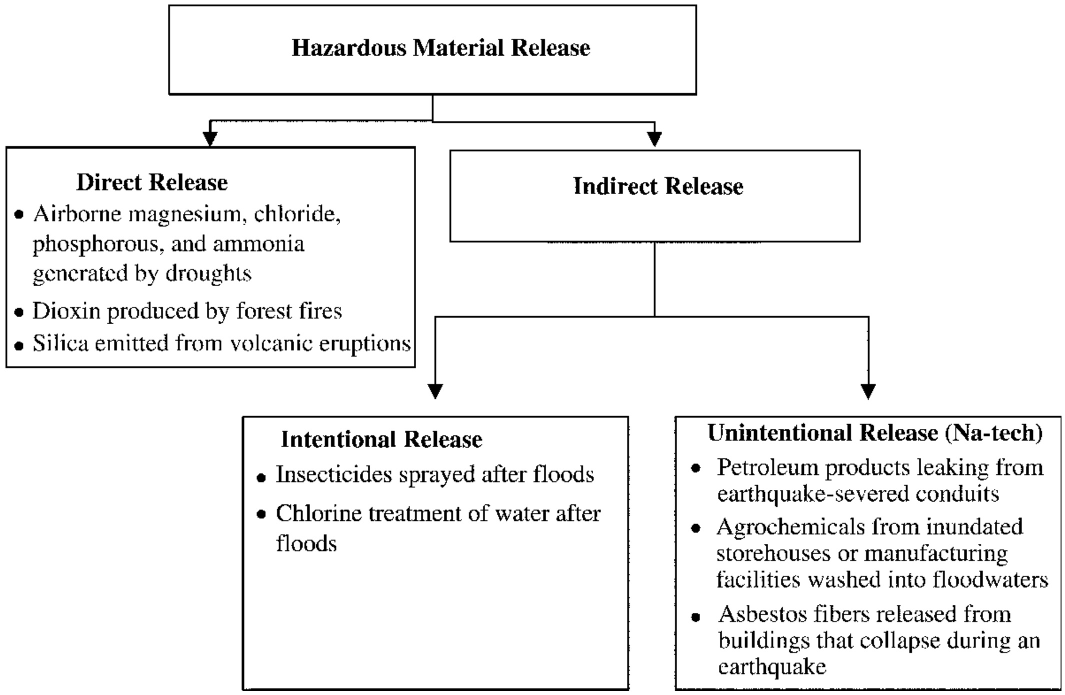

Figure 4-6 Source: Science of the Total Environment – *Classification of hazardous material releases associated with natural disasters. 2004.*[96]

4.9 Prioritization of Mitigation Action Items

For the 2020 NHMP update, the 2014 Vulnerability Assessment scores (Section 4.5.5), the research examining social vulnerability (Section 4.6), and results from public outreach conducted between 2017-2019 (Appendix B) were all considered when prioritizing Mitigation Action Items. This approach ensured the Project Team considered our community research, what community members feel is most important (public outreach), and what vulnerable populations require specific attention as part of our natural hazard's mitigation planning.

Eugene and Springfield Emergency Management developed a list of Mitigation Action Items (Appendix A) using the following information:

- The 2014 Vulnerability Assessment emphasized strengthening the fossil fuel, transportation, and electricity sectors because they are crucial to the operation of all other sectors. Sector experts identified earthquakes, winter storms, floods, and wildfire events as the hazards of greatest concern. Actions supporting these systems were raised in priority.
- The Cities of Eugene and Springfield along with Sub-Plan Holders have done

[96] Young, Stacy, Lina Balluz, and Josephine Malilay. "Natural and technologic hazardous material releases during and after natural disasters: a review." *Science of the Total Environment* 322, no. 1-3 (2004): 3-20. doi:10.1016/s0048-9697(03)00446-7.

extensive work mitigating natural hazards. Several studies were done to better understand the areas' risk which was also incorporated into evaluating Mitigation Action Items.

- Finally, many community members took time to provide feedback at numerous NHMP public outreach events. This feedback provided input on local hazard mitigation priorities (survey results are detailed in Appendix B). Respondents indicated earthquakes, geomagnetic disturbances, flooding, and winter storms are the hazards the two City governments should prioritize. Respondents also indicated a strong preference for actions protecting utilities and critical facilities.

Based on these criteria and an understanding of local conditions, emergency managers selected those actions most likely to mitigate these priority vulnerabilities.

5 Special Jurisdictions

5.1 Multijurisdictional Planning History

In 2004 and 2005, the Cities of Eugene and Springfield developed their first Natural Hazards Mitigation Plan (NHMP) entitled "Multi-Hazard Mitigation Plan for the Eugene/Springfield Metropolitan Area." Due to the proximity of the cities and shared risks for a majority of the identified natural hazards, it was determined pooling resources and developing a multijurisdictional plan was the best course of action. The Eugene-Springfield NHMP, along with the shared Emergency Operation Plan (EOP), was so successful the partnership continues to this day.

Since the initial NHMP, Eugene Water and Electric Board (EWEB), Rainbow Water Board (RWD), and Springfield Utility Board (SUB) collaborated with the cities to develop the plan. All three utilities' involvement increased significantly over the years.

In 2017, with the guidance from the Oregon Office of Emergency Management (OEM), both jurisdictions decided to reorganize the structure of the NHMP to better align with "special district" requirements set forth by the Robert T. Stafford Act, as amended by the Disaster Mitigation Act (DMA). Since EWEB, RWD, and SUB invested a significant amount of time assisting with the development of this plan, they agreed formal adoption of the NHMP was in their best interest to ensure their eligibility to participate in the programs outlined within the Stafford Act.

This annex sets forth the expectations and requirements for a special district wishing to become an official Eugene-Springfield NHMP Sub-Plan Holder.

5.1.1 Benefits of Multijurisdictional Plans

There are many reasons why a jurisdiction or special district may choose to join a multijurisdictional NHMP. Benefits of such a partnership include:

- improved communication and coordination;
- comprehensive mitigations approach to reduce risks;
- maximized economies of scale by leveraging individual capabilities;
- support from varying disciplines and backgrounds;
- shared costs and resources for the implementation of mitigation items; and
- avoidance of duplication of efforts.

5.1.2 What is a Special Jurisdiction?

A multijurisdictional hazard mitigation plan is jointly prepared by more than one jurisdiction. The Code of Federal Regulations (CFR) Title 44 Part 201, Mitigation Planning, defines jurisdictions as a “local government” which is any “county, municipality, city, town, township, public authority, school district, special district, intrastate district, or council of governments…” The 2017 Oregon Revised Statute (ORS) 198.01 defines “district,” as approved by the Oregon State Legislature. These approved districts are, generally, public entities providing a service to the public, and have an independent governing body.

Within this plan these “local governments” are referred to as special districts or Sub-Plan Holders.

5.2 Expectations

The Stafford and Disaster Mitigation Acts require the plan must clearly document how each planning partner (Plan Holder), seeking eligibility under a NHMP, participated in the plan’s development. The joint Eugene-Springfield Area Multi-Jurisdictional Natural Hazards Mitigation Plan will be considered as the base plan with each special district added as an annex. For this planning process, “participation” is defined by the following criteria:

- **Point of Contact (POC)** – Each entity is required to provide a current POC to the NHMP Project Manager.
- **Level of Effort** – There is no estimated time commitment required to become a NHMP Sub-Plan Holder. Planning effort is determined by a Sub-Plan Holder successfully completing the requirements, set forth by FEMA, to obtain an “Approvable Pending Adoption” notice within the required timeframe.
- **Participation** – Sub-Plan Holders are encouraged to attend all NHMP Update Committee meetings but are required to attend at least one a year. Each Sub-Plan Holder is responsible for completing their own public outreach, though pooling resources to do so is encouraged.
- **Duration of Process** – Sub-Plan Holders must be committed to the entire NHMP process which includes the five-year plan update cycle as well as execution of mitigations actions.
- **Hazard Identification and Risk Assessment** – All Sub-Plan Holders must complete this assessment. This includes analyzing what degradation or loss of their infrastructure would do to the surrounding community and how their risk differs from the planning area.
- **Mitigation Action Review** – At least annually, all Sub-Plan Holders must take part in a review of standing mitigation action items at a NHMP Update Committee meeting and identify at least one mitigation action for each hazard

that creates significant vulnerability to the Sub-plan Holder.

- **Plan Adoption** – The governing boards of each entity must adopt the NHMP and provide adoption documentation to FEMA via OEM in a timely manner.

The Project Manager will provide planning tools and instructions to assist in the initial creation, and subsequent updates, of each entity's respective annex. Though the Project Manger's role is to coordinate the NHMP updates, they are not responsible for creating and/or updating a special district's annex.

5.3 Procedures for Becoming a NHMP Sub-Plan Holder

To be eligible for programs under DMA a jurisdiction or special district must maintain an approved and current NHMP. Not all eligible entities within Eugene or Springfield are included within this NHMP. It is only a requirement to have such a plan if an entity wants to participate in programs laid out by the Stafford and Disaster Mitigation Acts. Entities may choose to adopt a NHMP at any time. Additionally, they can decide to absolve their involvement in this program at any time.

5.3.1 New Requests for Partnership

Eligible special districts within the Eugene-Springfield planning area may request to become a formal Sub-Plan Holder to this NHMP at any point. It's requested that interested special districts submit inquiries to the City of Eugene's Emergency Management team. The most up-to-date contact information can be found on the city's emergency management webpage.

5.3.2 Review of Requests to Become an Official Sub-Plan Holder

Upon notification by an interested special district, the NHMP Project Manager will provide any additional information and/or collect needed information from the interested party. The NHMP Project Team will then review the request. This review will look at:

1. Is the entity eligible under the guidelines set forth by the Stafford and Disaster Mitigation Acts?
2. Are the entity's hazards similar to the base plan's identified hazards?

After this review the entity will be notified of either:

- their approval; or
- their denial with an explanation and recommendation on what NHMP development path may better suit their special district.

An example of this would be a publicly owned utility, with its own governing board, serving half of a county. This utility fits the definition of a “special district” outlined within the Stafford Act. Since the service area is much larger than a single city, however, their request would be declined. This is due to the fact they do not share the same hazards or planning area as the base plan. It would be recommended for this special district to either develop their own NHMP or partner on the county’s NHMP. If this was a real example, the Project Manager would offer information and guidance on the best way to pursue this course of action.

5.4 Terminating Sub-Plan Holder Partnerships

The eligibility afforded under this process to official NHMP Sub-Plan Holders can be terminated in two ways. First, a Sub-Plan Holder can request to be removed from the plan. This may be done because the Sub-Plan Holder has decided to develop its own plan, identified another NHMP better suited to its needs, or they no longer wish to take part in the programs for which an approved and current plan makes them eligible.

A Sub-Plan Holder wishing to voluntarily leave the plan shall inform the NHMP Project Manager of this request in writing. This notification can occur at any time during the course of the planning cycle. A Sub-Plan Holder wishing to purse this course of action is advised to make sure they are eligible under a new planning effort to avoid any period of noncompliance under the DMA.

Upon notification of this intent the Project Manager will immediately notify both the Oregon Office of Emergency Management (OEM) and FEMA in writing of the Sub-Plan Holder’s desire to no longer be a part the planning effort, and the eligibility afforded to the Sub-Plan Holder should be rescinded upon the plan’s expiration.
The second way a Sub-Plan Holder may terminate their partnership with this plan is by failing to meet the expectations for a NHMP Sub-Plan Holder (see Section A.2). Each Sub-Plan Holder agreed to these terms upon adopting the plan.

The Project Manager and Project Team will monitor a Sub-Plan Holder’s eligibility status. The determination of whether a partner is following the expectations of a Sub-Plan Holder will be based on the following factors:

- Is the Sub-Plan Holder providing current POC information to the NHMP Project Manager in a timely manner?
- Is the Sub-Plan Holder supporting the NHMP Update Committee by attending the required number of meetings?
- Is the Sub-Plan Holder completing and maintaining an approvable annex?
- Is the Sub-Plan Holder making a reasonable effort to complete mitigation action items?

- Is the Sub-Plan Holder completing adequate natural hazard mitigation outreach as laid out under regulation 44 CFR 201.6 for local mitigation plans?

Completing an annex does not end with plan approval. This partnership was formed on the premise Sub-Plan Holders would pool resources and strive to reduce risk within the planning area. Failure to support this lessens the effectiveness of this effort. Before removing a Sub-Plan Holder from this planning process the NHMP Project Manager will:

- collect justifications for this decision;
- inform the NHMP Project Team of this information;
- notify the Sub-Plan Holder of possible termination of partnership and request their explanation and intentions;
- confirm Sub-Plan Holder's wish to no longer participate in the NHMP;
- conduct a vote by the NHMP Project Team to terminate the partnership with the Sub-Plan Holder in question; and
- provide written notification to the Sub-Plan Holder's POC of termination of partnership, and information on when eligibility under the current NHMP expires.

There is no penalty for terminating this partnership. The special district in question is responsible for ensuring their eligibility under the Stafford and Disaster Mitigation Acts via a different NHMP planning process, however. If the special districts wish to terminate their involvement in maintaining a NHMP completely, it is their responsibility to understand what that means for their special district and take full responsibility for any programs for which they are no longer eligible.

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A Eugene Water & Electric Board

NHMP Project Team Member:

Jeannine Parisi, Customer Relations Manager

A.1 Jurisdictional Profile

A.1.1 Introduction

The Eugene Water & Electric Board (EWEB) is the largest publicly owned electric and water utility in Oregon. The City of Eugene (the City) commenced utility operations in 1908 with the purchase of a privately-owned water system. In 1911, upon completion of the City's first municipal hydroelectric power plant, the City organized the Eugene Water Board to operate the City's electric and water utilities. The name of the Eugene Water Board was changed to the Eugene Water & Electric Board in 1949.

EWEB is chartered by the City and supplies electric and water service within the city limits of Eugene and to certain areas outside the city limits. Employing about 500 people, EWEB operates as a primary government, and is not considered a component unit of the City. EWEB is governed by a five-member Board of Commissioners who are elected by voters residing in the City. The Board is responsible for the adoption of this plan and funding for priority activities. The General Manager will oversee plan implementation

- **Population served**: 168,916 (2017 estimate, U.S. Census Bureau)
- **Land area served**: 236 square miles
- **Land area owned**: 44.15 square miles

This annex notes EWEB specific variances from the Eugene-Springfield Area NHMP base plan (Sections 1-4, 6). Variances arise due to differing risks faced by EWEB compared to the Cities of Eugene and Springfield. The different risks are due to utility specific regulations, infrastructure, and locations. Unless explicitly expressed by this annex, EWEB complies with the 2020 NHMP. Public outreach activities are located in Appendix B.

A.1.2 Electric System

The Electric System supplies service to 93,000 residential, commercial, and industrial customers within the City of Eugene and areas along the McKenzie River between the cities of Walterville and Vida, where two of EWEB's hydro-power plants are located.

Power delivered to customers is supplied by the Bonneville Power Administration (BPA) via EWEB-owned generation resources, other contracted resources, and purchases from the wholesale energy markets. EWEB's power supply sources are primarily hydro-power, but also include wind, biomass, and solar. The electric utility's 2019 operating budget is $212 million. The budget for capital improvements is $37 million and the budget for debt service is $16 million.

- **Total Electric System Service Area**: 236 square miles
- **Transmission and distribution lines**: 1,300 miles
- **Substations**: 38
- **Utility-owned hydroelectric facilities**: 4

Electric System operating assets historical costs[1] are listed below (Table A-1). A new operating license for the Carmen-Smith Hydroelectric Project was issued in May 2019. Capital improvements at this facility under the new licensing requirements are projected to cost $116 million. The insured value of all hydro-electric production facilities, which approximates replacement value, is over $320 million as of March 2019.

The estimated values of major electric assets are listed in below.

Table A-1 Historical Cost

Major Electric Asset	Historical Cost (As of Dec 2018)
Land	$8,969,999
International Paper Biomass (Turbine #4)	$10,363,488
Foote Creek[2] Wind Farm	$11,789,767
Hydro Production[3]	$162,579,170
Transmission	$84,785,666
Distribution	$313,808,256

[1] Cost when the asset was first placed in service and capital improvement costs to that asset over time.
[2] Windfarm located in Carbon County, Wyoming, co-owned with Pacific Power Corp.
[3] Includes $29 million for the Stone Creek Hydroelectric project located on Clackamas River, Oregon.

General Plant[4]	$158,027,521
Telecommunications	$19,452,088
Completed Construction, not yet classified	$16,979,283
Construction Work in Progress	$16,972,396
TOTAL:	$803,727,634

Source: EWEB

Current and Anticipated Service Trends

Studies commissioned by the City of Eugene estimate the area's population will grow by 34,000 people by 2031, or by an average annual rate of 1.4 percent. However, unless a large industrial facility locates in our service territory, electric consumption trends are expected to stay relatively flat, with most new customers served through existing facilities and energy resources. This is due to higher energy efficient buildings and equipment, use of natural gas for heating and industrial uses, and the on-going success of utility energy conservation programs.

A.1.3 Water System

EWEB provides treated drinking water to 61,000 residential, commercial, industrial, and public sector customers within its Eugene service territory. EWEB also supplies wholesale water to the River Road and Santa Clara water districts in unincorporated North Eugene and has wholesale water contracts with the City of Veneta and the Willamette Water Company.

The water utility maintains three water rights for drinking water at a single point of delivery on the McKenzie River. EWEB efforts to diversify water supply sources include a groundwater permit issued in 2008 and a surface water registration and permit issued on the Willamette River. Water permits will not be certificated until a sufficient volume of water from these sources is distributed for municipal use.

Raw water is collected via two river intake structures located at Hayden Bridge in Springfield and delivered to a nearby treatment plant. The water treatment plant pre-treats, filters, and treats the raw water for consumption. Two large transmission lines in a seven-mile long corridor bring treated water to the Eugene city limits. From there, transmission and distribution pipelines deliver water to customers.

EWEB operates three primary baseline reservoirs to store water, and a number of smaller reservoirs at upper elevations. Pressure to deliver the water is controlled largely from the filtration plant which is capable of serving approximately 85 percent of EWEB

[4] Includes electric utility portion of fleet and administration/operational buildings.

consumers. A system of pumps and reservoirs serve EWEB's remaining consumers. The Water System's 2019 operating budget is $20 million. The budget for capital improvements is $15 million and the budget for debt service is $5 million.

- Reservoirs: 23 (89 M gallons capacity)
- Pump stations: 27
- Water distribution system: 800 miles

The estimated value of major water utility assets, in historical cost and insured values (when value approximates replacement costs) is listed below (Table A-2).

Table A-2 Estimated Value of Major Water Utility Assets

Major Water Utility Assets	Historical Cost (as of Dec 2018)	Insured Value (as of March 2019)
Land	$1,258,733	
Hayden Bridge Treatment Plant	$35,742,975	$99,332,597
Source of Supply	$24,411,213	
Water Transmission & Distribution	$145,416,693	
Reservoirs/Pumping	$38,653,795	$74,279,546
General Plant	$37,847,775	
Completed Construction, net yet classified	$6,418,961	
Construction Work in Progress	$6,551,690	

Source EWEB.

Current and Anticipated Service Trends

Similar to the electric utility, water consumption remains nearly flat despite population growth. While annual usage is highly weather dependent, the growth trend is marginal over time due to efficiency standards in plumbing codes and changing irrigation practices. Additional wholesale water contracts to nearby small cities are technically feasible but not likely in the near future.

A.2 Applicable Regulations, Plans

EWEB's elected Board of Commissioners annually reviews and adopts the ten-year capital improvement plans for the water and electric utility. Resiliency is a strategic priority for the utility, therefore the mitigation actions described in the Natural Hazard Mitigation Plan are reflected in the capital improvement plans. Over the next five years, EWEB has plans for $204M in electric capital projects and $95M in water system upgrades. Annual Board review and adoption of the capital improvement plans ensures that mitigation action items have both policy-level and financial commitments for implementation and affords a mechanism to explicitly track project progress or delays in a public meeting setting. Once adopted, EWEB's NHMP priority actions will be included as an attachment to the capital improvement plans to further reinforce integration of the plans.

- **Eugene City Charter Chapter X, Section 44:**
  Conveys authority to maintain and operate the electric and water utility to the Eugene Water & Electric Board.

- **Eugene City Code 2.175 – 2.212**
  Sets forth powers and duties of the Eugene Water & Electric Board.

- **2019 Electric and Water 10-Year Capital Improvement Plans**
  Describes routine capital work like pole and water main replacements, specific upgrades over $1 million such as reservoir rebuilds, and large multi-year projects typically financed through bonds. The $311 million electric and $212 million water plans have a strategic focus on reliability and resiliency.
- **2018 – 2022 Water Management and Conservation Plan**
  Required submission to Oregon Water Resources Board that includes water curtailment response.

- **2016 Emergency Action Plans for Carmen-Smith Hydroelectric Project and Leaburg/Walterville Power Canals**
  Provides guidance to EWEB staff and emergency response personnel to safeguard the lives and property of people living in close proximity to and downstream of EWEB hydroelectric facilities; required and approved by the Federal Energy Regulatory Commission.

- **2015 EWEB Water System Master Plan**
  Outlines long term planning options for resiliency, reliability and optimization of EWEB's water System.

- **2012 EWEB Emergency Water Supply Plan**
  Analyzes options for secondary drinking water supplies and outlines a path forward to provide provisional water to EWEB customers.

- **Mutual Aid Agreements for Electric Restoration Efforts**
  - Lane Mutual Aid Agreement (2017)
  - Western Region Mutual Assistance Agreement (2014)
  - EWEB, Rainbow Water District, and Springfield Utility Board Mutual Aid Agreement (2006)

- **NERC Emergency Operations Plans**
  Specifies electric load shedding required under emergency conditions. Dictates communications with outside electrical supply entities and required restoration actions and coordination.

A.3 Jurisdiction-Specific Natural Hazard Event History

Table A-3 lists past occurrences of natural hazards affecting EWEB over the past 15 years and the damage received to EWEB assets for each incident.

Table A-3 Natural Hazard Events

Type of Event	FEMA Disaster # (if applicable)	Date	Preliminary Damage Assessment
Severe Winter Storm	TBD	February 25 – March 4, 2019	$4.3M
Windstorm	N/A	April 7, 2017	
Winter Storm/Freezing Rain	DR-4296-OR	December 14 -17, 2016	$4.2 M
Severe Winter Storm	DR-4258-OR	December 6 – 23, 2015	$195,000
Severe Winter Storm	DR-4169-OR	February 6 – 14, 2014	$1.9 M
Severe Winter Storm	DR-4055-OR	January 17-21, 2012	$35,000
Severe Winter Storm		March 21-26, 2012	
Windstorm		March 13 - 16, 2011	
Severe Winter Storm		December 27 – 29, 2008	
Windstorm		February 2-4, 2006	
Windstorm	FEMA-1405-DR-OR	February 7, 2002	$1.5 M

Source EWEB.

A.4 Hazard Risk Ranking

Table A-4 presents the ranking of hazards of concern, using vulnerability multiplied by probability divided by capacity to calculate and prioritize total risk to Eugene Water and Electric Board (see Section 4.2.2, Components of Risk Analysis, for an explanation of the Risk Metrics). These are the identified hazards to EWEB and may vary from those listed in Section 1, Table 1-1.

Table A-4 EWEB Risk Matrix

Hazard	Vulnerability High = 3 Moderate = 2 Low = 1	Probability High = 3 Moderate = 2 Low = 1	Capacity High = 3 Moderate = 2 Low=1	Risk Total <1.5 = Low 1.5-2.9 = Moderate 3-4.5 = High >4.5 = Very High	Risk
Earthquake	3	2	1	6	Very High
Windstorm	3	3	2	4.5	High
Winter storm	3	3	2	4.5	High
Wildfire	2	3	2	3	High
Flood - Riverine	2	2	2	2	Moderate
Drought	1	3	2	1.5	Moderate
Geomagnetic Disturbance	1	2	2	1	Low
Landslide	1	2	2	1	Low
Volcano	1	1	3	.33	Low

Source EWEB.

As Table A-4 above indicates, EWEB's risk ranking is nearly identical to the planning area. The one exception is geomagnetic disturbances, which ranked low in EWEB's evaluation. As a local utility, EWEB manages relatively little electric transmission infrastructure, which is most sensitive to this phenomena therefore our asset vulnerability is comparatively small. Further, events of this nature are managed proactively by the Bonneville Power Administration which has protocols and actions EWEB would take to shed electric load in advance of a predicted event and requirements EWEB would follow during an actual geomagnetic disturbance to limit damage to our systems.

A.5 Evaluation of Recommended Action Items

Table A-5 lists the initiatives that make up the EWEB hazard mitigation plan. EWEB is the lead agency and funding source for these initiatives unless otherwise noted.

Table A-5 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazard Mitigated	Mitigation Action	Estimated Cost	Timeline
	X	Earthquake, Geomagnetic disturbances	Seismic upgrades of critical facilities: Rebuild Currin Substation using IEEE[5] standards to reduce risk of interference with electrical equipment from geomagnetic disturbances.	$750K[6] (substation)	2020-2021
X	X	Earthquake	Seismic upgrade of critical facilities: Changes to EWEB Roosevelt Operations Center (ROC) to remain operational after earthquake event; move EWEB dispatch into ROC from EWEB Headquarters and build new back-up control center in seismically sound building at Hayden Bridge.	$3.5 M	2019-2025
	X	Earthquake	Seismically anchor transformers, and control building, and add flexible bus connections at nine substations.	$1.2 M	2019-2027
X		Multi-Hazard (earthquake, flood-riverine, winter storms, windstorms, geomagnetic disturbances)	Seismic upgrade to critical facilities: New Holden Creek Substation built to seismic standards replacing Leaburg Substation on riverbank using IEEE standards; removes 17 miles overhead electric lines. Add second transformer for resiliency.	$7.5M	2018-2020

[5] Institute of Electrical and Electronics Engineers (IEEE) 693

[6] Total project cost of Currin Substation Rebuild is estimated at $7.5M. Only costs associated with seismic upgrade, estimated at 10% of new construction overall costs, are included.

Table A-5 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazard Mitigated	Mitigation Action	Estimated Cost	Timeline
X		Earthquake	Replace baseline reservoirs[7] with seismic-code facilities	$10M per site	2023 (first reservoir)
X		Earthquake, Landslide	Use all-restraint water mains in areas prone to landslides	2 times cost of standard pipe	2030
X		Earthquake, Flood-Riverine	Replace gaseous chlorine at filtration plant with on-site liquid hypochlorite system with 90 days on-site storage	$3.5M	2019
	X	HazMat	Change out mineral oil to non-toxic FR3[8] in new transformers to reduce spill risk when poles fall or transformers fail, focusing on 427 upriver transformers.	Approx. $800k/year	2030
X		Multi-Hazard (earthquake, wildfire, drought)	Establish micro-grids and emergency pumping and filtration systems at critical facilities for drinking water distribution and independent electric operation. Micro-grids at Howard Elementary School has been installed, and a 1 MW system at EWEB Roosevelt Operations Center are currently under development.	$1M per site[9]	2018 - 2023
	X	Multi-Hazard (earthquake, wildfire, volcano, windstorm)	Test blackstart capabilities, load requirements, and transmission switching needs for Leaburg hydro-electric plant to power critical facilities in Eugene during major outages.	$50,000	2019 - 2023

[7] EWEB has three 'base' elevation reservoirs that serve over 80% of our customers.
[8] FR3 fluid is a natural ester derived from renewable vegetable oils – providing improved fire safety, transformer life/loadability, and environmental benefits.
[9] Howard Elementary School installation supported in part by Oregon Department of Energy grant ($300k).

Table A-5 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazard Mitigated	Mitigation Action	Estimated Cost	Timeline
	X	Multi-Hazard (windstorm, winter storms)	Re-frame 4.3 miles of electric line and undergrounding 1.5 miles of line in 15 high outage areas.	$2.7M[10]	2019-2020
X		Multi-Hazard (earthquake, wildfire, drought)	Develop emergency water distribution sites using wells at area schools/community centers – two sites completed, and three other sites are in design or construction.	$200K per site	2018 - 2023
X		Multi-Hazard (earthquake, wildfire, drought)	Construct new water filtration plant on the Willamette River for secondary source of supply and treatment/delivery options for drinking water.	$50M	2023-2030
X		Multi-Hazard (earthquake, wildfire, drought)	Construct and test mobile treatment trailer that can deliver potable water from sources like rivers or pools.	$80,000	2020

Table A-6 below lists the action items contained in EWEB's hazard mitigation plan and identifies the priority for each item based on probable benefits, funding availability and project timeline. It is not intended to act as a formal cost/benefit analysis.

Table A-6 Mitigation Strategy Priority

Mitigation Action Item	Hazards Mitigated	Costs	Benefits	Benefits Equal or Exceed Cost?	Grant Eligible?	Can be funded under existing programs or budgets?	Priority
Rebuild/Seismic Upgrades to Currin Substation	Earthquake, GMDs	Low	Moderate	Yes	Yes	Yes	High

[10] $1.5M of project funded via FEMA Public Assistance grant award (DR-4296) following 2016/17 winter storms.

Table A-6 Mitigation Strategy Priority

Mitigation Action Item	Hazards Mitigated	Costs	Benefits	Benefits Equal or Exceed Cost?	Grant Eligible ?	Can be funded under existing programs or budgets?	Priority
Seismic Upgrades to Critical Facilities: EWEB Operations and Dispatch	Earthquakes	Moderate	Moderate	Yes	Yes	Yes	Moderate
Anchor Substation Transformer	Earthquake	Moderate	Moderate	Yes	Yes	Yes	High
Replace Leaburg Substation w/New Holden Creek Substation	Earthquakes, Multi-hazard	Low	High	Yes	Yes	Yes	High
Rebuild/Rebuild Baseline Reservoirs	Earthquakes	Moderate	Moderate	Yes	Yes	Yes	Moderate
All-Restraint Water Mains	Earthquake, Landslide	Moderate	Moderate	Yes	Yes	Varies	Low
Build Hypochlorite System at Filtration Plant	HazMat, Earthquake, Riverine flood	Moderate	High	Yes	N/A	Yes	High
Replace Mineral Oil with FR3 in Transformers	Earthquakes, Multi-hazard	Low	Moderate	Yes	N/A	Yes	Low
Establish Micro-Grids @ Emergency Facilities	Multi-Hazard (Earthquake, Wildfire, Drought, HazMat Spill)	Moderate	Low	No	Varies	No	Low
Enable Localized Generation to Power Critical Facilities	Multi-Hazard (Earthquake, Wildfire, Volcano, Windstorm)	Moderate	Moderate	Yes	Varies	Yes	Moderate

Table A-6 Mitigation Strategy Priority

Mitigation Action Item	Hazards Mitigated	Costs	Benefits	Benefits Equal or Exceed Cost?	Grant Eligible ?	Can be funded under existing programs or budgets?	Priority
Undergrounding /Re-Framing Electric Distribution	Winter Storm, Windstorm	Low	High	Yes	Yes	Yes	High
Develop Emergency Water Distribution Sites	Multi-Hazard (Earthquake, Wildfire, Drought, HazMat Spill)	Low	Moderate	Yes	Yes	Yes	High
Develop Emergency Water Distribution Sites	Multi-Hazard (Winter Storm, windstorm, landslide)	Low	Moderate	Yes	Yes	Yes	High
Secondary Water Filtration Plant	Multi-Hazard (Earthquake, Wildfire, Drought, HazMat Spill)	High	High	Yes	No	No	Moderate
Mobile Water Treatment Trailer	Multi-Hazard (Earthquake, Wildfire, Drought, HazMat Spill)	Low	Moderate	Yes	Yes	Yes	High

A.6 Future Needs

EWEB will be conducting a water system risk and resilience assessment in accordance with recent updates to Section 1433 of the Safe Drinking Water Act. This risk assessment of both natural disasters and bio-terrorist attacks is to be submitted to the Environmental Protection Agency by March 31, 2020.

Additional analysis is also planned around improving our ability to isolate and serve critical facilities using just our localized energy resources. Studies planned include modeling the load capabilities of additional generation supplies beyond EWEB hydro-electric facilities such as the University of Oregon natural gas plant and industrial co-generation plants, and assessing what electric distribution system automation is needed to quickly shed load and redirect power to critical facilities.

As part of our focus on resiliency, the utility will be developing staff evacuation plans for flood/wildfire events and updating EWEB business continuity plans.

A.7 Additional Comments

Since the adoption of the 2014 NHMP, EWEB has completed several initiatives to mitigate community risk to hazards of concern. Some of these were listed in the plan, while others were not included at the time. Action Item updates for the 2014 NHMP are in Appendix A. Some mitigation initiatives completed but not outlined in the 2014 NHMP include:

- Seismic upgrades of critical facilities: a $3 million upgrade to the Hayden Bridge Filtration Plant was completed in 2017 and constructed the seismically-rated Holden Creek Substation.
- Back-up power at critical facilities: a $1.0 million project to add back up power to the Hayden Bridge raw water intake system and treatment plan was completed in 2018. The back-up generation is sufficient to deliver 20 million gallons of water per day and has the fuel capacity to run 24- hours without re-fueling.
- Purchased property and completed preliminary design for construction of secondary water treatment plant on the Willamette River ($2.5M).
- Installed seismic early warning systems at two hydro-electric plants to automate safety actions and reduce risk to life/property in partnership with the University of Oregon ($25K).
- Provided approximately 15,000 three-gallon emergency water containers to EWEB customers at discounted price to use at emergency distribution sites/mobile trailers, with considerable outreach and education as part of the distribution process (approximately $100k).
- Purchased and equipped three mobile water distribution trailers to provide emergency drinking water during outages ($80,000 each). Two trailers were loaned to Salem/Keizer personnel to provide drinking water to residents during a multi-week water curtailment due to algal bloom in summer 2018.
- Completed two emergency water distribution well sites and hosted utility/community drills where residents could fill free water storage containers using distribution equipment and learn how to disinfect water for public use (October 2018 and May 2019). Next step is to create an operating manual so that non-utility personnel can set up and disperse water during emergencies enabling EWEB staff to focus on system repairs and service restoration. Our goal is to have another two sites up and running by the end of 2019.

- Installed microgrid for back-up power to the emergency well and other facilities at Howard Elementary School. Final commissioning will be completed this summer.
- Conducted power system and generator capability studies in 2018 for islanded operation of critical loads at Leaburg facility.
- Completed seismic anchoring retrofit of Spring Creek and Prairie Substation transformers.

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B Rainbow Water & Fire District

NHMP Project Team Member:

Jamie Porter, Superintendent

B.1 Jurisdictional Profile

B.1.1 Introduction

Rainbow Water & Fire District was incorporated as a domestic water supply district by a Lane County election held August 22, 1949. On June 9, 1952, Lane County voters also empowered the district to protect its inhabitants from fire, which Rainbow has fulfilled by contracting with the City of Springfield under an intergovernmental agreement for fire protection and emergency medical services. In 1985, Rainbow formally changed its name to Rainbow Water and Fire District to provide clarity on property tax bills but continues to do business as Rainbow Water District.

Rainbow is a special district, a political subdivision of the State of Oregon serving residents of unincorporated Lane County adjacent to the Springfield city limits. Rainbow's primary purpose is to provide water for domestic use, secondarily providing fire protection and operating a small system of streetlights on higher volume county roads in Rainbow's service area. A five-member Board of Commissioners, elected by the residents within its service boundaries, governs the district. RWD employs seven employees. The Board is responsible to adopt this plan and fund priority activities. The Superintendent will oversee plan implementation.

- **Population served**: 23,000 (City and County customers in north Springfield comprise about 37% of the population of Springfield, which was 62,353 per the 2017 U.S. Census Bureau estimate)
- **Land area served**: 8.0 square miles (Rainbow-served portions of north and west Springfield)
- **Land area owned:** 23.3 acres

This annex notes the Rainbow Water District specific variances from the Eugene-Springfield Area NHMP Base Pan (Sections 1-4). Variance arise due to differing risks faced by RWD compared to the Cities of Eugene and Springfield. This is due to utility specific regulations, infrastructure, and locations. Unless explicitly expressed by this annex, RWD complies with the Base Plan. Public outreach activities are in Appendix B.

B.1.2 Water System

Rainbow provides drinking water to 2,400 residential customers within its county service area in north Springfield. Rainbow also provides wholesale water to the Springfield Utility Board for use by residential, commercial, industrial, and public sector customers inside the city limits.

The utility maintains permitted and certificated water rights to use groundwater from eleven wells located at four different wellfield facilities in North Springfield. Groundwater is pumped to the surface and disinfected with chlorine. Transmission piping delivers the treated water to the distribution system for consumption.

Chase Well #2 is classified as groundwater under the influence of surface water and receives additional filtration. The Chase Wellfield also raises the pH of the water to reduce the potential for corrosion. The Weyerhaeuser Wellfield is jointly owned and operated by Springfield Utility Board (SUB), and has additional treatment provided by granular activated carbon filters.

Rainbow operates two storage reservoirs (Kelly Butte and Moe Hill/Vitus Butte) to store water for fire protection and daily demand in the North System. (Springfield Utility Board is a part owner of Moe Reservoir, and has six other reservoirs to serve other parts of Springfield.) The discharge pressure of the deep well pumps delivers water directly to the reservoirs. Rainbow's annual operating budget is $2.5M.

- **Reservoirs**: 2 (5 million gallons total capacity)
- **Wells**: 11 (including 3 jointly owned with Springfield Utility Board)
- **Water transmission/distribution system**: 12 miles

Total value of critical infrastructure and equipment owned by the water district is $9.9M.

The estimated value of major water district assets is listed below in Table B-1.

Table B-1 Estimated Value of District Assets

Asset	Estimated Value
Chase Wellfield Water Treatment	$2,876,329
Source of Supply	$2,363,657
Water Transmission & Distribution	$3,144,568
General Plant	$1,520,636

B.1.3 Current and Anticipated Service Trends

Rainbow primarily serves single family residential county customers on septic systems. Most new development takes place inside the City of Springfield limits, to allow higher densities and connection to public sewer. Because of this development pattern, Rainbow sees very little new construction activity, yet helps serve new City customers through our wholesale contract with SUB.

As property within the boundaries of Rainbow is annexed to the City, water customers are transferred to SUB who will be the eventual water provider as the City expands. Small infill housing developments have provided new customers, however, so the Rainbow customer count has been stable and is anticipated to remain steady for the duration of this plan.

The Springfield area has experienced modest population growth, but more efficient plumbing codes and irrigation practices have offset increased demand to keep water consumption trends relatively flat. Annual usage is weather dependent, so seasonal fluctuations still do occur.

With the low volume of private development, Rainbow staff have been able to invest time in the management and operations of the water systems for the unincorporated communities of Marcola, Deerhorn, and Shangri-La. These small systems operate independently with their own water supplies and part-time operators, under the supervision of Rainbow's licensed staff.

B.2 Applicable Regulations, Plans

- **Oregon Revised Statutes, Chapter 264**
  Conveys the statutory authority to operate as a domestic water supply district.
- **1995 Urban Services Agreement**
  Guidance for coordination of water services inside the Urban Growth Boundary.
- **2006 Mutual Aid Agreement for Cooperative Interties**
  Provision for the emergency exchange of water between Eugene Water & Electric Board (EWEB), SUB and Rainbow, with the Eugene-Springfield water utilities sharing water supplies during times of potential or actual water shortage.
- **2010 Water System Master Plan (joint SUB & Rainbow)**
  Outlines long-term planning options for resiliency, reliability and optimization of the joint SUB and Rainbow water System. (A 2019 master plan update is in progress)
- **2018 – 2023 Water Management and Conservation Plan**
  Required submission to Oregon Water Resources Board that includes water curtailment response.
- **Oregon Water/Wastewater Emergency Response Network**
  Voluntary mutual aid agreement between Oregon utilities to share resources and equipment, and improve emergency planning, coordination, and training.

Opportunities for Rainbow Water District to expand upon or otherwise improve existing policies and programs include:

- Incorporate NHMP 2020 findings or projects into the pending SUB-RWD 2020 Water System Master Plan.
- In accordance with policies promulgated by the 2013 Oregon Resilience Plan, develop a seismic risk assessment and mitigation plan that both identifies critical facilities and evaluates the likelihood and consequences of seismic failures. (This will take our existing analysis of storage reservoirs and expand upon it to include pipelines and buildings.)
- Provide additional information on Flood Riverine impacts expected from climate change or private development responses to support regional FEMA remapping efforts.
- Map critical facilities in relation to each hazard.
- Conduct one or more Rainbow-specific events to educate customers about natural hazard risks and the district's mitigation efforts.

B.3 Jurisdiction-Specific Natural Hazard Event History

Table B-2 lists occurrences of natural hazards which have impacted Rainbow Water District over the past 5 years.

Table B-2 Natural Hazard Events

Type of Event	FEMA Disaster # (if applicable)	Date	Preliminary Damage Assessment
Flooding Event		April 7-9, 2019	
Heavy Snow Event	DR-4432-OR	Feb. 23-26, 2019	
Windstorm		April 7, 2017	
Winter Storm/ Freezing Rain	DR-4296-OR	December 14-17, 2016	$5,000 (actual $4963 paid out on 3/16/18)
Severe Winter Storm	DR-4258-OR	December 6-23, 2015	
Severe Winter Storm	DR-4169-OR	February 6-14, 2014	

B.4 Hazard Risk Ranking

Table B-3 presents the ranking of hazards of concern, using vulnerability multiplied by probability divided by capacity to calculate and prioritize total risk to Rainbow Water District (see Section 4.2.2, Components of Risk Analysis, for an explanation of the Risk Metrics). These are the identified hazards to RWD and may vary from those listed in the Section 1, Table 1-1.

Table B-3 RWD Risk Matrix

Hazard	Vulnerability High = 3 Moderate = 2 Low = 1	Probability High = 3 Moderate = 2 Low = 1	Capacity High = 3 Moderate = 2 Low=1	Risk Total <1.5 = Low 1.5-2.9 = Moderate 3-4.5 = High >4.5 = Very High	Risk
Earthquake	3	2	1	6	Very High
Winter Storm	3	3	2	4.5	High
Flood - Riverine	3	3	2	4.5	High
Windstorm	2	2	1	4	High
Drought	2	3	2	3	High
Wildfire	2	2	2	2	High
Geomagnetic Disturbance (GMD)	1	3	2	1.5	Low
Landslide	1	2	2	1	Low
Volcano	1	1	3	.33	Low

The RWD risk matrix differs slightly from the planning area. Flood – riverine risk is raked high for RWD due to the location of our wellfields. Adjacent to the McKenzie River, our wellfields are susceptible to flooding which could directly impact our access to the wellfields and our ability to continue to safely supply water. Alternatively, landslide risk is rated low because we do not have facilities in identified landslide-prone areas, although pipelines still have some vulnerability. Finally, we rank geomagnetic disturbance risk as low. A GMD could interrupt the electric grid or our control systems, however we have multiple wells and expect to be able to continue providing water under emergency conditions using portable generators and manual level controls.

B.5 Evaluation of Recommended Action Items

Table B-4 lists Rainbow Water District's natural hazard Mitigation Action Items. RWD is the lead agency and funding source for these initiatives unless otherwise noted.

Table B-4 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazards Mitigated	Mitigation Action	Estimated Cost	Timeline
X	X	Multi-Hazard (earthquake, winter storm, windstorm, wildfire)	Install transfer switch and used backup generator at Rainbow office (primary control center)	$12,000	2016-17 Completed
X	X	Multi-Hazard (earthquake, winter storm, windstorm, wildfire)	Install transfer switch at Chase Wellfield for emergency water supply and treatment power	$55,000	2017-18 Completed
X	X	Multi-Hazard (earthquake, winter storm, windstorm, wildfire)	Purchase generator and install transfer switch at Chase Wellfield for backup EOC SCADA/lighting	$8,000	2017-18 Completed
X	X	Earthquake	Flexible joints and seismically-actuated isolation valves at Moe Hill (Vitus Butte) Reservoir	$535,000	2017-21
X	X	Earthquake, Flood-Riverine	Install automatic valve actuators for chlorine gas cylinders at all wellfields (Chase equipped 2018)	$50,000	2018-20
X		Multi-Hazard (earthquake, winter storm, wildfire)	Install ham radio and emergency data transmission antennas at Kelly Butte and/or Moe Hill Reservoirs.	$30,000	2019-21
X	X	Multi-Hazard (earthquake, winter storm, wildfire)	Install redundant control system capability at Chase WTP.	$35,000	2019-21

Table B-4 Hazard Mitigation Action Items					
New Assets	**Existing Assets**	**Hazards Mitigated**	**Mitigation Action**	**Estimated Cost**	**Timeline**
X	X	Flood-Riverine	NOAQ Boxwall or equivalent for flood protection at Chase WTP.	$20,000	2019-21
X	X	Multi-Hazard (earthquake, winter storm, windstorm, wildfire)	Install transfer switch at I-5 Wells and obtain trailer-mounted generator[1] for Chase or I-5 Wells.	$150,000	2019-21
X		Earthquake, Drought	Develop small emergency water distribution sites located at/near private wells with tested water.	$25K per site (3 sites)	2019-23
X		Earthquake, Landslide	Use all-restraint water mains for landslide risk transmission mains	2 times cost normal pipe	2019-29
	X	Multi-Hazard (all hazards)	More customer outreach (social media/promotions/bill inserts) for emergency prep education.	$5,000 / year	2019-29

[1] Awarded a 2019 SPIRE Grant for a 108kW diesel generator capable of running two Chase wells.

Table B-5 below lists the Action Items contained in RWD hazard mitigation plan and identifies the priority for each item based on probable benefits, funding availability, and project timeline. It is not intended to act as a formal cost/benefit analysis.

Table B-5 Mitigation Strategy Priority

Mitigation Action Item	Hazards Mitigated	Costs	Benefits	Benefits Equal or Exceed Cost?	Grant Eligible ?	Can be funded under existing programs or budgets?	Priority
Moe Hill Reservoir Seismic Upgrades	Earthquake	High	High	Yes	Yes	Yes	High
Chlorine Cylinder Actuators	Multi-hazard	High	High	Yes	No	Yes	High
Emergency Communication Equipment	Multi-hazard	Low	Low	Yes	Yes	Yes	Moderate
Secondary Control System	Multi-hazard	Low	Moderate	Yes	Varies	Yes	Moderate
I-5 Wells Transfer Switch	Multi-hazard	Moderate	Moderate	Yes	Varies	Yes	Moderate
Portable Backup Generator	Multi-hazard	Moderate	Moderate	Yes	Yes	Possibly	Moderate
Emergency Supply Wells	Earthquake	Moderate	Moderate	Yes	Varies	Yes	Low
Restrained Water Mains	Earthquake	High	Moderate	No	Varies	No	Low
Increased Public Outreach	Multi-hazard	Low	Moderate	Yes	Yes	Yes	Moderate

B.6 Future Needs

Below is a list of identified research needs concerning risk posed by specific hazards to Rainbow Water District, its assets, and the associated community.

- Investigating seismic early warning systems at Moe Reservoir which would automate safety actions and reduce risk to life and property in partnership with the University of Oregon. One option is joining the ShakeAlert network, another is working with SUB to utilize two or more independent Flo-Loc sensor to compare signals and improve detection accuracy.
- To protect electrical transformers, wells, and treatment equipment from Riverine Flood risks that could interrupt public water supply, investigate possible portable flood barrier systems such as NOAQ Boxwall which could be erected in the event of rising flood waters.

B.7 Additional Comments

Since the adoption of the 2014 NHMP, Rainbow has started and/or completed several initiatives to mitigate risk to the community from hazards of concern. These items were not listed in the 2014 Eugene-Springfield NHMP as Rainbow was not a formal participant. RWD became a formal Sub-Plan Holder with the adoption of this 2020 Natural Hazards Mitigation Plan.

- Pursue seismic upgrades of critical Springfield water facilities as recommended in a 2014 seismic analysis report. In October 2017, SUB and Rainbow jointly began engineering design of seismic improvements to three Springfield reservoirs. Improvements to SUB's 57th Street Reservoirs 1 and 2 were under construction over 2018-19, and upgrades to the jointly owned Moe Reservoir are under design with construction pending for 2019-20. Total Moe design and construction estimated at $535,000.
- Install a $12,000 backup generator and manual transfer switch at the Rainbow Water District office, a critical facility.
- Purchase a $8,000 portable generator and install a manual transfer switch at the Chase Wellfield to power computers and lights for a backup SCADA/EOC.
- Install a $55,000 manual transfer switch at the Chase Wellfield to allow connection to a larger portable generator capable of powering up to three wells and treatment equipment. (We have been awarded a SPIRE grant to obtain a trailer-mounted generator that would be enough to run two wells and provide one million gallons of treated water per day.)
- Provided nearly 800 three-gallon emergency water containers to Rainbow customers at a discounted price. These were provided for use at emergency

distribution sites or for home storage and tied to emergency preparedness public education (approximately $6,000).

- We purchased a used box trailer and are investigating the possibility of equipping it as a mobile water treatment and/or distribution trailer, to provide emergency drinking water during outages. This might be shared with small neighboring Lane County water systems that Rainbow supports.
- Water has been tested at a private well at Northwood Community Church. This is our first target site for an emergency well that could be powered by a generator and utilize area volunteers to distribute a small volume of water (20-30 gpm) to provide bare minimum drinking and sanitation water at a neighborhood level.

C Springfield Utility Board

NHMP Project Team Member:

Tracy Richardson, Utility Planner

C.1 Jurisdictional Profile

C.1.1 Introduction

Springfield Utility Board was founded in 1949 and is an independently operated municipal electric and water utility governed by a locally-elected board. The utility offers its customers some of the lowest water and electric rates in the Pacific Northwest, with equity in excess of $100 million and with no debt.

- **Population served**: Approximately 32,000
- **Land area served**: 25 square miles

This annex notes the SUB specific variances from the Eugene-Springfield Area NHMP base plan (Sections 1-4). Variances arise due to differing risks faced by SUB compared to the Cities of Eugene and Springfield. This is due to utility specific regulations, infrastructure, and locations. Unless explicitly expressed by this annex, SUB complies with the base plan.

C.1.2 Electric System

The Electric System supplies service to approximately 31,151 residential, commercial, and industrial customers within the City of Springfield.

Power delivered to customers is supplied by Bonneville Power Administration (BPA). The electric utility's annual operating budget is approximately $60M, with $6.2M budgeted for capital work.

- **Total Electric System Service Area**: 25+ miles
- **Miles of Overhead Transmission Line**: 24
- **Miles of Overhead Distribution Line**: 192
- **Miles of Underground Distribution Line**: 140
- **Substations**: 8

C.1.3 Current and Anticipated Electrical Service Trends

Springfield Utility Board has an annual electric peak load of 162 Megawatts, with Bonneville Power Administration (BPA) as the sole source of power. Unless a large customer load locates in our service territory, electric consumption is anticipated to stay relatively flat. This is due to ongoing success of utility energy conservation programs.

C.1.4 Water System

SUB provides approximately three billion gallons of water to 20,000 residential, commercial, and industrial customers within its Springfield service territory annually. SUB also provides wholesale water to the Rainbow Water District. In addition, SUB has a wholesale water contract with the City of Glenwood.

The water utility's water source is ninety (90) percent from its thirty-four (34) wells and ten percent (10) from the Willamette River.

The majority of SUB's water comes from a system of seven wellfields that tap groundwater form a vast aquifer that lies beneath Springfield. Supplementing this is water drawn from the Middle Fork Willamette River. The water utility's annual operating budget is approximately $16M, with $7.7M budgeted for capital work.

- **Total Water System Service Area**: 25 miles
- **Pump Stations**: 6
- **Wellfields**: 7
- **Annual Water Served**: 3 billion gallons
- **Water Distribution System**: 240 miles

C.1.5 Current and Anticipated Water Service Trends

SUB's water service provides approximately three billion gallons per year. Similar to the electric utility, water consumption remains nearly flat despite population growth. While annual usage is highly weather dependent, the growth trend is marginal.

C.2 Applicable Regulations, Plans

- **Springfield City Code Chapter XI, Sections 36-46**
  Sets powers and duties and conveys authority to maintain and operate the electric and water utility to Springfield Utility Board.

- **2018 Electric and Water 10-Year Major Capital Improvement Plans**
  Describes capital work like pole and water main replacements and large multi-year projects. These plans have a strategic focus on reliability, resiliency, and compliance.
- **2010 SUB Water System Master Plan**
  Provides an assessment of SUB's Water system and plans for future water supply and growth within the SUB service area over the next twenty years.
- **2019 Emergency Operations Plan**
  Provides guidance to SUB staff and emergency response personnel during emergency operations.
- **Mutual Aid Agreements for Electric Restoration Efforts**
  - American Public Power Association Mutual Aid Agreement
  - Bonneville Power Administration Mutual Assistance Agreement (2016)
  - Oregon Municipal Electric Utilities Mutual Aid Agreement(s)
  - Western Region Mutual Assistance Agreement (2014)

SUB integrates the mitigation plan into other planning mechanisms through our capital planning. The actions, contents, and strategies identified in the NHMP 2020 serve as SUB's Capital Planning process.

C.3 Jurisdiction-Specific Natural Hazard Event History

Table C-1 lists past occurrences of natural hazards affecting SUB over the past 15 years and the damage received to SUB assets for each incident.

Table C-1 Natural Hazard Events

Type of Event	FEMA Disaster # (if applicable)	Date	Preliminary Damage Assessment
Winter Storm/Freezing Rain	DR-4296-OR	December 14 -16, 2016	$205,750
Severe Winter Storm	FEMA-4169-OR	February 6 – 10, 2014	$308,750
Windstorm		February 2-4, 2006	
Severe Winter Storm	FEMA-1510-OR	January 1-7, 2004	$33,500
Windstorm	FEMA-1405-DR-OR	February 7, 2002	$551,000

C.4 Hazard Risk Ranking

Table C-2 presents the ranking of hazards of concern, using Vulnerability multiplied by Probability divided by Capacity to calculate and prioritize total risk to Springfield Utility Board (see Section 4.2.2, Components of Risk Analysis, for an explanation of the Risk Metrics). These are the identified hazards to SUB and may vary from those listed in the Section 1, Table 1-1.

Table C-2 SUB Risk Matrix

Hazard	Vulnerability High = 3 Moderate = 2 Low = 1	Probability High = 3 Moderate = 2 Low = 1	Capacity High = 3 Moderate = 2 Low=1	Risk Total <1.5 = Low 1.5-2.9 = Moderate 3-4.5 = High >4.5 = Very High	Risk
Earthquake	3	2	1	6	Very High
Windstorm	3	3	2	4.5	High
Winter storm	3	3	2	4.5	High
Geomagnetic Disturbance	2	2	1	4	High
Wildfire	2	3	2	3	High
Flood - Riverine	2	2	2	2	High
Landslide	2	2	2	2	Moderate
Drought	1	3	2	1.5	Low
Volcano	1	1	3	.33	Low

As Table C-2 above indicates, SUB's risk matrix differs slightly from the planning area. Drought is ranked low in SUB's evaluation due to a reliance on groundwater. Short-term droughts have limited impact to services and water availability for the utility. Alternatively, flood-riverine is ranked high in SUB's evaluation due to wellfield location. SUB's Thurston and Willamette Wellfields are located within the floodplain and are susceptible to flooding which could directly impact access to the wellfields and SUB's ability to continue to safely supply water.

C.5 Evaluation of Recommended Action Items

Table C-3 lists the initiatives that make up the SUB hazard mitigation plan. SUB is the lead agency and funding source for these initiatives unless otherwise noted.

Table C-3 Hazard Mitigation Action Items

New Assets	Existing Assets	Hazard Mitigated	Mitigation Action	Estimated Cost	Timeline
X		Multi-Hazard (earthquake, riverine flood, winter storms, windstorms, geomagnetic disturbances).	Construction of new Glenwood Substation.	$5M	2015-2022
X		Multi-Hazard (earthquake, riverine flood, winter storms, windstorms, geomagnetic disturbances).	Construction of Thurston Water Treatment Plant (Pilot)	Pending	2020-2028
	X	Earthquake	Seismic upgrade to critical Electric facilities.	$7M	2018-2019
	X	Earthquake	Seismic retrofit of South 57th Street Reservoirs	$2.4	2019-2023
	X	Earthquake	Seismic retrofit of Moe Reservoir	$279,900	2020-2024
X	X	Earthquake	Replace 4000 feet of water distribution system pipeline	$910,000	2019-2028
	X	Multi-Hazard (earthquake, riverine flood, winter storms, windstorms, geomagnetic disturbances).	Substation Protection Upgrades	$1.14M	2019-2028
	X	Multi-Hazard (earthquake, riverine flood, winter storms, windstorms, geomagnetic disturbances).	Electric Distribution System Upgrades	$242,000	2019

Table C-4 below lists the action items contained in SUB's hazard mitigation plan and identifies the priority for each item based on probable benefits, funding availability and project timeline. It is not intended to act as a formal cost/benefit analysis.

Table C-4 Mitigation Strategy Priority

Mitigation Action Item	Hazards Mitigated	Costs	Benefits	Benefits Equal or Exceed Cost?	Grant Eligible ?	Can be funded under existing programs or budgets?	Priority
Build Glenwood Substation	Earthquake	High	High	Yes	Unsure	Yes	High
Seismic Retrofits and Upgrades to Critical Facilities: SUB Water Operations	Earthquake	High	High	Yes	Yes	Yes	High
Seismic Retrofits and Upgrades to Critical Facilities: SUB Electric Operations	Earthquake	High	High	Yes	Yes	Yes	High
Upgrade or Replacement of Electric Distribution Poles	Multi-Hazard (Earthquake, Winter Storm)	High	High	Yes	Yes	Yes	Moderate
Replace Aging Water Distribution Pipelines	Earthquake	High	High	Yes	Unsure	Yes	High
Electric Voltage Conversion Project: Glenwood, Hayden Bridge, Mohawk	Multi-Hazard (Earthquake, Winter Storm)	High	Moderate	Yes	Unsure	Yes	Moderate
Secondary Water Filtration Plant	Multi-Hazard (Earthquake, Wildfire, Drought, Winter Storm)	High	High	Yes	No	No	Moderate

Appendix A: NHMP 2020 Action Items Table

P = High correlation to hazard. S = Moderate correlation to hazard. Blank = Minimal or low correlation to hazard. Bold = Priority Action Items.

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
1	P											Resistant Landscaping	The majority of Oregon has been in a drought for the past several years. Though mandatory water rationing has never been instituted in the Cities of Eugene and Springfield, it has become apparent water conservation measures need to be taken now to prevent/delay public water rationing in the future.	Adopt drought resistant landscaping policies.	Eugene Public Works	Employee Time	2025
2	P											Class A Recycled Water Demonstration Project	The majority of Oregon has been in a drought for the past several years. Though mandatory water rationing has never been instituted in the Cities of Eugene and Springfield, it has become apparent water conservation measures need to be taken now to prevent/delay public water rationing in the future.	Pursue a water reuse partnership with MWMC. The Metropolitan Wastewater Management Commission (MWMC) will add facilities to the wastewater treatment plant to produce the first ever stream of Class A recycled water - the highest quality recycled water class in Oregon, suitable for all water uses except drinking. Initially, 0.5-1.0 million gallons per day of recycled water will be produced for use at local sand and gravel operations, City street tree watering, and 100% of landscape irrigation at the wastewater plant. The Eugene-Springfield Fire Training Facility is also being pursued as a demonstration site. Demonstration sites will build community awareness and user familiarity with recycled water to expand uses to more urban greenspace irrigation, industrial users, and other Public Works uses.	MWMC, Eugene Public Works, Springfield Development & Public Works	$4-5 Million	Facility completion 2020; full-scale demonstration uses summer 2021
3		P										Local Active Transportation Infrastructure Evaluation	Though many street bridges have been evaluated for seismic stability no off-street or pedestrian bridges have been. Foot bridges will be vital after a large earthquake, so ensuring their seismicity is vital.	Evaluate off-street path bridges crossing over the Willamette River to complete a high-level seismic assessment of all major City bridges.	Eugene Public Works	$30,000	2020

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
4		**P**										**Local Transportation infrastructure Seismic Upgrades**	**Eugene Public works Engineering identified thirteen priority transportation structures as part of a vulnerability assessment study. These structures a slated for the first phase of seismic improvements to local transportation infrastructure.**	**Complete seismic improvements to three of the thirteen priority transportation structures.**	**Eugene Public Works**	**$3 million**	**2023**
5		P										Unreinforced Masonry Building Database	Currently, there is no inventory of unreinforced masonry buildings within the Eugene-Springfield area. Since these structures are at a greater risk from various natural disasters, such a database would improve Eugene-Springfield Fire, and other planning/response departments, to plan for and respond to structural collapses after a major event.	Develop a database of unreinforced masonry buildings (URMs) for first responders to utilize for planning and response operations. Areas include Eugene, Springfield, and parts of Lane County (Eugene-Springfield Fire's response area).	Eugene-Springfield Fire, Eugene Emergency Management, Springfield Emergency Management	Employee Time	2023
6		**P**										**Springfield Critical Facilities Retrofit**	**Many structures in the Eugene-Springfield area are not up to current seismic standards. With the risk posed by earthquakes to this area, it is vital critical infrastructure is retrofitted.**	**Implement phase two of the seismic retrofit of Springfield City Hall and three Springfield Fire Stations.**	**Springfield Facilities, Springfield Emergency Management**	**$1.5 million**	**2025**
7		**P**								**S**		**Emergency Fuels Assessment - Phase II**	**In the Fall of 2019, the City of Eugene completed phase one of the Emergency Fuels Assessment for Lane County to evaluate how a major event could disrupt the areas' fossil fuel supplies critical for emergency response after a large event. It is well documented Oregon's fossil fuel infrastructure is extremely vulnerable, especially from a major earthquake.**	**Finish phase two of the Emergency Fuels Assessment for Lane County to determine the best allocation and rationing methods for fossil fuels after a catastrophic event such as a Cascadia Subduction Zone (CSZ) earthquake when usable fuel to run emergency response operations will be very limited.**	**Eugene Emergency Management**	**$45,000**	**October 2021**

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
8		**P**								**S**		**Increase Fuel Capacity**	**It is well documented a CSZ earthquake would severely limited available fossil fuel resources critical for emergency response and recovery. With limited options for the refueling of publicly owned emergency response vehicles it is critical that methods to expand fuel capacity within the Cities are explored.**	**Research methods to increase fossil fuel capacity around critical facilities such as upgrading generator fuel tanks to high capacity tanks.**	**Eugene Emergency Management, Springfield Emergency Management, Eugene Public Works, Springfield Development & Public Works**	**Employee Time**	**2024**
9		**P**										**Seismically Retrofit Eugene Fueling Station**	**The City of Eugene owns one fueling station build before current seismic standards were adopted.**	**Seismically retrofit the Eugene fueling station and associated buildings to ensure it is usable after a CSZ earthquake.**	**Eugene Emergency Management, Eugene Public Works**	**TBD**	**TBD**
10		P										Earthquake Damage Study	In 2018, City of Eugene Emergency Management staff members identified discrepancies between the HAZUS earthquake damage estimates, highlighted in the State of Oregon's 2015 NHMP and in the 2014 Eugene-Springfield Multi-Jurisdictional NHMP, and their planning assumptions. Through working with DOGAMI, it was determined that the initial earthquake damage assessment was completed using generic infrastructure information. Updated data inputs could dramatically increase earthquake damage estimates which are vital for planning purposes.	In partnership with DOGAMI, update the earthquake damage estimate study for the Eugene-Springfield area.	Eugene Emergency Management, Springfield Emergency Management, in partnership with DOGAMI	TBD	2021
11		P										Seismic Upgrades - Eugene	Many structures in the Eugene-Springfield area are not up to current seismic standards. With the risk posed by earthquakes to this area, it is vital critical infrastructure is retrofitted.	Finish seismic upgrades to City owned facilities.	Eugene Emergency Management, Eugene Facilities	TBD	2030

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
12		P										Wastewater Pump Station Retrofit	A recent review of the West Irwin Pump Station's vulnerability indicated the station is not seismically sound. The West Irwin Pump Station was originally constructed in 1964. It is the second largest pump station in Eugene, with a service area of approximately 3,300 acres. This station has a firm capacity of 11 million gallons a day (MGD), with a maximum flow of 21 MGD.	Retrofit the Pump Stations to meet current seismic standards.	Eugene Public Works, MWMC , Springfield Development and Public Works	$8 Million	June 2022
13			P									Outreach Awareness	Extreme weather (tornadoes, damaging hail, and lightening) are rare in the Eugene-Springfield area, but could occur. With the rarity of these events, many people do not know what to do if a large tornado or damaging lightening or hail were to occur.	Research and incorporate extreme weather safety awareness into the Cities' public outreach program.	Eugene Emergency Management, Springfield Emergency Management	Employee Time	2023
14				P								Update Floodplain Maps	Current floodplain maps are extremely outdated and do not reflect current river conditions.	Actively seek funding to update the Eugene-Springfield floodplain maps focusing on the Willamette River through Eugene and the Mill Race, Willamette River through Glenwood, and the 42nd Street Levee Seclusion Zone in Springfield.	Eugene Emergency Management, Springfield Emergency Management	$5 million	2030
15				**P**								**Levee Certification**	**There are several existing levee or flood control structures in Springfield that were built prior to certification standards.**	**Seek and maintain certification of the 42nd Street Levee and other flood control structures within Springfield.**	**Springfield Emergency Management, Springfield Development and Public Works**	**$2 million**	**2025**
16				P								Streambank and Erosion Control	Several areas along the McKenzie River are experiencing erosion. This erosion is risking both the 42nd Street Levee and the EWEB water intake.	Stream bank stabilization near the 42nd street levee.	Springfield Emergency Management, Springfield Development and Public Works, EWEB	$2 million	2024

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
17					P							Stormwater Improvements	Several areas within the Cities of Eugene and Springfield experience mild to moderate flooding due to stormwater. Some locations experience regular flooding and significant damages or road closures.	Projects include culvert replacements and streambank stabilization. Using prioritization criteria, the highest priority stormwater capital projects are selected for inclusion in the Cities' Capital Improvement Programs. Projects prioritization criteria include whether a project addresses a potential risk to life or property (e.g. flooding), and whether it resolves an ongoing repetitive issue.	Eugene Public Works, Springfield Development and Public Works	$1 million	2030
18					P							Stormwater Master Plan Updates	Several areas within the Cities of Eugene and Springfield experience mild to moderate flooding due to stormwater. Some locations experience regular flooding and significant damages or road closures.	Update the City of Eugene's 2002 Stormwater Basin Plan, and Springfield's 2008 Stormwater Facility Master Plan, including stormwater-related data, hydraulic modeling of the system, any recommended changes to design standards, and a prioritized list of stormwater capital projects. This plan guides stormwater management in each City's local stormwater basins for the next decade and beyond.	Eugene Public Works, Springfield Development and Public Works	$800,000	December 2025
19					P							Stormwater and Climate Change Impacts	It is known climate change will effect our weather. Rain is expected to become less frequent, but with more intense showers. This is expected to change flooding traditionally seen in this area and tax the local stormwater system event further.	Evaluate stormwater design standards taking into consideration climate change modeling.	Eugene Public Works, Springfield Development and Public Works	$250,000	2022
20	S	S	S	S	S	P	S	S	S	S	S	Continuity of Operations Plans	During a moderate to catastrophic event normal methods of document storage and retrieval may not be available. Limited or no access to critical documents can cripple response and recovery efforts.	Develop Continuity of Operations Plans (COOP) for the City of Eugene's Public Works, Police, Fire departments, and all Springfield departments.	Eugene Emergency management, Springfield Emergency Management	Staff Time	2025

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
21		S					P					Analysis of 2018 DOGAMI Landslide Study	The Willamette Valley is prone to landslides. A new DOGAMI study puts the risk to the South Hills of Eugene and Southeast Hills of Springfield at a higher risk than previously expected. With development expected in those area, a committee must review and recommend next actions based on the DOGMAI report to ensure safe and resilient development.	Using the DOGAMI landslide study released the summer of 2018 (IMS-60), determine areas and buildings at risk from landslides and propose comprehensive land use policies and construction standards accordingly.	Eugene Emergency Management, Springfield Emergency Management, Eugene Planning and Development Department, Springfield Development and Public Works Department	Staff Time	2024
22								**P**				**Fuels Reduction**	**The Eugene Springfield area has a significant wildland urban interface area. These areas are at a much higher risk of wildfires due to dense brush and vegetation being in close proximity to buildings and residential infrastructure.**	**Reduce fuels on public lands, focusing on the hillsides in the southern portion of both Cities.**	**Eugene-Springfield Fire, Eugene Public Works, Springfield Development and Public Works.**	**$200,000**	**2025**
23								P				Community Wildfire Protection Plan (CWPP)	The Eugene Springfield area has a significant wildland urban interface area. These areas are at a much higher risk of wildfires due to dense brush and vegetation being in close proximity to buildings and residential infrastructure.	Develop the Eugene-Springfield Community Wildfire Protection Plan.	Eugene-Springfield Fire, Eugene Public Works, Springfield Development and Public Works, Eugene Emergency Management, Springfield Emergency Management	$90,000	2022

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
24								P				Update the Wildland-Urban Interface (WUI) Plan	The Eugene Springfield area has a significant wildland urban interface area. These areas are at a much higher risk of wildfires due to dense brush and vegetation being in close proximity to buildings and residential infrastructure.	Update the Eugene-Springfield WUI plan and address access routes.	Eugene-Springfield Fire	Staff Time	2025
25								S	P	S		Species Specific Tree Removal	We have a number of tree species in our inventory that are known to be susceptible to failure in storms and under normal weather conditions. This is due to pests (i.e. emerald ash borer), disease (i.e. thousand canker disease) and structural problems endemic to the species (i.e. sweetgum with included bark, big leaf maple) with decay, etc.	Identify and remove species with known failure profiles and potential defects. Plant or replant drought tolerant and disease, pest and damage resistant tree species. Work with City departments, contractors and non-profits to complete this work.	Eugene Public Works, Springfield Development and Public Works	$200,000	2020
26									**S**	**P**		**Defective Tree Maintenance**	**Wind, ice, and heavy snow can topple trees or cause large limb failure leading to blocked roads, infrastructure damage, and electrical hazards and outages. This was evident during the ice storm of 2016 and snow storm of 2019.**	**Utilize contract crews to perform maintenance pruning. Provide clearance and mitigate defects, such as overextended branches prone to failure under increased loads, along major arterials and priority traffic routes. Unhealthy or structurally unsound trees will be removed and replanted.**	**Eugene Public Works**	**$200,000**	**2022**
27										P		Sheltering	During the snowstorm of 2019 the American Red Cross's sheltering resources were utilized in rural areas leaving the Cities without the sheltering reserves they typically rely on.	Develop a consolidated plan for community sheltering and associated outreach needs to provide sheltering, during large scale events or incidents when American Red Cross resources are diverted elsewhere. This will allow the Cities to provide emergency shelters even during events or incidents when the American Red Cross may not be able to provide these services to the Cities.	Eugene Emergency Management, Springfield Emergency Management	$250,000	2026

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
28											P	Lahar Risk Study	Lahars can often be the most damaging port of a volcanic eruption to a community. Initial USGS predictions show the Eugene-Springfield area could be impacted by such an event during an eruption of one of the nearby volcanoes. It is unknown what impacts the local area would experience, however.	Evaluate the lahar risk to the McKenzie River valley.	Eugene Emergency Management, Springfield Emergency Management	$200,000	2024
29											P	Ash Removal	At this time, though volcanic ashfall is a low risk hazard, it is unknown how the Cities would remove and dispose of such debris.	Research ash removal methods.	Eugene Emergency Management, Springfield Emergency Management	Staff Time	2025
30		P		S						S		Food Supplier Coalition	Some 90% of food consumed locally is produced outside of the area. The vast majority of food consumed in the Eugene-Springfield area is brought in by truck and trailer on I-5 from distribution centers in San Francisco and Portland. Local grocery stores have a three-day supply of food at any one time. Severe flooding, severe winter storm, or severe earthquake events can cause disruption to the resupply of local grocery stores.	Develop a coalition of food suppliers to identify options to address supply chain concerns after a major disaster.	Eugene Emergency Management, Springfield Emergency Management	Staff Time	2027
31	S	P	S	S	S	S	S	S	S	S	S	Vulnerable Populations Two Weeks Ready	Vulnerable populations are often disproportionally negatively effected by natural disasters. In 2017 the Cities of Eugene and Springfield started pursuing outreach to non-governmental organizations which support these populations, specifically those individuals with mobility issues. These initial outreach events were very successful, but a coordinated effort to conduct such outreach regularly has yet to be pursued.	Utilizing relevant vulnerable populations maps, developed for the Lane Livability Consortium, develop an outreach plan to engage vulnerable populations to be two weeks ready with emergency supplies.	Eugene Emergency Management, Springfield Emergency Management	Staff Time	2022

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
32	S	P	S	S	S	S	S	S	S	S	S	Long-term Care and Nursing Home Facilities Emergency Planning Assistance	In 2017 the Centers for Medicare & Medicaid Services started enforcement of their final rule "Emergency Preparedness Requirements for Medicare and Medicaid Participating Providers and Suppliers" which set specific requirements for long-term care and nursing home facilities emergency planning and preparedness. Despite the rule, significant support and/or resources were not provided. Since the rule was put in place the Cities along with Lane County Public Health have received numerous phone calls requesting information or assistance by various long-term and nursing home facilities in the local area.	Support and assist Lane County Public Health in developing and conducting trainings or outreach on emergency preparedness and planning for long-term and nursing home facility leadership as they take steps to comply with the Emergency Preparedness Rule set forth by the Centers for Medicare and Medicaid Services.	Lead: Lane County Public Health Support: Eugene Emergency Management, Springfield Emergency Management	Staff Time	2025
33	S	P	S	S	S	S	S	S	S	S	S	Public Safety Communications Reliability	Many of the components of the LRIG Radio System were not designed and/or installed to provide public safety grade reliability directly or via back-up systems. This radio system is critical for first responder communications following a disaster.	Work with the Lane Radio Interoperability Group (LRIG) System partners to develop a first responder communication system with public safety grade reliability.	Eugene-Springfield Fire, Eugene Police, Eugene Public Works, Springfield Development and Public Works, Springfield Police	$10 million	2030
34		P	S	S	S	S	S	S	S	S		Damage Assessment Plan	Eugene is currently preparing a comprehensive all-hazards Damage Assessment Plan. Springfield intends to modify Eugene's Plan for its use so that both cities have a coordinated Plan.	Finalize the Eugene-Springfield Damage Assessment Plan	Eugene Emergency Management, Springfield Emergency Management	Staff Time	2022

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
35		**P**	**S**	**P**	**S**		**S**	**P**				**Mass Evacuation**	**Eugene and Springfield do not have all-hazard Mass Evacuation Plans.**	**Develop and exercise a City evacuation plan**	**Eugene Emergency Management, Springfield Emergency Management**	**$450,000**	**2024**
36		P				P						Currin Substation Upgrades	EWEB operates 33 substations that are essential assets for power delivery to our community; most were built before awareness of seismic risk to the Northwest electric grid. EWEB will systematically upgrade each substation to meet current seismic codes and increase reliability of these assets to withstand a range of natural disasters.	Rebuild Currin Substation to include seismic upgrades and the Institute of Electrical and Electronics Engineers standards to reduce risk of interference with electrical equipment from geomagnetic disturbances.	EWEB	$750,000	2020-2021
37		P										Roosevelt Operations Center (ROC) Seismic Upgrades	This critical facility was originally built for electric and water operations, engineering and field crews, but is being updated to consolidate nearly the entire utility workforce. Seismic upgrades as well as re-location and reinforcement of primary and secondary communications are an essential component of the consolidation efforts.	Seismically retrofit EWEB's Roosevelt Operations Center (ROC) to remain operational after an earthquake. After completion move EWEB's dispatch into ROC from the EWEB Headquarters and build a new backup Dispatch Center in a seismically sound building near Hayden Bridge.	EWEB	$3.5 million	2018-2021
38		P			S	P			S	S		New Holden Creek Substation	This project replaced an older substation and electrical equipment located right along the river's edge to a more secure location with equipment built to current seismic standards. The next phase will add a second transformer to create more redundancy for upriver customers, while re-wiring significantly reduces exposure to electric outages caused by tree limbs on wires.	Replace older substation with new Holden Creek Substation to include seismic upgrades and the Institute of Electrical and Electronics Engineers standards to reduce risk of interference with electrical equipment from geomagnetic disturbance. This project will replace the Leaburg Substation on the riverbank and move 17 miles of overhead electrical lines.	EWEB	$7 million	2018-2019

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
39		P										Baseline Reservoirs Seismic Upgrades	None of EWEB's main reservoirs meet current seismic or drinking water site security standards, the oldest of which was built in 1939. EWEB plans to upgrade these facilities as well as build a reservoir on another site to further diversify our water supplies.	Replace baseline reservoirs with facilities meeting current seismic codes.	EWEB	$10 million per site	2023 (First Reservoir)
40		S					P					All-Restraint Water Mains - EWEB	For areas on our service territory that are prone to landslides, using this technology when main replacements occur will reduce the likelihood of water main breaks, causing outages and potential boil-water notices.	Use all-restraint water mains in areas prone to landslides.	EWEB	Two times the cost of standard piping.	2030
41		S		P								Upgrade Water Chlorination System	The existing water chlorination process was identified as a single point of failure as there is one product supplier in our region. The new liquid hypochlorite system also reduces the risk of a hazardous materials exposure to employees and nearby residents during natural disasters.	Replace gaseous chlorine at the filtration plant with an on-site liquid hypochlorite system with a 90 day on-site storage supply.	EWEB	$3 million	2019
42		S	S				S	S	S	P		Replace Transformer Mineral Oil	EWEB has over 16,000 transformers in our electric distribution system, many of which or mounted on electric poles. When poles are hit by cars or fail during storms, the transformers leak oil which creates hazardous materials risk and slows restoration times. 427 transformers will be replaced in the upriver portion of our system, replacing mineral oil with a less toxic transformer oil.	Replace mineral oil with nontoxic FRP, a natural ester derived from renewable vegetable oils providing improved fire safety, transformer life, and environmental benefits, in all new transformers to reduce spill risk when poles fall or transformers fail.	EWEB	$800,000	2030
43	S	P						S				Micro-Grids	Micro-Grid technology allows facilities to operate independently of the electric grid. EWEB installed micro-grids may use a combination of solar, battery and generator technologies to operate well pumps to supply emergency water to our community.	Establish micro-grids at critical facilities for drinking water distribution and independent electrical operation. Micro-grids at Howard Elementary School and ROC are currently under development.	EWEB	$1 million	2018-2023

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
44		S						S	P	S	S	Blackstart Capabilities	Most of EWEB's power comes from the Bonneville Power Administration and EWEB is in the southern-most portion of their transmission system. In the event of a regional power failure involving the BPA system, Eugene is not expected to be a high restoration priority. EWEB is contracting out technical studies to better understand capabilities and what investments are needed to enable our local generating facilities to serve at least a portion of our community's power needs.	Test blackstart capabilities, load requirements, and transmission switching needs for Leaburg hydro-electric plant to power critical facilities in Eugene during major outages.	EWEB	$50,000	2019-2023
45									S	P		Electric Line Re-framing and Undergrounding	FEMA Hazard Mitigation Project #406 addresses system resiliency improvements in areas experiencing more frequent and prolonged electrical outages.	Re-frame 4.3 miles of electric line and underground 1.5 miles of line in 15 high outage areas.	EWEB	$2.7 million	2019-2020
46	S	P						S				Emergency Water Distribution	With one source of supply and a single transmission corridor delivering water to 200,000 residents, our drinking water system is particularly vulnerable. Emergency water sites will be distributed throughout neighborhoods to provide 2-3 gallons of water to area residents for public health and safety.	Develop emergency water distribution sites using seismically sound wells at local schools or community centers. There are three sites currently in design and construction.	EWEB	$200,000 per site	2018-2023
47							S		S	P		Seismic Upgrades - Substation Equipment	EWEB has prioritized nine most critical substations to reinforce equipment to better withstand earthquakes.	Seismically anchor transformers and control buildings and add flexible bus connections at each substation.	EWEB	$1.2 million	2019-2027
48	S	P						S				Secondary Water Treatment Facility	While EWEB has invested heavily to upgrade infrastructure at the Hayden Bridge Filtration Plant, it is still a single facility built sixty years ago. A smaller, second water treatment plant, preferably on a different river, would greatly increase redundancy of our water supply.	Construct a new water filtration plant on the Willamette River for a secondary source of and treatment/delivery option for drinking water.	EWEB	$50 million	2023-2030

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
49	S	P						S				Mobile Water Treatment	A significant portion of Eugene does not have access to groundwater, restricting the location of emergency water distribution sites. A mobile treatment facility would enable EWEB to provide emergency water to such locations, particularly southwest Eugene.	Construct and test a mobile treatment trailer capable of delivering potable water from sources like rivers or pools using a bio-filtration process.	EWEB	$80,000	2019
50		P										Seismically Stable Pipes and Valves	Pipes and valves not specially designed to resist earthquakes experience significant failure after an earthquake.	Install flexible joints and seismically activated isolation valves at Moe Hill (Vitus Butte) Reservoir.	Rainbow Water District	$535,000	2017-2021
51		P		S								Chlorine Gas Valve Actuators	In the event of strong ground shaking, a chlorine cylinder may become damaged and release gas that could be detected by a chlorine gas sensor.	Install automatic valve actuators for chlorine gas cylinders at all wellfields (Chase equipped 2018).	Rainbow Water District	$50,000	2018-2020
52		P	S	S		S	S	S	S	S	S	Emergency Communication	Standard voice and data communications rely on fiber optic lines that may become damaged, requiring line-of-sight radio communications as a backup.	Install HAM radio and emergency data transmission antennas at Kelly Butte and/or Moe Hill Reservoirs.	Rainbow Water District	$30,000	2019-2021
53		P	S	S		S	S	S	S	S	S	Redundant Control System	Damage to the 42nd Street levee or a has mat incident on Highway 126 could result in the evacuation of the primary control center, requiring relocation to a backup facility for water system control and operations.	Install redundant control system capability at Chase WTP.	Rainbow Water District	$35,000	2019-2021
54				P								NOAQ Boxwall	Water source and treatment facilities near the McKenzie River have some increased risk of flooding and would benefit from a portable flood barrier that could provide an additional margin of safety during high water events.	NOAQ Boxwall or equivalent for flood protection at Chase WTP.	Rainbow Water District	$20,000	2019-2021
55	S	P	S	S		S	S	S	S	S	S	Transfer Switch and Generator	In the event of a regional power outage, a trailer-mounted generator could be transported and connected by transfer switch to larger wells to provide on the order of one million gallons per day if piping systems are intact.	Install transfer switch at I-5 wells and obtain trailer-mounted generator for Chase or I-5 wells.	Rainbow Water District	$150,000	2019-2021

Ref. #	Drought	Earthquake	Extreme Weather	Flood Riverine	Flood Stormwater	Geomagnetic Disturbance	Landslide	Wildfire	Windstorm	Winter Storm	Volcano	Action Name	Problem Statement	Mitigation Action	Implementation Leads	Estimated Cost	Timeline
56	S	P	S	S		S	S	S	S	S	S	Emergency Water Distribution Site	In the event of a regional power outage, or broken distribution piping, emergency water sites distributed throughout neighborhoods would allow portable generators and small wells to provide 2-3 gallons of water per day to area residents for health and safety.	Develop three small emergency water distribution sites located at or near private wells with tested water.	Rainbow Water District	$25,000 per sites	2019-2023
57		S					P					All-Restraint Water Mains - RWD	For areas prone to landslides, using this technology when main replacements occur will reduce the likelihood of water main breaks causing outages and potential boil-water notices.	Use all-restraint water mains for landslide risk transmission mains.	Rainbow Water District	Two times the cost of standard piping.	2019-2029
58		P		S		S			S	S		Glenwood Sub Station			Springfield Utility Board	$5 million	2015-2022
59		P		S		S			S	S		Thurston Water Treatment Plan			Springfield Utility Board	TBD	2020-2028
60		P										Seismic Upgrades		Seismically retrofit critical electric facilities.	Springfield Utility Board	$7 million	2018-2019
61		P										57th Street Reservoir Retrofit		Seismically retrofit the South 57th Street Reservoirs.	Springfield Utility Board	$2.4 million	2019-2023
62		P										Moe Reservoir Retrofit		Seismically retrofit the Moe Reservoir.	Springfield Utility Board	$279,900	2020-2024
63		P										Seismically Stable Pipes		Replace 4000 feet of water distribution system pipeline.	Springfield Utility Board	$910,000	2019-2028
64		P		S					S	S		Substation Protection Upgrades			Springfield Utility Board	$1.14 million	2019-2028
65		P		S		S			S	S		Electric Distribution System Upgrades			Springfield Utility Board	$242,000	2019

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Appendix B: Planning and Public Process Part 1: Planning

Part 1: Plan

Development Process Overview

As discussed in Section 1, the NHMP Update Committee is composed of four distinct groups:

- The **Project Team** is responsible for physically updating and editing the NHMP and was composed of the following individuals:
  - Jessica Gourley – Project Manager – City of Eugene
  - Kevin Holman – City of Eugene
  - Carrie Karl – City of Eugene
  - Ken Vogeney – City of Springfield
  - Jeannine Parisi – Eugene Water & Electric Board
  - Tracy Richardson – Springfield Utility Board
  - Jamie Porter – Rainbow Water District

- The **Steering Committee** is composed of departments and sub-plan entities responsible for development and implementation of mitigation items. The following individuals represented the associated entities:
  - Randi Bowers-Payne, City of Eugene
  - Myrnie Daut, City of Eugene
  - Greg Ferschweiler, City of Springfield
  - Chris Heppel, City of Eugene
  - Jill Hoyenga, Eugene Water & Electric Board
  - Louranah Janeski, City of Eugene
  - Eric Johnson, City of Eugene
  - Ray Joseph, City of Eugene
  - Doug McGillivray, Eugene Water & Electric Board
  - Lisa McLaughlin, Eugene Water & Electric Board
  - Matt McRae, City of Eugene
  - Mark Rust, City of Springfield
  - Tod Schwartz, City of Springfield
  - Melysa Slavkovsky, City of Eugene
  - Katie Terrazas (Blair), City of Eugene
  - Patence Winningham, City of Eugene

- The **Advisory Board** is composed of stakeholders who lend their knowledge based on their experience, training, or insight to help develop mitigation items.

- The **Community**– residents of Eugene and Springfield offer their insight, input, concerns, and support for hazards as well as possible mitigation items. This entity is usually represented by members of the Eugene-Springfield Community Emergency Response Team (CERT) or by specific mitigation outreach events for the community.

The primary implementation group for the Eugene-Springfield Area Natural Hazards Mitigation Plan is the NHMP Steering Committee. The NHMP Update Committee is composed of all four groups and meets quarterly to coordinate implementation efforts.

The NHMP Project Team conducted the initial vulnerability assessment utilizing the 2014 Regional Climate and Hazards Vulnerability Assessment and the studies which developed out of it. The Risk Matrix is part of this assessment. Once complete, the Project Team brought the Vulnerability Assessment results to the full NHMP Update Committee on October 29, 2018 for review. Based on this review, edits were made, and the Vulnerability Assessment and Risk Matrix were finalized.

Once the vulnerability assessment process (described in Section 4) was complete, the NHMP Project Team (identified in Section 1.1.1) and members of the NHMP Steering Committee (identified in Section proposed a number of mitigation strategies to address some of the most pressing vulnerabilities highlighted by the assessment. The Project Team met in January and the Steering Committee met in April of 2019. Purposed mitigation strategies were brought to the full NHMP Update Committee at the end of April 2019 for review.

The NHMP Project Team and Steering Committee vetted mitigation strategies through a detailed review and discussion of each strategy proposed. Following this review, actions in need of additional refinement were identified by the Project Manager who then met with partners critical to the implementation of the mitigation action in question. For example, for the Mitigation Action Item *Community Wildfire Protection Plan (CWPP)* a meeting was set up with staff from Eugene Public Works, Eugene-Springfield Fire, Lane County Emergency Management, and the U.S. Forest Service to discuss the implications of the mitigation strategy. This process was repeated for any critical Mitigation Action Item requiring more development. NHMP Sub-Plan Holders (EWEB, RWD, and, SUB) conducted similar reviews for their purposed Mitigation Action Items.

Meeting Descriptions

Below is a brief description of the NHMP Update Committee, Project Team, and Steering Committee meetings – starting with the most recent, including those scheduled, but not yet completed at the time of this update’s publishing:

NHMP Update Committee

Date: August 27, 2019 3:00 pm to 4:30pm

Attendees:
- Ken Vogeney, City of Springfield Emergency Management
- Kevin Holman, City of Eugene Emergency Management
- Frank Wilson, Lane Transit District (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Jamie Porter, Rainbow Water District (Project Team)
- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Gregory Ferschweiler, City of Springfield (Steering Committee)
- Selene Jaramillo, Lane County Public Health (Advisory Board)
- Zach Silva, Lane County Public Health

Topics:
- Review of the full 2020 Eugene-Springfield Area Natural Hazards Mitigation Plan 2020 Update.
- Update timing of formatting of NHMP 2020
- Next steps toward approval of NHMP

NHMP Update Committee

Date: April 29, 2019 3:00 pm to 4:30 pm

Attendees:
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Jamie Porter, Rainbow Water District (Project Team)
- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Ray Joseph, City of Eugene Floodplain Manager, (Steering Committee)
- Tracy Richardson, Springfield Utility Board (Project Team)

Topics:
- 2020 Mitigation Action Item review and approval.
- 2014 NHMP Mitigation Action Item updates.

NHMP Steering Committee

Date: April 2, 2019 9:00 am to 11:00 am

Attendees:
- Eric Johnson, City of Eugene Public Works – Maintenance Division
- Matt Rodrigues, City of Eugene Public Works – Engineering Division
- Mel Damewood, Eugene Water & Electric Board – Engineering and Operations Chief
- Ken Vogeney, City of Springfield Emergency Management
- Kevin Holman, City of Eugene Emergency Management

Topics:
- 2020 Mitigation Action Item selection.

NHMP Project Team

Date: January 22, 2019 10:30 am to 12:30 pm

Attendees:
- Jessica Gourley, City of Eugene
- Katie Terrazas (Blair), City of Eugene
- Ken Vogeney, City of Springfield
- Kevin Holman, City of Eugene
- Patence Winningham, City of Eugene

Topics:
- Review of 2014 Mitigation Action Items
- What 2014 Mitigation Actions Items to move forward to the 2020 NHMP Update.
- What 2014 Mitigation Action Items are completed, modified, or canceled.
- Selection of 2020 NHMP Mitigation Action Items

NHMP Update Committee

Date: January 28, 2019 3:00 pm to 4:30 pm

Attendees:
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Jamie Porter, Rainbow Water District (Project Team)

- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Katie Terrazas (Blair), City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Patence Winningham, City of Eugene Emergency Management (Steering Committee)
- Randi Bowers-Payne, City of Eugene Risk Services (Steering Committee)
- Ray Joseph, City of Eugene Floodplain Manager, (Steering Committee)
- Sarah Pulse, Lane County Public Health (Advisory Board)
- Tracy Richardson, Springfield Utility Board (Project Team)

Topics:
- Review of the full 2020 Eugene-Springfield Area Natural Hazards Mitigation Plan 2020 Update.

NHMP Update Committee

Date: October 29, 2018 3:00 pm to 4:30 pm

Attendees:
- Becca Puleo, University of Oregon Emergency Management (Project Team)
- Bill Burns, Department of Geologic and Mineral Industries (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Gregory Ferschweiler, City of Springfield (Steering Committee)
- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Ken Vogeney, Springfield Emergency Management (Project Team)
- Kevin Holman, Eugene Emergency Management (Project Team)
- Mark Nystrom, City of Eugene City Manager's Office (Advisory Board)
- Nancy Calhoun, Department of Geologic and Mineral Industries (Advisory Board)
- Randi Bowers-Payne, City of Eugene Risk Services (Steering Committee)
- Selene Jaramillo, Lance County Public Health (Advisory Board)
- Tracy Richardson, Springfield Utility Board (Project Team)

Topics:
- DOGAMI Landslide Conclusion Briefing
- Public Outreach Update
- 2014 NHMP Mitigation Action Item Updates

NHMP Update Committee

Date: July 30, 2018 3:00 pm to 4:30 pm

Attendees:

- Becca Puleo, University of Oregon Emergency Management (Project Team)
- Bill Burns, Department of Geologic and Mineral Industries (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Gregory Ferschweiler, City of Springfield (Steering Committee)
- Jeannine Parisi, Eugene Water &Electric Board (Project Team)
- Ken Vogeney, Springfield Emergency Management (Project Team)
- Kevin Holman, Eugene Emergency Management (Project Team)
- Mark Nystrom, City of Eugene City Manager's Office (Advisory Board)
- Nancy Calhoun, Department of Geologic and Mineral Industries (Advisory Board)
- Randi Bowers-Payne, City of Eugene Risk Services (Steering Committee)
- Selene Jaramillo, Lance County Public Health (Advisory Board)
- Tracy Richardson, Springfield Utility Board (Project Team)

Topics:

- Detailed review, status, and updates of the 2014 NHMP Mitigation Action Items
- Public Outreach update
- Group Share concerning Mitigation Action Items or other mitigation work

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NHMP Project Team

Date: April 30, 2018 10:30 am to 12:30 pm

Attendees:

- Becca Puleo, University of Oregon Emergency Management (Project Team)
- Bill Burns, Department of Geologic and Mineral Industries (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Carl Stubbs, Eugene School District 4J (Advisory Board)
- Eric Johnson, City of Eugene Public Works (Steering Committee)
- Frank Wilson, Lane Transit District (Advisory Board)
- Greg Ferschweiler, City of Springfield (Steering Committee)
- Geoff Simmons, Eugene-Springfield Community Emergency Response Team (CERT)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Katie Terrazas (Blair), City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Management (Project Team)
- Kevin Holman, City of Eugene Emergency Management (Project Team)
- Linda Cook, Lane County Emergency Management (Advisory Board)

- Louranah Janeski, City of Eugene Public Works – Floodplain Manager (Steering Committee)
- Mark Rust, City of Springfield (Steering Committee)
- Nancy Calhoun, Department of Geologic and Mineral Industries (Advisory Board)
- Randi Bowers-Payne, City of Eugene Risk Services (Steering Committee)
- Sarah Puls, Lane County Public Health (Advisory Board)

Topics:

- DOGAMI Landslide Mapping and Mitigation Update
- Public Outreach Update
- 2014 NHMP Mitigation Action Item Update

NHMP Update Committee

Date: January 29, 2018 3:00 pm to 4:30 pm

Attendees:

- Bill Clingman, Lane Council of Governments (Advisory Board)
- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Katie Terrazas, City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Linda Cook, Lane County Emergency Manager (Advisory Board)
- Louranah Janeski, City of Eugene Floodplain Manager (Steering Committee)
- Randi Bowers-Payne, City of Eugene (Steering Committee)

Topics:

- Review the 2020 NHMP Section 1 update
- Review the 2020 NHMP Section 2 update
- 2014 NHMP Action Item updates

NHMP Update Committee

Date: October 30, 2017 3:00 pm to 4:30 pm

Attendees:

- Doug McGillivray, Eugene Water & Electric Board (Steering Committee)
- Frank Wilson, Lane Transit District (Advisory Board)
- Jeannine Parisi, Eugene Water & Electric Board (Project Team)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Katie Terrazas, City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)

- Kevin Holman, City of Eugene Emergency Manager (Project Team)
- Lily Gillilan, Upper Willamette Soil and Water Conservation District (Advisory Board)
- Melysa Slavkovsky, City of Eugene Public Works (Steering Committee)
- Patence Winningham, City of Eugene Emergency Management (Steering Committee)
- Randi Bowers-Payne, City of Eugene Risk Services (Steering Committee)
- Ray Joseph, City of Eugene Floodplain Manager, (Steering Committee)
- Sarah Pulse, Lane County Public Health (Advisory Board)
- Tina Romero, Student/Community Member (Advisory Board)
- Tracy Richardson, Springfield Utility Board (Project Team)

Topics:

- Work plan and quarterly meeting outline
- 2020 NHMP Section 1 update review
- 2014 NHMP Action Item updates

NHMP Update Committee

Date: July 31, 2017 3:00 pm to 4:30 pm

Attendees:

- Chris Heppel, City of Eugene (Steering Committee)
- Doug McGillivray, Eugene Water &Electric Board (Steering Committee)
- Greg Ferschweiler, City of Eugene (Steering Committee)
- Jamie Porter, Rainbow Water District (Project Team)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Jim Polston, City of Springfield (Steering Committee)
- Katie Terrazas, City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Lisa McLaughlin, Eugene Water & Electric Board (Steering Committee)
- Louranah Janeskie, City of Eugene Flood Plan Manger (Steering Committee)

Topics:

- "Special Districts" and other FEMA updates
- 2020 NHMP update/rewrite timeline update
- 2014 NHMP Action Item updates

NHMP Update Committee

Date: April 24, 2017 3:00 pm to 4:30 pm

Attendees:

- Bill Burns, via phone, Department of Geologic and Mineral Industries (Advisory Board)
- Frank Wilson, Lane Transit District (Advisory Board)
- Jessica Gourley, City of Eugene Emergency Management (Project Team)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Kevin Holman, City of Eugene Emergency Manager (Project Team)
- Louranah Janeski, City of Eugene Floodplain Manager (Steering Committee)
- Matt Hastings, 4J School District (Advisory Board)
- Melysa Slavkovsky, City of Eugene Public Works (Steering Committee)
- Nancy Calhoun, via phone, Department of Geologic and Mineral Industries (Advisory Board)
- Teresa Lang, Lane Transit District (Advisory Board)
- Tod Schwartz, City of Springfield (Steering Committee)

Topics:

- “Special Districts” official partners to NHMP
- PDM concerns/financial constraints
- 2014 NHMP Action Item updates
- Next quarter priorities

NHMP Update Committee

Date: January 30, 2017 3:00 pm to 4:30 pm

Attendees:

- Becca Puleo, University of Oregon (Advisory Board)
- Jill Hoyenga, Eugene Water & Electric Board (Steering Committee)
- Katie Terrazas, City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Management (Project Team)
- Kevin Holman, City of Eugene Emergency Management (Project Team)
- Lisa McLaughlin, Eugene Water & Electric Board (Steering Committee)
- Louranah Janeski, City of Eugene Floodplain Manager (Steering Committee)
- Mark Walker, McKenzie-Willamette Medical Center (Advisory Board)
- Melysa Slavkovsky, City of Eugene Public Works (Steering Committee)
- Patence Winningham, City of Eugene Emergency Management (Steering Committee)
- Selene Jaramillo, Lane County Public Health (Advisory Board)
- Tod Schwartz, City of Springfield (Steering Committee)

Topics:

- LPC Economy and Recovery Finance Project
- 2014 NHMP Action Item updates
- Next quarter priorities
- 2020 NHMP update planning

NHMP Update Committee

Date: October 25, 2016 3:00 pm to 5:00 pm

Attendees:

- Becca Puleo, University of Oregon (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Greg Ferschweiler, City of Springfield (Steering Committee)
- Jill Hoyenga, Eugene Water & Electric Board (Steering Committee)
- Katie Terrazas, City of Eugene Emergency Management (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Management (Project Team)
- Kevin Holman, City of Eugene Emergency Management (Project Team)
- Lisa McLaughlin, Eugene Water & Electric Board (Steering Committee)
- Louranah Janeski, City of Eugene Floodplain Manager (Steering Committee)
- Myrnie Daut, City of Eugene (Steering Committee)
- Nancy Calhoun, via phone, Department of Geologic and Mineral Industries (Advisory Board)
- Selene Jaramillo, Lane County Public Health (Advisory Board)

Topics:

- 2014 NHMP Action Item updates
- Next quarter priorities
- DOGAMI landslide hazards project update
- Emergency water supply guidebook
- NFIP-ESA biological opinion overview
- 2020 NHMP update planning

NHMP Update Committee

Date: May 24, 2016 4:00 pm to 5:00 pm

Attendees:

- Not available

Topics:

- 2014 NHMP Action Item updates
- Next quarter priorities
- Emergency water supply guidebook update
- Portland equity planning and mitigation material share
- Community energy planning, eLab
- NHMP progress report, timeline, and roles

NHMP Update Committee

Date: January 26, 2016 3:00 pm to 5:00 pm

Attendees:

- Bill Burns, via phone, Department of Geologic and Mineral Industries (Advisory Board)
- Bill Clingman, Lane Council of Governments (Advisory Board)
- Greg Ferschweiler, City of Springfield (Steering Committee)
- Jill Hoyenga, Eugene Water & Electric Board (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Kevin Holman, City of Eugene Emergency Manager (Project Team)
- Lisa McLaughlin, Eugene Water & Electric Board (Steering Committee)
- Matt McRae, City of Eugene (Steering Committee)
- Melysa Slavkovsky, City of Eugene Public Works (Steering Committee)
- Myrnie Daut, City of Eugene (Steering Committee)

Topics:

- 2014 NHMP Action Item updates
- Next quarter priorities

NHMP Update Committee

Date: October 27, 2015 3:00 pm to 5:00 pm

Attendees:

- Bill Clingman, Lane Council of Governments (Advisory Board)
- Jill Hoyenga, Eugene Water & Electric Board (Steering Committee)
- Ken Vogeney, City of Springfield Emergency Manager (Project Team)
- Lisa McLaughlin, Eugene Water & Electric Board (Steering Committee)
- Louranah Janeski, City of Eugene Floodplain Manager (Steering Committee)
- Mark Walker, Mackenzie Willamette Medical Center (Advisory Board)
- Matt McRae, City of Eugene (Steering Committee)
- Melysa Slavkovsky, City of Eugene (Steering Committee)
- Myrnie Daut, City of Eugene (Steering Committee)
- Patence Winningham, City of Eugene Emergency Management (Steering Committee)
- Randi Bowers-Payne, 4J School District (Advisory Board)
- Selene Jaramilo, Lane County Public Health (Advisory Board)

Topics:

- 2014 NHMP Action Item updates
- Next quarter priorities

NHMP Update Committee

Date: May 11, 2015 1:00 pm to 3:00 pm

Attendees:
- Not available

Topics:
- 2014 NHMP Action Item updates
- Form implementation teams for priority NHMP Action Items
- Updates and adjustments process

NHMP Update Committee

Date: January 26, 2015 3:00 pm to 5:00 pm

Attendees:
- Not available

Topics:
- 2014 NHMP Action Item updates
- Priorities for next quarter

Part 2: Public Process

Public involvement in the update of the Eugene-Springfield Area Natural Hazards Mitigation Plan has been accomplished in multiple ways:

A. **2014 Regional Climate and Vulnerability Assessment**
There was extensive stakeholder involvement from community businesses, partner agencies, and non-governmental organizations (NGOs) within the process of conducting the community climate and hazards vulnerability assessment. The 2014 Regional Climate and Vulnerability Assessment Project Team met with a group of eight to twelve representatives from each of the eleven different sectors for six hours each. This extensive effort provided rich detail and clear guidance about the priority areas for natural hazard mitigation in Eugene-Springfield. More detail about the process is in Section 4.4.

B. **Lane Preparedness Coalition**

The Lane Preparedness Coalition Steering Committee meets multiple times a year. These meetings often included a 5-10 minute status briefing by the NHMP Project Manager. The NHMP update reflects their feedback.

C. Open Houses

EWEB offers yearly open houses (Table BB-1) for the public to learn about project updates, incentive programs, and winter storm mitigation efforts. This yearly effort includes a social media campaign for those unable to attend in person.

Table BB-1 EWEB Open Houses

Date	Event	Audience	# of Attendees	# Reached by Social Media
10/17/2017	EWEB Open House (Figure B-1)	Community Members	70	44,620
10/16/2018	EWEB Open House (Figure B-2)	Community Members	100	21,220

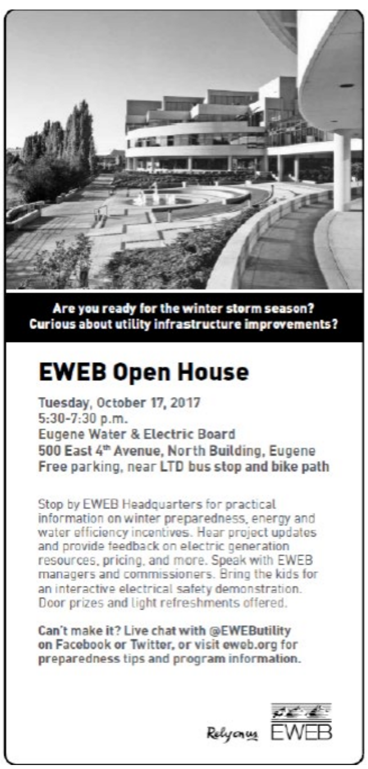

Figure B-1 and B-2. EWEB Open House

D. In Public Events

The NHMP Project Team attended multiple community events to make natural hazard mitigation outreach more engaging and relatable. Community members were asked to provide input through direct comment or voting on specific hazards they would like the Cities to mitigate against as well as specific mitigation projects they would like pursued.

Many projects listed within this plan are 5, 10, or even 15-year projects. With the long-term focus of this plan, in 2018 the Project Team started to involve children in their outreach since some of the projects outline in this plan will be completed after they come of age. Voting results will aid in the selection of Mitigation Action Items as well as track educational outreach efforts.

To record this information, large posters were made with various voting options. Event attendees were asked to place a sticker on the item receiving their "vote". Each attendee received one vote per poster. Adult votes were documented with gold stars while votes from children were recorded using various colored stars (excluding gold).

By making natural hazard mitigation outreach more relatable and engaging Plan and Sub-Plan Holders saw an increase in the number of community members involved in the plan update. Two of the events, Disaster Movie in the Park (Figure B-7) and Public Works Day (Figure B-6), were highlighted in the Strategic Alliance for Risk Reduction (STARR) newsletter for FEMA Region 10 (Figure B-3 and B-4).

News from Region 10

Hazard Mitigation Planning Can Be Fun!

The City of Eugene shows us how

Eugene-Springfield Natural Hazards Mitigation Planning (NHMP) staff, with guidance from OEM and FEMA mitigation experts, decided to switch tactics for their 2020 NHMP update to generate more public involvement. The new outreach efforts started May 17th at Eugene's annual Public Works Day. Staff wanted to determine if there were any gaps between children and adults in their understanding of hazards. Recognizing today's children will manage and influence the plan in 5, 10, or 15 years, staff developed an activity both children and adults could participate in and understand, while helping guide planning efforts.

It was a fast-paced, hands-on event with thousands of people attending. Children and adults talked with staff to learn some of what goes on behind the scenes with the NHMP. While at the booth, participants ranked the natural hazards they thought were the most important to "be stronger against." People were eager to engage with staff. Many were surprised and interested to learn there are people employed in mitigating natural hazards for their community. People asked a host of questions concerning the NHMP and natural hazards the City of Eugene faces.

Responses from the event produced some surprising results. One thing the City recognized was how comparable the public's view of risk was to the NHMP Project Team's risk assessment for the City. Many of the children seemed to have a realistic grasp on many of the hazards in question. Very few children placed their vote on winter storms while several adults did. We believe this is due to adults remembering the devastating Ice Storm of 2016 and "snow days" are hoped for by children across the nation. Making NHMP outreach more engaging and hands-on proved successful and far surpassed the expectations of NHMP staff.

The next large event will be a "Disaster Movie in the Park" on August 31st. Eugene Water and Electric Board (EWEB) and the City of Eugene, along with support from the City of Springfield, Rainbow Water District, and Springfield Utility Board (SUB), will be partnering to host this event. The format will be similar to the Public Works Day NHMP outreach. Attendees will be asked to vote on specific mitigation action items they would like to see completed followed by an interactive disaster movie.

– Jessica Gourley is an Emergency Management Analyst with the City of Eugene, Oregon. For more information about the event, email Jessica.K.Gourley@ci.eugene.or.us.

RiskMAP
Increasing Resilience Together

Figure B-3. Public Works Day

Movies for Mitigation

By Amanda Siok, FEMA Region 10 Earthquake Program Manager

Our June 2018 Newsletter featured a story on the City of Eugene, Oregon's public outreach efforts for their hazard mitigation plan. Since then, the City has been increasing their reach and expanding their audience in an effort to really learn what their residents want to do to reduce their vulnerability to natural hazards.

In cooperation with the Eugene Water and Electric Board (EWEB), City of Springfield, Rainbow Water District, and Springfield Utility Board (SUB), they hosted a "Disaster Movie in the Park" this August. Using a local park, the city set up voting tables where residents of all ages could vote on specific mitigation projects they want the city to complete. The publicly prioritized projects will feed directly into the plan's hazard mitigation strategy (Elements C4 and C5).

The city had other engaging booths set up for the public to visit. Residents could sign up for Map Your Neighborhood, win prizes by spinning the Water & Electric Board wheel, and learn about mitigation, CRS, and the city's flood programs.

By the time the sun went down, the disaster film "San Andreas" was queued up, the popcorn was ready, and 150 people had voted on mitigation projects. Before the film began, Jessica Gourley with Eugene Emergency Management briefly spoke to the audience about reducing vulnerability to disasters and the value of proactively strengthening the city's infrastructure. Once the movie was over, many residents commented on wanting to prevent damage to their homes and workplaces.

An approved Hazard Mitigation Plan must "document how the public was involved in the planning process during the drafting stage" (Element A3- Local, A2 Tribal). Eugene's efforts met this requirement because the public helped to prioritize the hazards of concern that the city "should be stronger against". In fact, the city of Eugene went above and beyond minimum requirements to fully engage input from the public.

The city of Eugene has done a tremendous job obtaining buy-in to the mitigation message, meaningfully engaging the public in their mitigation plan, and making the required plan update a worthwhile process to increase the resilience of the city. Kudos to Jessica and the rest of the Eugene Emergency Management Team!

Figure B-4. Disaster Movie in the Park

Figure B-5. (left to right) Tracy Richardson (SUB), Jessica Gourley (City of Eugene), (CERT Volunteer), and Ken Vogeney (City of Springfield) and Willamalane Children's Celebration.

Figure B-6. Jessica Gourley (City of Eugene) speaking with voters at Public Works Day


Disaster Movie in the Park
SAN ANDREAS
When: August 31st , festivities begin @ 7:30 pm
movie @ dusk
Where: Washington Park
2025 Washington St. Eugene, OR
➢ Learn about the Eugene-Springfield Natural Hazard Mitigation Plan.
➢ Vote on mitigation projects you think Eugene should complete.
➢ See what EWEB is working on.
➢ Play the Hazards game and win prizes!
➢ Free popcorn!
➢ Fun for the whole family!
Questions:
Jessica.K.Gourley@ci.eugene.or.us
or call 541-682-5762
EWEB
Eugene
Rainbow Water District
SUB
SPRINGFIELD UTILITY BOARD
SPRINGFIELD OREGON

Figure B-7

Voting Results

Residents of Eugene and Springfield were asked to vote for what hazard they feel mitigation efforts should focus on as well as specific projects they would like to see completed. Table BB-2 shows votes cast at each outreach event and total votes for all public outreach events. For adults, the hazard mitigation area of focus which received the most votes was earthquakes, followed by floods, geomagnetic disturbances, and winter storms (Table BB-5). The top three hazards children wanted mitigation efforts to focus on were earthquakes, geomagnetic disturbances, and floods (Table BB-3). Adults selected earthquakes, floods, and winter storms (Table BB-4).

For the second voting option, Disaster Movie in the Park attendees were asked to vote on a selection of mitigation projects grouped by categories (seismic stability for infrastructure, large scale transportation planning projects, and mitigation projects for hazards of moderate risk). Attendees were asked to vote for the project they would like to see competed within each category. The top three projects were:

- Seismic retrofits for critical and public infrastructure;
- Dam notification and evacuation planning, with local transportation and lifeline planning, and seismic retrofit projects coming in at a close second; and
- Wildland-urban interface zoning and land development planning.

Table BB-2 Votes Cast

Date	Event	Hazards of Concern Poster		Project Poster
		# of Child Votes	# of Adult Votes	Project Votes
05/17/2018	Public Works Day (Figure B-6)	524	134	-
07/14/2018	Active Bethel Citizens Family Fun Night	25	30	-
07/28/2018	Willamalane Children's Celebration (Figure B-5)	135	126	-
08/31/2018	Disaster Move in the Park	4	29	121
09/29/2018	BRING Event	A2	38	-
10/10/2018	Employee Wellness Fair	0	121	-
10/10/2018	Agnes Stewart Class (AS1)	23	1	-
12/03/2018	Agnes Stewart Class (AS3)	24	0	-
01/15/2019	A3 School	21	2	-
02/12/2019	Agnes Stewart Class (AS2)	25	0	-
01/19/2019	Springfield LDS Stake	5	64	-
	Totals	786	542	121

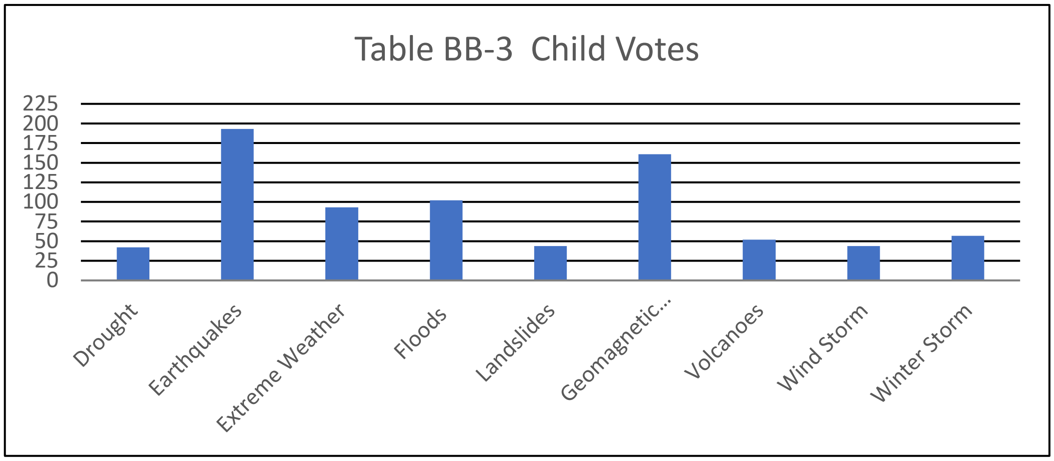
Table BB-3 Child Votes
225
200
175
150
125
100
75
50
25
0
Drought
Earthquakes
Extreme Weather
Floods
Landslides
Geomagnetic...
Volcanoes
Wind Storm
Winter Storm

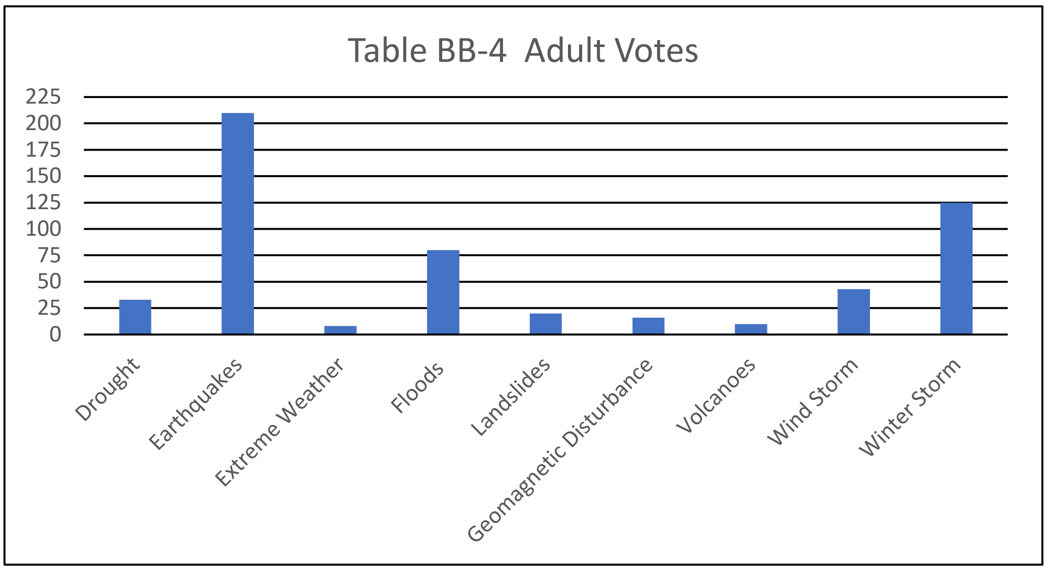
Table BB-4 Adult Votes
225
200
175
150
125
100
75
50
25
0
Drought
Earthquakes
Extreme Weather
Floods
Landslides
Geomagnetic Disturbance
Volcanoes
Wind Storm
Winter Storm

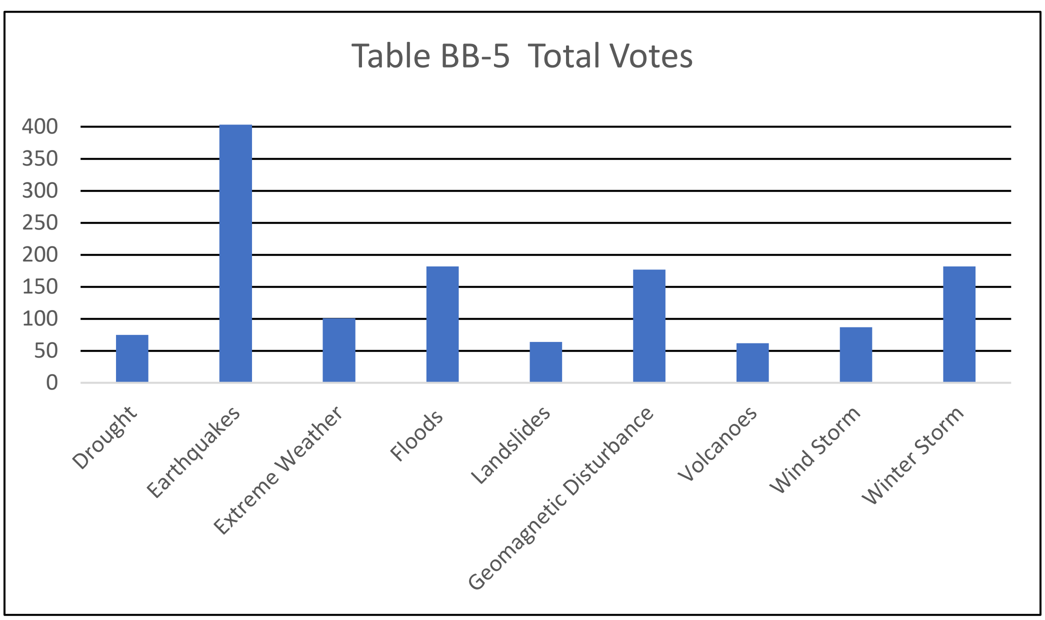
Table BB-5 Total Votes
400
350
300
250
200
150
100
50
0
Drought
Earthquakes
Extreme Weather
Floods
Landslides
Geomagnetic Disturbance
Volcanoes
Wind Storm
Winter Storm

Emergency Water Station Events

A project to utilize well water, either through rebuilt or new water wells at public sites such as schools, for distribution of water during an emergency emerged out of the 2014 NHMP. As a result, two emergency well sites were commissioned and built in the Eugene-Springfield area. Opening events (Picture B-1 and B-2) allowed Sub-Plan Holders the opportunity to show attendees how to use the emergency wells under non-crisis situations, as well as promote similar mitigation work. These events gave the unique opportunity to not only show community members how to prepare for a water emergency but also how loss of electric and other vital services could impact the delivery of drinking water (Table BB-6).

Table BB-6 Emergency Drinking Water Events

Date	Event	Audience	# of Attendees
10/06/2018	Emergency Water Distribution Station – Bethel Farm (Figure 8)	Community Members	200
9/30/2014	Emergency Water Distribution Station – Howard Elementary (Figure 7)	Community Members	300
N/A	Water containers distributed	Community Members	600

Picture B-1

Picture B-2

Upcoming Public Outreach

The following events (Table BB-7) will occur after we get approval pending adoption from FEMA.

Table BB-7 Public Outreach Events

Date	Event	Audience	# of Attendees
TBD	Display on the City of Eugene website.	Community Members	TBD

Appendix C: Community Profile

Geography and Climate

The Eugene-Springfield area is located in the south end of the Willamette Valley, at the confluence of the Willamette and McKenzie Rivers, between the Coast Range and the Cascade Mountains. The Eugene-Springfield area contains a diversity of landscapes: wetlands, rivers, lakes, creeks, riparian areas, grasslands, uplands, and foothills. In addition to the Willamette and McKenzie Rivers, there are numerous creeks and a canal system running through the area as well as several large lakes and reservoirs including Fern Ridge Reservoir.

The climate for the Eugene-Springfield area is moderate. The average range of high temperature in January is 47 degrees while the average low is 34 degrees. In August, the average high temperature is 83 degrees with an average low of 51 degrees. The recorded annual range of daily temperatures is between 42 degrees and 64 degrees. Each year the Eugene-Springfield area receives about 38 inches of precipitation.[1]

Population and Demographics

Eugene and Springfield make up the largest cities in the Lane Metropolitan Planning Organization (MPO) area. The estimated population of Eugene in 2018 was 169,695 people which is a 20.7% increase since 2010. The annual growth rate is .99%. The estimated population for Springfield in 2018 was 60,865, a 14.1% increase since 2010. Springfield has an annual average growth rate of 1.52%.

Within the Lane MPO, key population and demographic trends include:

- 79.9% of the population identifies as white (non-Latino).
- 14.9% of the population identifies as minority.
- 8% of the population identifies as Latino, an 81% increase since 2000.
- Almost 90.5% of the population speaks only English.
- About 9.5% of the population speaks a language other than English at home, mainly Spanish, Chinese, German, Japanese, and French.
- Nearly 16.5% of people living in the Lane MPO area have one or more disability.
- In Eugene, 52% of all households are family households; and in Springfield 59% of all households are family households. Students living together near the University of Oregon and Lane Community College in Eugene can account for the difference in the number of family households between the two cities.

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[1] Western Regional Climate Center. www.wrcc.dri.edu, Eugene, Oregon (352706), accessed. July 26, 2019.

- The largest population by age in the Lane MPO is 25 to 34 year's old and makes up 14.7% of the population.[2]

Additional data regarding Eugene and Springfield's population and social demographics can be found on the Lane Council of Governments' webpage and the Livability Lane Equity and Opportunity Assessment from July 2014.[3] [4]

Employment and Economics

Employment

Eugene and Springfield are the largest centers for employment in the Lane MPO area. The economy has generally been moving away from timber and manufacturing centers and towards a retail and service-based economy. Many jobs are now geared towards retail, healthcare, professional and business services, leisure, and hospitality. In 2018, Eugene's unemployment rate was 4.6% and Springfield's was 4.7%. Unemployment rates have remained generally stable since the 1990s with the highest rates peaking from 2008-2010 during the national economic downturn. Additional information regarding Eugene and Springfield's employment and economy can be found in the Springfield Commercial and Industrial Buildable Lands Inventory and Economic Opportunity Analysis (2015) and the City of Eugene Economic Opportunity Analysis (2010).

Median Household Income

In 2017, the median household income for Eugene was $50,184 and Springfield's was $41,700. For comparison, the median household income for Lane County was $47,710, Oregon was $60,212, and the median income for the United States was $61,372.[5]

Poverty

Using data from 2009-2011, Eugene's poverty rate was 23.5%, and Springfield's was 22.4%. Eugene's rate is affected by a large student population attending University of Oregon and Lane Community College. When college students are removed from the calculation, the poverty rate lowers to 16.2% for Eugene.[6]

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[2] US Census 2010 Block level data, Table P12.
[3] Lane Counsel of Governments 2014. "Demographic Information." http://lcog.org/589/Demographic-Information, accessed July 26, 2019.
[4] Lane Livability Consortium. 2014. "Equity and Opportunity Assessment." http://www.livabilitylane.org/files/EOA_report/LLC%20EOA%20Report%207AUG14_FINAL_sm.pdf, accessed October 29, 2014.
[5] Lane Counsel of Governments 2014. "Demographic Information."
[6] U.S. Census Bureau. 2013. "Examining the Effect of Off-Campus College Students on Poverty Rates." https://www.census.gov/newsroom/blogs/random-samplings/2017/12/off-campus.html?CID=CBSM, accessed June 25, 2019.

Transportation

Transportation is an important consideration when planning for emergency service provisions. Future growth will put pressure on roads, the airport, rail systems, and rivers. The Eugene-Springfield area has been a longstanding choice for transportation interchanges to occur due to the location.

Interstate 5, the major highway that connects Oregon to Washington and California, runs between the cities of Eugene and Springfield. State Highway 99 also runs north-south through the City of Eugene, connecting the area to Junction City to the north and Goshen to the south. State Highway 126 runs east-west through both Eugene and Springfield connecting the Cities to nearby communities such as Walterville to the east and Veneta to the west.

Union Pacific owns and operates the rail system which runs north-southeast through Eugene. Additionally, there is a smaller cargo rail connecting the Eugene-Springfield area to the coast. Amtrak runs passenger trains daily through the area.

The Eugene-Springfield area is home to the Eugene Airport, which is the second largest airport in Oregon and the fifth largest airport in the Pacific Northwest. The airport is owned and operated by the City of Eugene. [7]

Please refer to Section 3 for Eugene and Springfield transportation maps.

Land Use

Eugene contains nineteen different land use designations. Public land is scattered throughout the entire City limits for both Eugene and Springfield. Industrial infrastructure (heavy and light) is centered around Highway 99 and the Pacific Union rail yard as well as along Highway 126 heading west. The majority of the City is zoned Low-Density Residential.

Springfield has designated twenty-two different zones for land use purposes. The majority of Heavy Industrial Zoning is located in the central part of the City and in the northwest corner. Areas zoned for Public Lands & Open Space are spread throughout the City. Additionally, most of the City is zoned Low-Density Residential.

Refer to Section 3 for the Eugene and Springfield Zoning maps.

[7] City of Eugene. 2019. “Transportation Options.” https://www.eugene-or.gov/487/Transportation-Options, accessed July 26, 2019.

Housing

In Eugene, there has been an increase in multi-family housing, due in large part to additional student housing near the University of Oregon. Both Eugene and Springfield have seen a decline in the construction of single-family housing. Regardless, the majority of both Cities are composed (over 50%) of single-family housing with 30% of total housing categorized as multi-family housing. Less than 5% of Eugene, and 9% of Springfield is composed of mobile homes, boats, RVs, and vans.

In Eugene, renters occupy 51.7% of housing and 48.3% is occupied by owners. Springfield is similar with 49.2% of housing occupied by renters and 50.8% occupied by owners. On average, renters in Eugene have a median gross rent of about $959 a month while Springfield is about $862 a month. Eugene's median gross rent is slightly higher than that of Lane County ($921), but lower than Oregon ($988) and the US ($982)[8]. The median monthly owner costs, with a mortgage, are about $1,614 a month for Eugene, and $1,283 for Springfield. Eugene's median monthly owner costs are higher than Lane County ($1,454), Oregon ($1,594), and the US ($1,515).[9]

Historic and Cultural Resources

Historic and cultural resources such as historic structures and landmarks can help define a community and generate revenue from tourism. Because of their role in defining and supporting the community, protecting these resources is important. Eugene has sixty-three sites on the National Register of Historic Places and Springfield has seven. Table CC-1 summarizes the historic sites in Eugene and Springfield built before 1900. Eugene has sixteen pre-1900 sites on the National Historic Registry, and Springfield has five.[10]

[8] US Census Bureau. 2013-2017. American Community Survey, table DP-4.
[9] US Census Bureau. 2013-2017. American Community Survey, table B25088.
[10] National Register of Historic Places. http://www.nps.gov/nr/, accessed July 26, 2019.

Table CC-1 Pre-1900 Historic Sites

City	Site	Estimated Year Built
Eugene	Flanagan Site (specific location information restricted)	Pre-European Native American archaeological site
Eugene	Frank L. & Ida Chambers House	1891
Eugene	Chase Gardens Residential Grouping	1889
Eugene	Danie & Catherine Christian House	1885
Eugene	Christian-Patterson Rental Property	1890
Eugene	Deady Hall	1873
Eugene	Blair Boulevard Historic Commercial Area	1875
Eugene	Pioneer Cemetery	1872
Eugene	Masonic Cemetery and Hope Abbey Mausoleum	1859
Eugene	A.V. Peters House	1869
Eugene	Shelton-McMurphy House and Grounds	1888
Eugene	Smeede Hotel	1884
Eugene	Villard Hall	1885
Eugene	Benjamin Franklin Dorris House	1850-1874
Eugene	East Skinner Butte Historic District	1850-1874
Eugene	Lane County Clerk's Building	1853
Springfield	Brattain-Hadley House	1893
Springfield	Robert E. Campbell House	1870
Springfield	Dorris Ranch	1899
Springfield	Southern Pacific Railroad Passenger Station and Freight	1891
Springfield	Larimer House	1885

Table CC-1. Pre-1900 Historic Sites. Source: National Register of Historic Places National Register Information System, accessed November 201442.

Additionally, the National Registry of Historic Places has listed Springfield's Washburne Historic District as worthy of preservation. The Washburn Historic District, established in 1985, has fifteen buildings built between 1885 and 1924.[11]

[11] Springfield Historic Commission. "Washburne Historic District." http://www.ci.springfield.or.us/dsd/planning/hcommission/Site%26Bldgs/Washburne.html, accessed October 29, 2014.

Although not listed on the National Register of Historic Places, the Gray/ Jaqua house on Highway 126 east of Springfield is considered one of the oldest existing buildings in the City of Springfield and is currently being developed into a City park.

Throughout the year, the Cities of Eugene and Springfield have many community events and annual traditions. A few examples include: the Eugene Marathon; track and field events at University of Oregon's Hayward Field, and the weekend markets in both Eugene and Springfield.

Critical Facilities

Critical facilities are facilities that are essential to government response and recovery activities (e.g., hospitals, police, and fire stations). The interruption or destruction of any of these facilities would have a debilitating effect on incident management.

The City of Eugene owns and manages the following facilities:

- Eleven fire stations and a training center
- Three police stations
- A Public Works facility on Roosevelt Boulevard

The City of Eugene and the City of Springfield participate in joint management of the regional wastewater treatment facility.

As the Lane County seat, Eugene also contains several county government facilities including the Lane County Sheriff's Office and Lane County Jail.

The City of Springfield owns and manages the following facilities:

- City Hall
- Five fire stations
- The Springfield Justice Center Facility containing the police department, jail, and courts
- The Maintenance Division facility

The following utilities are locally owned and operated, and work in close partnership with the City of Eugene and the City of Springfield. Information regarding their facilities are located within their respective annexes.

- Eugene Water & Electric Board (EWEB)
- Rainbow Water District (RWD)
- Springfield Utility Board (SUB)

As of 2010, the Eugene and Springfield Fire Departments and Emergency Medical Services (EMS) have merged, and the departments are now jointly serve the Eugene and Springfield communities.

Eugene and Springfield contain a number of significant federal facilities. In Springfield, the National Guard Resource Center houses the National Guard, Federal Reserve forces, and the dispatch center for the U.S. Forest Service's fire fighting forces. Eugene houses the U.S. District Court for the District of Oregon and the 970th Transportation Detachment for the United States Army Reserve 654th Regional Support Group.
The Eugene-Springfield area is home to the following hospitals: Sacred Heart Medical Center University District, Sacred Heart Medical Center at RiverBend, and McKenzie-Willamette Medical Center.

Government Structure

Eugene and Springfield both operate under a council-manager framework. The councils enact policy and the City Manager is responsible for operations.

In Eugene, the City Council consists of a mayor and eight City Councilors. The City of Eugene contains the following City departments:

- **Central Services**: Provides centralized support for other City departments. It includes the City Manager's Office, Municipal Court, City Prosecutor's Office, Employee Resource Center, Finance, Facilities Management and Information Services.
- **Eugene Springfield Fire**: Protecting and preserving life, property and the environment through prevention, education, medical, rescue, and fire suppression services.
- **Library, Recreation, and Cultural Services**: Supports an informed society, offers opportunities for lifelong learning and health, and provides cultural experiences.
- **Planning and Development**: Enforces zoning ordinances, works with general public to plan and monitor development activities.
- **Police**: Protecting, training, and enhancing the lives of the residents.
- **Public Works**: Provides a wide range of services and programs related to parks and open space, transportation, stormwater and wastewater infrastructure, and natural resource stewardship.

The Springfield City Council consists of the mayor and six City Councilors elected for four-year terms. The mayor and council are responsible for the appointment of the City Manager, City Attorney, municipal court judges, and advisory committees. Springfield City Hall and the separate Justice Center contain the offices of the following City departments:

- **City Attorney's Office**: Responsible for the legal representation of the City of Springfield. Provides advice and support to the City Council, City staff, and boards and commissions.
- **City Manager's Office**: Directs and coordinates City department plans to help meet City Council goals. Oversees the administration of all City departments and appoints department directors.
- **Development and Public Works**: Enforces zoning ordinances, works with general public to plan and monitor development activities. Designs, constructs, operates, and manages public infrastructure including streets, sanitary sewers, stormwater management facilities, public buildings, and other facilities.
- **Eugene Springfield Fire**: Protecting and preserving life, property and the environment through prevention, education, medical, rescue, and fire suppression services.
- **Finance**: Manages the finances of the City and Metropolitan Wastewater Management Commission and operates Municipal Court.
- **Human Resources**: Supports and develops staff.
- **Information Technology**: Ensures the City's computer and communication systems are efficient, and up to date.
- **Library**: Gives the community access to reading and learning through books, computers, technology, and children's cultural events.
- **Police**: Protects lives and property by enforcing laws, preventing crimes, and operating the municipal jail.

The Willamalane Parks and Recreation District is responsible for managing parks within the City of Springfield.

Existing Plans and Policies

Communities often have existing plans and policies which guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports of studies. Plans and policies already in existence have support from residents, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt to changing conditions and needs.[12]

At the state level, Statewide Planning Goals, related statutes and administrative rules provide a framework for all local land use planning. Statewide Planning Goal 7 (Natural Hazards) requires local governments to adopt comprehensive plans

[12] Burby, Raymond J., ed 1998. *Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities*.

(inventories, policies, and implementing measures) to reduce risk to people and property from natural hazards including floods (coastal and riverine), landslides, earthquakes and related hazards, tsunamis, coastal erosion, and wildfires. In accordance, the Eugene-Springfield Metropolitan Plan is the guiding document for regional land use planning and includes policies related to development in the floodway and floodplain, geologic conditions, and on hillsides. Statewide Planning Goal 7 further states local governments should coordinate their land use plans and decisions with emergency preparedness, response, recovery, and mitigation plans.[13] As the City of Eugene and City of Springfield plans, listed below, are being developed or renewed the Eugene-Springfield Area NHMP 2020 findings will be incorporated into the planning process.

The Eugene-Springfield Area Natural Hazards Mitigation Plan includes a range of recommended action items to reduce the area's vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives of the area's existing plans and policies. Linking existing plans and policies to the Natural Hazards Mitigation Plan helps identify existing resources which can be used to implement the Mitigation Action Items. Implementing action items through existing plans and policies increases the likelihood projects will be supported, implemented, and updated.

The City of Springfield manages its comprehensive, land use, infrastructure, and capital improvement planning all through a single city department – the Development and Public Works Department. This integration of functions provides a direct conduit for identifying community needs and improvements and integrating them into codes, procedures, and plans. A specific example of this integration would be the update of the City of Springfield's Development Code standards. The City's Emergency Manager is a member of the project team providing recommendations for code amendments related to natural hazards and other relevant issues. Integrated planning also extends to the plans themselves. For example, the City's 5-year Capital Improvement Program (CIP) – A Community Reinvestment Plan, contains a project list which includes a listing of the other plans, such as the Natural Hazards Mitigation Plan, that are related to the project. The City Council conducts a public hearing and adopts the updated CIP every other year.

The following list documents the plans and policies already in place in the Eugene-Springfield area.

- **Plan: Public Facilities and Services Plan**
  Date of Last Revision: 2001, amendments 2011
  Author/Owner: City of Eugene, City of Springfield, Lane County

[13] United States. Oregon Planning Department of Land Conservation and Development. *Goal 7: Areas Subject to Natural Disasters and Hazards; Guidelines A Planning.* September 2001. Accessed November 2019. https://www.oregon.gov/lcd/OP/Pages/Goal-7.aspx

Description: An appendix to the Metro Plan described above, that describes the water, sewer and transportation facilities which are to support the land uses designated in the Comprehensive Plans.
Relation to Natural Hazard Mitigation: Mitigation actions relating to water and wastewater treatment facilities should be linked to goals and policies outlined in the Public Facilities and Service Plans.

- **Plan: Regional Transportation Plan**
  Date of Last Revision: 2017
  Author/Owner: Lane County, City of Eugene, City of Springfield, City of Coburg, Oregon Department of Transportation, Lane Transit District
  Description: Guides the management and development of appropriate transportation facilities in Lane County, incorporating the community's vision, while remaining consistent with State, regional, and local plans including the metro area's comprehensive plan.
  Relation to Natural Hazard Mitigation: Mitigation actions relating to improving transportation facilities should be linked with goals and policies expressed in the transportation system plan.

- **Plan: Eugene-Springfield Metropolitan Area General Plan**
  Date of Last Revision: 2015
  Author/Owner: City of Eugene, City of Springfield, Lane County
  Description: The Eugene-Springfield Metropolitan Area General Plan (also known as the Metro Plan) formerly served as Eugene and Springfield's comprehensive plans. Its current purpose is to provide overarching metro-wide support for the Eugene Comprehensive Plan and the Springfield Comprehensive Plan described below.
  Relation to Natural Hazard Mitigation: Provides overarching policy guidance for future development and land use in the Eugene-Springfield metro area.

- **Plan: Eugene-Springfield Multi-jurisdictional Emergency Operations Plan**
  Date of Last Revision: 2019
  Author/Owner: City of Eugene, City of Springfield
  Description: Details plans and policies for emergency response in all aspects of city life.
  Relation to Natural Hazard Mitigation: This document is primarily response-based but contains elements that are pertinent to mitigation.

- **Plan: Envision Eugene Comprehensive Plan**
  Date of Last Revision: 2017
  Author/Owner: City of Eugene
  Description: The Eugene Comprehensive Plan is new. Previously the Metro Plan served as Eugene and Springfield's comprehensive plans. The plan purpose is to promote sustainability and sustainable land use development, contain urban development, promote redevelopment, protect natural resources, foster

economic vitality, provide efficient and cost-effective services, and ensure a sense of history and place.
Relation to Natural Hazard Mitigation: Provides policy guidelines for future development and land use in Eugene.

- **Plan: Eugene Capital Improvement Program, 2020-2025**
  Date of Last Revision: 2019
  Author/Owner: City of Eugene
  Description: The City of Eugene's Capital Improvement Program (CIP) forecasts the City's capital needs over a six-year period based on various long-range plans, goals, and policies. The program is updated every two years and provides a list of capital improvements programmed for funding in the next five years. These improvements are aimed at improving neighborhoods, providing economic growth, improving traffic safety, complying with environmental standards, and maintaining the existing infrastructure.
  Relation to Natural Hazard Mitigation: CIP projects are selected based on identified needs, available funding and associated limitations, and support or direction from official advisory groups, City Council and other sources of guidance. Projects are compiled from plans and reports including the NHMP 2020.

- **Plan: Development Code (Eugene)**
  Date of Last Revision: 2012
  Author/Owner: City of Eugene
  Description: Interprets land use code. Outlines decision making processes, code enforcement, penalties, and non-conforming situations. It is the primary implementation tool of the Metro Plan (comprehensive plan).
  Relation to Natural Hazard Mitigation: Should reflect needs and issues related to development in hazardous areas. Contains regulations for development on steep slopes

- **Plan: Climate Action Plan 2.0 Draft**
  Date of Last Revision: 2010 (Community Climate and Energy Action Plan, draft 2019
  Author/Owner: City of Eugene
  Description: Builds on the momentum created by Eugene's Climate Recovery Ordinance (CRO) by identifying research-based actions that help the community reach its climate goals.
  Relation to Natural Hazard Mitigation: CAP 2.0 incorporates policies, plans, and strategies adopted by City Council which allows the community to become more resilient by working on actions that we are committed to implementing. The CAP 2.0 identifies the NHMP as an action item as part of Section 5: Resilience – Health, Emergency and Natural Resources.

- **Plan: Springfield 2030 Refinement Plan**

Date of Last Revision: 2016
Author/Owner: City of Springfield
Description: Springfield is developing a City-wide refinement plan called the Springfield 2030 Refinement Plan that will guide growth and development for the Metro area east of Interstate 5 through the 2010-2030 planning period. Updates to the Downtown Refinement Plan, Glenwood Refinement Plan and Visioning for Main Street refinement plan updates are also underway.
Relation to Natural Hazard Mitigation: Provides land use policy and maps areas for future development in Springfield.

- **Plan: Development Code (Springfield)**
  Date of Last Revision: June 2019
  Author/Owner: City of Springfield
  Description: Interprets land use code. Outlines decision making processes, code enforcement, penalties, and non-conforming situations. It is the primary implementation tool of the Metro Plan (comprehensive plan).
  Relation to Natural Hazard Mitigation: Should reflect needs and issues related to development in hazardous areas.

- **Plan: Springfield Capital Improvement Program, 2012-2016**
  Date of Last Revision: 2011
  Author/Owner: City of Springfield
  Description: The City of Springfield's Capital Improvement Program (CIP) is a five-year Community Reinvestment Plan that describes the funding and construction of City public facilities. A fundamental purpose of the CIP is to facilitate the efficient use of limited capital resources. The stated goals for the CIP are to: provide a balanced program for capital improvements given reasonably anticipated funding over a five-year or greater planning period and identifying the extent to which resources can meet capital needs; improve neighborhoods; provide for economic and community growth; improve safety, access, and mobility of transportation modes; comply with environmental standards and improving environmental quality; maintain the existing City infrastructure; and protect public health and safety.
  Relation to Natural Hazard Mitigation: Mitigation items linked with capital improvements are linked with goals and policies of the capital improvement plan.

Social Systems and Service Providers

Social systems can be defined as community organizations and programs that provide social and community-based services, such as health care or housing assistance, to the public. In planning for natural hazard mitigation, it is important to know what social systems exist within the community due to their existing connections to the public. Often, actions identified by this plan involve communicating with the public or specific subgroups within the population (e.g. elderly, children, low income). The Cities of

Eugene and Springfield can use existing social systems as resources for implementing such communication.

The following is a brief explanation of how the communication process works (Figure C-1) and how the community's existing social service providers can be utilized to provide natural hazard related messages to their clients.

There are five essential elements for communicating effectively to a target audience:

- The source of the message must be credible;
- The message must be appropriately designed;
- The channel for communicating the message must be carefully selected;
- The audience must be clearly defined; and
- The recommended action must be clearly stated, and a feedback channel established for questions, comments and suggestions.

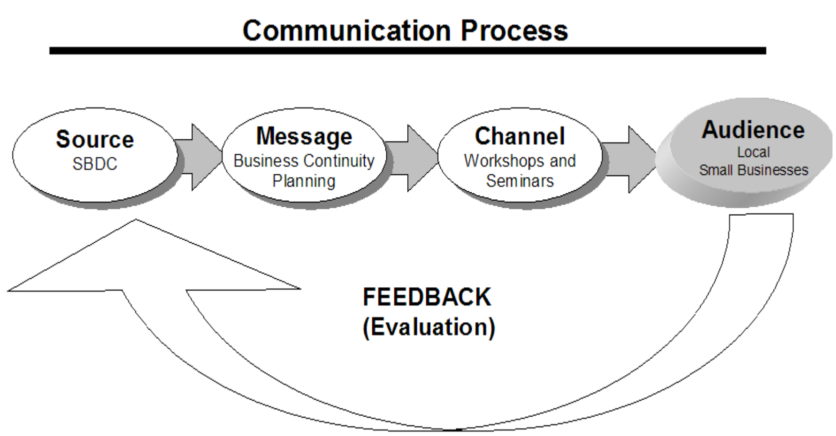

Figure C-1. Communication Process Source: Adapted from the U.S Environmental Protection Agency Radon Division's outreach program.

The following table (Table CC-2) provides a list of several local service agencies and organizations within Eugene and Springfield. The table provides information on each organization or program's service area, types of services offered, populations served, and how the organization or program could be involved in natural hazard mitigation. The three involvement methods identified in the table are defined below:

- Education and outreach - organization could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.
- Information dissemination - organization could partner with the community to provide hazard related information to target audiences.

- Plan/project implementation - organization may have plans and/or policies that may be used to implement mitigation activities, or the organization could serve as the coordinating or partner organization to implement mitigation actions.

The information provided in the table can also be used to complete action items by identifying potential coordinating agencies and internal and external partners.

Table CC-2 Eugene-Springfield Community Organizations

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
Eugene Chamber of Commerce 1401 Willamette St Eugene, OR 97401 (541) 484-1314	Represents the local businesses and disseminates information to businesses and visitors.	Eugene	X						Education and outreach & Information dissemination
Springfield Chamber of Commerce 101 South A Street Springfield, OR 97477 (541) 746-1651	Represents the local businesses and disseminates information to businesses and visitors	Springfield	X						Education and outreach & Information dissemination
Sacred Heart Medical Center 1255 Hilyard St. Eugene, OR 97401 (541) 686-7300	Provides healthcare to the area	Eugene, Springfield, and the surrounding area		X	X	X	X	X	Education and outreach & Information dissemination
Sacred Heart Medical Center- RiverBend 3333 RiverBend Dr. Springfield, OR 97477 (541) 222-7300	Provides healthcare to the area	Eugene, Springfield, and the surrounding area		X	X	X	X	X	Education and outreach & Information dissemination
McKenzie-Willamette Medical Center 1460 G St, Springfield, OR 97477 (541) 726-4400	Provides healthcare to the area	Eugene, Springfield, and the surrounding area		X	X	X	X	X	Education and outreach & Information dissemination

Table CC-2 Eugene-Springfield Community Organizations

Name and Contact Information	Description	Service Area	Population Served: Businesses	Children	Disabled	Elders	Families	Low-Income	Involvement with Natural Hazard Mitigation
Lions Club International 1075 Washington St #212 Eugene, OR 97401 (541) 484-0452	Community Organization	Eugene, Springfield, and the surrounding area	X	X	X	X	X	X	Education and outreach & Information dissemination
Rotary Club of Eugene 66 E 6th Ave Eugene, OR 97401 (541) 485-5983	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Airport Rotary Club, Eugene Airport 28855 Lockheed Dr Eugene, OR 97402 (541) 688-1406	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Emerald Rotary Club, Valley River Inn 1000 Valley River Way Eugene, OR 97401 (541) 510-3042	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene-Metropolitan Rotary Club, Downtown Athletic Club 999 Willamette St Eugene, OR 97401 (541) 345-3733	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Mid-Valley Rotary Club, Oregon Electric Station, 27 E 5th Ave Eugene, OR 97401 (541) 484-6717	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination

Table CC-2 Eugene-Springfield Community Organizations

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
Eugene Southtowne Rotary Club, Vet's Club 1626 Willamette St Eugene, OR 97401 (541) 689- 6872	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Delta Rotary Club, 66 E 6th Ave Eugene, OR 97401 (541) 914-1365	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Delta Rotary Club, 66 E 6th Ave Eugene, OR 97401 (541) 914-1365	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Springfield- Twin Rivers Rotary Club, Royal Caribbean Cruise 1000 Royal Caribbean Way Springfield, OR 97477 (541) 986-3277	Community Organization	Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination
Springfield Rotary Club, Holiday Inn 919 Kruse Way Springfield, OR 97477 (541) 689-2984	Community Organization	Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Elks Club 2470 W 11th Ave Eugene, OR 97402 (541) 338-7848	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Springfield Elks Club 1701 Centennial Blvd Springfield, OR 97477 (541) 747-2145	Community Organization	Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination

Table CC-2 Eugene-Springfield Community Organizations

Name and Contact Information	Description	Service Area	Population Served: Businesses	Children	Disabled	Elders	Families	Low-Income	Involvement with Natural Hazard Mitigation
Lane County Historical Society 740 W 13th Ave Eugene, OR 97402 (541) 682-4242	Community Historical Society	Lane County, including Eugene and Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Public Library 100 W 10th Ave Eugene, Oregon 97401	Public Library	Eugene		X	X	X	X	X	Education and outreach & Information dissemination
Springfield Public Library 225 Fifth St Springfield, OR 97477	Public Library	Springfield		X	X	X	X	X	Education and outreach & Information dissemination
Eugene Airport 28855 Lockheed Drive Eugene, OR 97402 (541) 682-5430	Regional Airport	Eugene and Springfield	X				X		Education and outreach & Information dissemination
University of Oregon Eugene, OR 97403 (541) 346-1000	State University	Eugene and Springfield	X				X		Education and outreach & Information dissemination
Lane Community College 4000 E 30th Ave Eugene, OR 97405 (541) 463-3000	Local Community College	Eugene and Springfield	X	X			X	X	Education and outreach & Information dissemination
Lane Transit District P.O. Box 7070 Eugene, OR 97401 (541) 682-6100	Local Public Transit System	Lane County and Cities	X	X	X	X	X	X	Education and outreach & Information dissemination
United Way Lane 3171 Gateway Loop Springfield, OR 97477 (541) 741-6000	Community Organization	Lane County and Cities	X	X			X	X	Education and outreach & Information dissemination

Table CC-2 Eugene-Springfield Community Organizations									
Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
American Red Cross Oregon Pacific Chapter 862 Bethel Drive Eugene, OR 97401 (541) 344-5244	Regional American Red Cross Headquarters	Benton, Coos, Curry, Douglas, Lane, Lincoln and Linn counties	X	X	X	X	X	X	Education and outreach & Information dissemination

Appendix D: Funding Programs

Introduction

There are numerous local, state and federal funding sources available to support natural hazard mitigation projects and planning. The Oregon Natural Hazard Mitigation Plan includes a comprehensive list of funding sources (refer to Oregon NHMP Chapter 2 Section F(1)). The following section includes an abbreviated list of some of the common funding sources utilized by local jurisdictions in Oregon. Because grant programs often change, it is important to periodically review available funding sources for current guidelines and program descriptions.

Federal Programs

Post Disaster Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

More information at: http://www.fema.gov/hazard-mitigation-grant-program

Pre-Disaster Mitigation Grant Program

The Pre-Disaster Mitigation (PDM) Grant Program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds.

More information at: http://www.fema.gov/pre-disaster-mitigation-grant-program

Flood Mitigation Assistance Grant Program

The overall goal of the Flood Mitigation Assistance (FMA) Grant Program is to fund cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other National Flood Insurance Program (NFIP) insurable structures. This specifically includes:

- Reducing the number of repetitively or substantially damaged structures and the associated flood insurance claims;
- Encouraging long-term, comprehensive hazard mitigation planning;
- Responding to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development activities; and
- Complementing other federal and state mitigation programs with similar, long-term mitigation goals.

More information at: http://www.fema.gov/flood-mitigation-assistance-program

Detailed program and application information for federal post-disaster and pre- disaster programs can be found in the 2015 Hazard Mitigation Assistance Guidance and Addendum, available at: https://www.fema.gov/media-library/assets/documents/103279 Note that guidance regularly changes. Verify that you have the most recent edition.

For Oregon Military Department, Office of Emergency Management (OEM) grant guidance on Federal Hazard Mitigation Assistance, visit: https://www.oregon.gov/oem/emresources/Grants/Pages/default.aspx

Community Development Block Grant Program

The Community Development Block Grant Program (CDBG) promotes viable communities by providing: 1) decent housing; 2) quality living environments; and 3) economic opportunities, especially for low and moderate income persons. Eligible activities most relevant to hazard mitigation include: acquisition of property for public purposes; construction/reconstruction of public infrastructure; and community planning activities. Under special circumstances, CDBG funds can be used to meet urgent community development needs arising in the last 18 months which pose immediate threats to health and welfare.

More information at: https://www.hud.gov/program_offices/comm_planning/communitydevelopment/programs

Basic & Applied Research/Development

National Earthquake Hazard Reduction Program

Through broad based participation, the National Earthquake Hazard Reduction Program (NEHRP) attempts to mitigate the effects of earthquakes. Member agencies in NEHRP are the United States Geological Survey (USGS), the National Science Foundation (NSF), the Federal Emergency Management Agency (FEMA), and the National Institute for Standards and Technology (NIST). The agencies focus on research and development in areas such as the science of earthquakes, earthquake performance of buildings and other structures, societal impacts, and emergency response and recovery.

More information at: http://www.nehrp.gov/

Decision, Risk, and Management Science Program, National Science Foundation

The Decision, Risk, and Management Sciences (DRMS) supports scientific research directed at increasing the understanding and effectiveness of decision making by individuals, groups, organizations, and society. Disciplinary and interdisciplinary research, doctoral dissertation research, and workshops are funded in the areas of judgment and decision making; decision analysis and decision aids; risk analysis, perception, and communication; societal and public policy decision making; management science and organizational design. The program also supports small grants for exploratory research of a time- critical or high-risk, potentially transformative nature.

More information at: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5423

Hazard ID and Mapping

National Flood Insurance Program: Flood Mapping; FEMA

Flood insurance rate maps and floodplain management maps for all NFIP communities.

More information at: http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping

FEMA Mapping Information Platform

For use in mapping of flood and other hazards.

More information at: https://hazards.fema.gov/femaportal/wps/portal

Mapping Standards Support, Department of the Interior (DOI)-USGS

Expertise in mapping and digital data standards to support the National Flood Insurance Program.

More information at: http://ncgmp.usgs.gov/standards.html

Soil Survey, United States Department of Agriculture (USDA)-Natural Resources Conservation Service

Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation, or related purposes.

More information at: http://soils.usda.gov/survey/printed_surveys/

Project Support

Community Development Block Grant Entitlement Communities Program, US Department of Housing and Urban Development

Provides grants to entitled cities and urban counties to develop viable communities (e.g., decent housing, a suitable living environment, expanded economic opportunities), principally for low- and moderate- income persons.

More information at: https://www.hud.gov/program_offices/comm_planning/communitydevelopment/programs

National Fire Plan (DOI – USDA)

The National Fire Plan (NFP) provides technical, financial, and resource guidance and support for wildland fire management across the United States. Addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability.

More information at: http://www.forestsandrangelands.gov/

Assistance to Firefighters Grant Program, FEMA

FEMA Assistance to Firefighters Grant Program (AFG) grants are awarded to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards. Three types of grants are available: Assistance to Firefighters Grant (AFG), Fire Prevention and Safety (FP&S), and Staffing for Adequate Fire and Emergency Response (SAFER).

More information at: https://www.usfa.fema.gov/grants/

Emergency Watershed Protection Program, USDA-NRCS

The Emergency Watershed Protection Program (EWPP) provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events.

More information at:
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/

Rural Utilities Service –USDA- Rural Development

Rural Utilities Service (RUS) provides much-needed infrastructure or infrastructure improvements to rural communities.

More information at: https://www.rd.usda.gov/about-rd/agencies/rural-utilities-service

Rural Development Assistance – Housing, USDA

The RDA program provides grants, loans, and technical assistance in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster necessary.

More information at: https://www.usda.gov/topics/rural/housing-assistance

Public Assistance Grant Program, FEMA

The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide assistance to state, tribal and local governments, and certain types of Private Non-Profit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President.

More information at: https://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

The National Flood Insurance Program, FEMA

NFIP makes available flood insurance to residents of communities that adopt and enforce minimum floodplain management requirements.

More information at: http://www.fema.gov/national-flood-insurance-program

Disaster Resources, HUD

HUD Disaster Resources occasionally provides grants to fund gaps and partners with Federal and state agencies to help implement disaster recovery assistance.

More information at: https://www.hud.gov/info/disasterresources

Emergency Management Performance Grants, FEMA

The Emergency Management Performance Grant Program (EMPG) helps state and local governments to sustain and enhance their all-hazards emergency management programs.

More information at: https://www.fema.gov/emergency-management-performance-grant-program

North American Wetlands Conservation Act, DOI-Fish & Wildlife Service

North American Wetlands Conservation Act (NAWCA) provides cost-share grants to stimulate public/private partnerships for the protection, restoration, and management of wetland habitats.

More information at: https://www.fws.gov/birds/grants.php

Wetlands Reserve program, USDA-NCRS

The Wetlands Reserve Program provides financial and technical assistance to protect and restore wetlands through easements and restoration agreements.

More information at:
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/

Secure Rural Schools and Community Self-Determination Act of 2000, USDA-United States Forest Service.

Reauthorized for FY2012, it was originally enacted in 2000 to provide five years of transitional assistance to rural counties affected by the decline in revenue from timber harvests on federal lands. Funds have been used for improvements to public schools, roads, and stewardship projects. Money is also available for maintaining infrastructure, improving the health of watersheds and ecosystems, protecting communities, and strengthening local economies.

More information at: http://www.fs.usda.gov/pts/

State Programs

Seismic Rehabilitation Grant Program

The Seismic Rehabilitation Grant Program (SRGP) provides state funds to strengthen public schools and emergency services buildings to diminish damage during an earthquake. Reducing property damage, injuries, and casualties caused by earthquakes is the goal of the SRGP.

More information at: http://www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehab/

Oregon Watershed Enhancement Board

While Oregon Watershed Enhancement Board's (OWEB) primary responsibilities are implementing projects addressing coastal salmon restoration and improving water quality statewide, these projects can also benefit efforts to reduce flood and landslide hazards. OWEB conducts watershed workshops for landowners, watershed councils, educators, and others, and conducts a biennial conference highlighting watershed efforts statewide. Funding for OWEB programs comes from the general fund, state lottery, timber tax revenues, license plate revenues, angling license fees, and other sources. OWEB awards approximately $20 million in funding annually.

More information at: https://sos.oregon.gov/blue-book/Pages/state/executive/watershed-enhancement.aspx

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Appendix E: Status of NHMP 2014 Actions

Mitigation Action Item Progress Report Forms

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#1: Dam Safety Evacuation	
Responsible Agency	City of Eugene: Public Works City of Springfield: Development and Public Works	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion date:__________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   For the 2020 NHMP update dams and hazardous material incidents were moved to annexes within the plan since they are not natural hazards, per say. Within each identified natural hazard section dam failure and hazardous material incidents are now two of four "impacts" the plan considers for each hazard.

2. What obstacles, problems, or delays did the project encounter?

   No obstacles or problems experienced. These mitigation action items are going to be reorganized and placed within the appropriate hazard to better align with the objectives of Natural Hazard Mitigation Plans.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   These projects are going to be revised to fit within the new identified natural hazard categories as outlined in the 2020 NHMP.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#2: Dam Safety Notification	
Responsible Agency	City of Eugene: Public Works City of Springfield: Development and Public Works	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☒ Project Restructured ☒ Project delayed: Anticipated Completion Date: TBD

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   For the 2020 NHMP update dams and hazardous material incidents were moved to annexes within the plan since they are not natural hazards, per say. Within each identified natural hazard section dam failure and hazardous material incidents are now two of four "impacts" the plan considers for each hazard.

2. What obstacles, problems, or delays did the project encounter?

   No obstacles or problems experienced. These mitigation action items are going to be reorganized and placed within the appropriate hazard to better align with the objectives of Natural Hazard Mitigation Plans.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   These projects are going to be revised to fit within the new identified natural hazard categories as outlined in the 2020 NHMP. Moving forward, this mitigation action item will be revised with Lane County as the lead.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#3: Inundation Maps for Planning	
Responsible Agency	Emergency Management	
Contact Phone/Email	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion date:___________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   For the 2020 NHMP update dams and hazardous material incidents were moved to annexes within the plan since they are not natural hazards, per say. Within each identified natural hazard section dam failure and hazardous material incidents are now two of four "impacts" the plan considers for each hazard. Both Cities have spoken with the Army Corp of Engineers, and are up to date on new mapping changes.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete though the final product was revised from what initially appeared in the 2014 NHMP.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#4: Dam Seismic Assessment	
Responsible Agency	Emergency Management	
Contact Phone/Email	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:___________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   For the 2020 NHMP update dams and hazardous material incidents were moved to annexes within the plan since they are not natural hazards, per say. Within each identified natural hazard section dam failure and hazardous material incidents are now two of four "impacts" the plan considers for each hazard. Both Cities have spoken with the Army Corp of Engineers, and confident in their assessments of the dam infrastructure.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

4.

   This project is considered complete since it has been canceled in favor of more appropriate mitigation items.

5. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#5: Local Transportation Infrastructure Seismic Evaluation	
Responsible Agency	City of Eugene Public Works	
Contact Phone/Email	Eric Johnson	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:__________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Fifteen of the City's highest priority bridges were analyzed for vulnerability to seismic events. Results of the high level analysis indicated the Ferry Street Viaduct project will utilize the bulk of the seismic retrofitting funding.

2. What obstacles, problems, or delays did the project encounter?

   Seismic retrofitting of bridges is expensive and often a multijurisdictional projects. The City is actively pursuing possible funding sources for future projects concerning the retrofitting of bridges.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete. Projects moving forward will address specific mitigation projects developed from the high level seismic assessments of the City's top fifteen priority bridges.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#6: Seismic Evaluation of Critical Facilities	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion date:__________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   A prioritized list of critical and City owned and/or rented facilities was developed. This list was then assessed for seismic stability. From this, a short list of facilities to either be looked at in closer detailed or retrofitted as is was developed.

2. What obstacles, problems, or delays did the project encounter?

   Not all buildings used by the City of Eugene are owned by the City. Getting approval for assessments and projects can be difficult.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete and will help determine more specific future mitigation projects concerning critical infrastructure and seismic stability

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#7: Seismic Evaluation of Non-Critical Facilities (FEMA 154)	
Responsible Agency	City of Eugene Public Works	
Contact Phone/Email	Eric Johnson	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:___________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   A Damage Assessment Group was formed. This group has developed an Emergency Operations Plan Annex for damage assessment and conducted Safety Assessment Program and Bridge Assessor training. The foundations of the group is in place, and will continue to be reviewed, evaluated, and changed as necessary

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete. Projects moving forward will address specific mitigation projects developed by the Damage Assessment Group.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#8: Non-Structural Seismic Evaluation (FEMA E74)	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Eric Johnson	
Project Status	☐ Project Completed ☐ Project Restructured ☐ Project Canceled ☒ Project delayed: ☐ Project On Schedule Anticipated Completion Date:__________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   This projected has been removed from the 2020 NHMP update in favor of more pressing mitigation action items. It will be revisited once higher priority items have been completed.

2. What obstacles, problems, or delays did the project encounter?

   It has been determine that staffing and resources would be better suited to address higher priority concerns, at this time.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is still relevant, but for the time being individual departments are addressing non-structural seismic evaluations on their own. A more formalized program will be addressed in a later NHMP update.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#9: Home Seismic Retrofits	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date:___________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Emergency Management team members met with representatives from Enhabit in 2017 to discuss a possible seismic retrofit program for residential homes similar to the project completed in Portland. It was determine that this project was not possible for the City to maintain, at this time.

2. What obstacles, problems, or delays did the project encounter?

   A seismic retrofit program for homes using federal grant money has many moving parts. It has been determine that resource be used to compete other projects before the time and man hours can be dedicated to such a project.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project will be revisited in a later update of the NHMP.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#10: Flood Maps	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:___________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   FEMA and partners have been remapping the floodplain maps for various locations of interest around Eugene and Springfield, but the project has been often delayed. A definitive timeline and/or release date for the new maps currently being worked on is unknown at this time.

2. What obstacles, problems, or delays did the project encounter?

   Federal partners are necessary to complete this project, and their timelines are often delayed due to other projects on emergencies within the United States.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is being restructured to address specific locations flood maps are believed to be incorrect or outdated using Risk Map funds.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#11: Flood Control Levee Certification and Maintenance	
Responsible Agency	City of Eugene: Public Works, City of Springfield: Emergency Management	
Contact Phone/Email	Jesse Cary-Hobbs (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:__________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Public Works receives a report from the US Army corps of Engineers annually that lists follow-up items related to levee maintenance. The department merges these items into annual work plans.

2. What obstacles, problems, or delays did the project encounter?

   With levee certification and maintenance delays are common since most of these projects are multijurisdictional in nature. Additionally, some, but not all, of the levee infrastructure that could affect Eugene-Springfield are owned by private or Federal partners.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete for the City of Eugene. Projects moving forward will address specific mitigation projects necessary for levee operation or maintenance. The City of Springfield will be pursuing a separate mitigation action item to seek and maintain certification for the 42st levee.

4. Other comments

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#12: Flood Insurance Study	
Responsible Agency	City of Eugene: Public Works Engineering, City of Springfield: Development and Public Works	
Contact	Ray Joseph (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:__________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   A Flood Insurance Program is maintained by the City of Eugene. The City of Springfield has been working to advance their program.

2. What obstacles, problems, or delays did the project encounter?

   Federal partners are necessary to complete this project, and their timelines are often delayed due to other projects on emergencies within the United States.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete for the City of Eugene. This project is being restructured to address specific locations flood maps are believed to be incorrect or outdated using Risk Map funds thus it is being combined with action item #10: Flood Maps from the 2014 NHMP.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#13: Repetitive Loss Records	
Responsible Agency	City of Eugene: Public Works Engineering, City of Springfield: Development and Public Works	
Contact	Ray Joseph (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:__________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   The Cities' Flood Insurance Programs maintain and provide repetitive loss property records to FEMA.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 04-2017
Action Item title	#14: Explore Flood Mitigation Actions With Property Owners (upon request)	
Responsible Agency	City of Eugene Public Works, City of Springfield Development and Public Works	
Contact Phone/Email	Formally Louranah Janeski	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   City of Eugene NFIP and CRS along with the City of Springfield's NFIP staff routinely provide flood risk literature, for outreach, as needed. This includes households within the 100 year floodplain.

2. What obstacles, problems, or delays did the project encounter?

   None.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This Action Item was removed from the 2020 NHMP Action Item list due to the fact it is general operating procedure for the Cities. Future Action Items will focus on attainable and targeted projects to improve NFIP or CRS standings.

4. Other comments

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#15: Maintain Frequent Stormwater Flooding Location Inventory	
Responsible Agency	City of Eugene Public Works	
Contact Phone/Email	Rob Hallett	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion date:__________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Public Works Maintenance Division maintains an Urban Stromwater Flooding Quick Check List for inspection and maintenance of the stormwater conveyance systems. Included in this list are priority inlets, outfalls, catch basins, and curb inlets. Staff use this list prior to, during, and after rain and snow events. The list is updated on a yearly basis and is included in the department's emergency on-call book.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete. Projects moving forward will address specific mitigation projects the Urban Stormwater Flooding Quick Check List may identify.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#16: Upgrade Culverts	
Responsible Agency	City of Eugene Public Works	
Contact Phone/Email	Jesse Cary-Hobbs	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:__________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Public Works has developed and maintains a list of culverts and ditches that have historic flooding issues. These assets are checked during rain events by Public Works staff. Additionally, staff have a maintenance standard for roadside ditches that outlines the thresholds for maintenance of ditches.

2. What obstacles, problems, or delays did the project encounter?

N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete. Projects moving forward will address problems or issues to specific areas/culverts.

4. Other comments

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#17: NFIP Compliance	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date:___________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   NFIP Compliance is now normal operation for the Cities of Eugene and Springfield.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#18: HazMat Locations	
Responsible Agency	City of Eugene and Springfield Fire and EMS	
Contact	Chris Heppel	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:___________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   The Lane Preparedness Coalition (LPC) has developed and complete an inventory of hazardous material locations of concern readily-available to response personnel.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   N/A

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#19: HazMat Preparedness	
Responsible Agency	City of Eugene and Springfield: Fire and EMS	
Contact	Chris Heppel	
Project Status	☒ Project Completed ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:__________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Eugene Springfield Fire and EMS currently staffs and maintains one of the State's Hazardous Material response teams.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   Any further projects relating to this mitigation action item will be address as they are identified as the Eugene Springfield Fire and EMS Hazardous Material team.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#20: Landslide Mapping	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Development and Public Works	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date:___________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   An updated landslide study, in partnership with the Oregon Department of Geology and Mineral Industries (DOGAMI), was completed for the Eugene-Springfield area and was release for publication the summer of 2018

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   Any further projects relating to this mitigation action item will be address finds specific to the completed study.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#21: Landslide Planning	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Development and Public Works	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:___________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   An updated landslide study, in partnership with the Oregon Department of Geology and Mineral Industries (DOGAMI), was completed for the Eugene-Springfield area and was release for publication the summer of 2018. This mitigation action item was postponed until the release of the updated study.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This mitigation action item will be restructured to address specific projects identified by the completed study.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#22: Emergency Fuel Distribution Plan	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion Date:_TBD_____

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   This mitigation action item has been delayed while the Emergency Fossil Fuels Assessment (2014 NHMP Action Item #33: Fossil Fuel Sector Assessment.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This mitigation action item will commence after the completion of the Emergency Fossil Fuel Assessment in 2020 to address the specific issues identified by the assessment.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#23: Community Recovery Planning	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Complete ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_TBD_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Various recovery plans have been developed between 2015-2020.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This action item is going to be restructured to address more specific community recovery planning needs.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#24: Local Electricity Generation	
Responsible Agency	Eugene Water and Electric Board	
Contact	Jeannine Parisi	
Project Status	☐ Project Complete ☐ Project Restructured ☐ Project Canceled ☐ Project delayed: ☒ Project On Schedule Anticipated Completion Date:_2020____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   In 2018, EWEB commissioned a study to better understand black start capabilities of its Leaburg and Walterville hydro-electric plants and identified the amount and location of critical loads in our service territory that should be served during emergency conditions. The study found that the Leaburg plant has the ability to operate independently from the grid but that the critical loads identified were slighter higher than the plant capacity at Leaburg.

   EWEB will also complete and test installation of our first 1MW microgrid at Howard elementary school. The microgrid will power the pump to the new well installed to provide emergency water to the community should EWEB's water filtration or distribution system fail in an emergency.

2. What obstacles, problems, or delays did the project encounter?

   To match critical loads, EWEB is now looking at other facilities for potential additional generation. EWEB co-owns generation at the International Paper plant and a secondary study is planned in 2019 to determine black start and load capabilities for this generator. We are also in the process of developing an Intergovernmental Agreement with the University of Oregon for their natural gas generator to feed EWEB's distribution system under emergency conditions.

   Regarding microgrid technology, these projects are very expensive to scale. The Howard micro grid lacks remote access to collect and analyze data and requires additional investment to operate as intended. However, staff believe the learning from Howard can be used for smaller scale projects at other emergency well sites.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   These projects are still relevant but require on-going resources, both engineering, design and capital improvements such as new switch gear to direct power just to critical loads to fully implement. As originally scoped, this mitigation item focused on developing a plan with implementation in 2020 so in this regard we are ahead of schedule.

4. Other comments:

   Back-up generation and adequate fuel storage is another important solution to maintain operability of critical facilities. In 2018, EWEB placed two new back-up generators at its Hayden Bridge filtration plant which are sufficient to deliver about 20 mgd of water to the community.

   We plan to have another emergency water station installed at the Sheldon Fire Station in 2019 and are sharing costs for an upsized fuel storage tank at the fire station to ensure we can run the emergency well in addition to the fire station loads, during emergency conditions.

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#25: Downed Power Lines	
Responsible Agency	Eugene Water and Electric Board	
Contact	Jeannine Parisi	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_TBD_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   EWEB was successfully awarded FEMA grant funds to re-frame 4.3 miles of electric line and underground 1.5 miles of distribution services in over a dozen high outage areas across Eugene. In most cases, EWEB will reconfigure and replace older overhead power lines that require two wires and replace them with new, higher capacity cable that requires only one wire. This reduces brown-outs when a tree limb falls on one wire and allows for the removal of crossarms, which are susceptible to falling tree limbs and a common culprit causing outages. Overall project costs are estimated at $2.7M with FEMA grant funding about 75% of those costs. The first projects will being in 2019.

2. What obstacles, problems, or delays did the project encounter?

   Coordination to correlate priority transportation routes with high priority distribution feeds did not occur and may not align with where electric feeds to service critical loads are located. The latter is of higher importance and focus to the utility in terms of mitigating risks from prolonged outages.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   Reducing outages by hardening and reconfiguring our transmission and distribution system is highly important. This mitigation item could be broadened beyond distribution to encapsulate EWEB current efforts to seismically anchor transformers at substations, as well as replace older two wire distribution with more resilient single cable lines.

4. Other comments:

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#26: Credentials	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Restructured ☒ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:_TBD_____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   N/A

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This action item has been removed from the NHMP 2020 update due to it being more of a response project. Credentialing will be address via the Emergency Operation Plan (EOP).

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#27: Broadcast Radio Communications	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date: TBD

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   N/A

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This action item has been removed from the NHMP 2020 update due to it being more of a response project. Communication protocol will be address via the Emergency Operation Plan (EOP). Any future mitigation projects concerning broadcast radio will focus on mitigating the effects of natural disasters on communication infrastructure.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#28: Continuity of Operations Plans	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Complete ☐ Project Canceled ☐ Project On Schedule ☒ Project Restructured ☐ Project delayed: Anticipated Completion Date: TBD	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   In 2014 the City of Eugene started to develop Continuity of Operations Plans (COOP) for all divisions and some work groups. Participation waned over the years due to staffing changes. A renewed emphasis was placed on COOP plans in 2018 with at least two divisions completing/updating theirs, and several more redeveloping plans.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   A version of this action item will be in the 2020 update of the NHMP, but will focus on more specific needs for COOP development.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#29: Staffing for Critical Systems	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☒ Project Restructured ☐ Project delayed: Anticipated Completion Date: TBD

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   N/A

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This item has been combined with the 2014 NHMP Action Item #28: Continuity of Operations Plans for the 2020 NHMP update.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#30: Local Food Availability	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule ☐ Project Restructured ☒ Project delayed: Anticipated Completion Date:_TBD____	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   N/A

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   N/A

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#31: Water Source	
Responsible Agency	Eugene Water and Electric Board	
Contact	Jeannine Parisi	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion Date: 2028

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Significant resources were allocated to this project from 2015-2018. With a conditional water right in hand, property was purchased for both the intake and for siting a 10 – 15 MGD water treatment plant. Water rates were increased by 3% per year to start paying for the project, accompanied with considerable public outreach and education on the need for a redundant supply of water. A team of experts were hired to help develop a preliminary design and more accurate costs for the plant.

2. What obstacles, problems, or delays did the project encounter?

   Land use issues for the treatment plant site required all three jurisdictions to concur on updating the Eugene-Springfield Metro Plan. While two of the three jurisdictions were in support, it was clear that one was not convinced that the site was appropriate for a water treatment facility. The project was deferred due to the combination of the high price tag, political risk and an overarching concern that under earthquake scenarios, the distribution system was vulnerable and would not be able to deliver water to the community. Instead, a revised emergency water supply program was adopted focusing on multiple, micro-distribution sites where people could fill containers with water under emergency conditions.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

Yes, discussions with partners are on-going and the secondary treatment plant is in EWEB's capital improvement plan with construction beginning in 2025.

4. Other comments:

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#32: Evacuation	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Restructured ☐ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:__________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   N/A

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This action item has been removed from the NHMP 2020 update due to it being more of a response project. Evacuation plans will be addressed via the Emergency Operation Plan (EOP). This project will be replaced with alternative project to mitigate the effects of natural disasters.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#33: Fossil Fuel Sector Assessment	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion Date: Fall 2020

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   The Emergency Fossil Fuels Assessment was initiated Spring of 2018. It is expected to conclude fall of 2020. The project was funded using Homeland Security Grant Program funding.

2. What obstacles, problems, or delays did the project encounter?

   Currently none.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   No revisions necessary.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#34: Water Storage	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date: Fall 2020

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Enough water was stored at the Emergency Operations Center (EOC) to last twenty EOC staff members for two weeks. Additional water was stored in strategic locations in some essential facilities.

2. What obstacles, problems, or delays did the project encounter?

   Logistics of storing so much water for an unknown time is costly and difficult with limited space.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   No revisions necessary. Enough water was stored to support initial response operations. This action item reaffirmed the need for the 2014 NHMP action item #31 Water Source which seeks to obtain multiple sources for emergency water within the Cities of Eugene.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#36: Lane Preparedness Coalition	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Restructured ☒ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   The Cities of Eugene and Springfield are Steering Committee members for the Lane Preparedness Coalition (LPC). At this time, both Cities will continue in these roles for the foreseeable future. This role is now considered normal day to day operation for both Cities. Due to this, the Action Item was removed from the 2020 NHMP update to allow for mitigation specific projects.

2. What obstacles, problems, or delays did the project encounter?

   None

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   LPC is still a relevant preparedness outreach tool/resource. Both Cities will continue to participate as LPC Steering Committee members.

4. Other comments;

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#37: Community Education and Outreach	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Complete ☐ Project Restructured ☒ Project Canceled ☐ Project delayed: ☐ Project On Schedule Anticipated Completion Date:________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   City of Eugene and Springfield Emergency Management staff routinely provides preparedness information to both employees and citizens.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is complete since it is now a normal portion of both Cities' day to day operations. Outreach will continue, and future mitigation items concerning this subject will focus on specific problems or issues to mitigate regarding outreach.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#38: 72 Hour Kits	
Responsible Agency	City of Eugene and Springfield Emergency Management	
Contact Phone/Email	Patence Winningham	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion date:__________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   City of Eugene and Springfield Emergency Management staff routinely provides preparedness information to both employees and citizens. The City of Eugene's emergency supply sale for employees continued to have record sales numbers as of 2017.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is considered complete, but it is also not relevant. Emergency Management staff across the State of Oregon now encourage people to have 2 weeks' worth of supplies. Future Action Items will focus on attainable and targeted projects to improve community and employee preparedness.

4. Other comments

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#39: Springfield Wildfire Plan	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date: 2025

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   City of Springfield was added to the Eugene-Springfield Fire, Urban Interface Fire Plan.

2. What obstacles, problems, or delays did the project encounter?

   With such a large group of stakeholders, meeting coordination has proven difficult.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   N/A

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#40: Wildfire Risk and Building Code	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene), Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☒ Project delayed: Anticipated Completion Date: 2025

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   In late winter/early spring, the Cities of Eugene and Springfield started discussions with the Western Lane District of the Oregon Department of Forestry to develop and implement a Community Wildfire Protection Plan (CWPP). As of April 2019, a diverse group of stakeholders have met twice to discuss the development and timeline for a Eugene-Springfield CWPP.

   Some fire hazard mapping was completed for the 2014 NHMP. This project has since been postponed until the completion of the Eugene-Springfield Community Wildfire Protection Plan (CWPP) (2014 NHMP Action Item 39: Springfield Wildland Plan). Refer to 2020 NHMP project #23.

2. What obstacles, problems, or delays did the project encounter?

   A CWPP must be completed prior to the start of this project.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project is still relevant.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#41: Downed Power Lines	
Responsible Agency	Eugene Water and Electric Board	
Contact	Jeannine Parisi	
Project Status	☐ Project Completed ☐ Project Canceled ☐ Project On Schedule ☒ Project Restructured ☐ Project delayed: Anticipated Completion Date: ________	

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Please see 2014 NHMP Action Item 25: Down Power Lines.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   N/A

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#42: Tree Trimming	
Responsible Agency	City of Eugene: Public Works, City of Springfield: Development and Public Works	
Contact	Eric Johnson (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☒ Project Restructured ☐ Project delayed: Anticipated Completion Date: ________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   As is, this Mitigation Action Item was removed from the 2020 NHMP update due to the fact tree trimming is everyday operations for both Cities.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   As is, this Mitigation Action Item is complete. Its concept will be restructured, however. Future mitigation projects will focus on removing tree species known to be prone to failure during snow or wind events based off of FEMA's guidance after the Ice Storm of 2016.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#43: Property Owner Education	
Responsible Agency	City of Eugene: Public Works, City of Springfield: Development and Public Works	
Contact	Eric Johnson (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☒ Project Restructured ☐ Project delayed: Anticipated Completion Date: ________

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Both the Cities of Eugene and Springfield regularly provide natural hazard education for property owners. The most common form of this is wildland-urban interface education; a partnership between Eugene-Springfield Fire, the Fire Marshal, and both Cities' Emergency Management programs.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   Since this Mitigation Action Item is now day to day operations for both Cities, it was removed from the 2020 NHMP update. Future mitigation projects will focus on specific projects to address mitigation of natural hazards on or near private property.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#44: Backup Power	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date: _______

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Almost all critical facilities for both Eugene and Springfield are equipped with generators. New generators are being installed with expanded fuel tanks to allow for operations during prolonged power outages. In 2013 the city of Eugene began developing department/division specific Continuity of Operations Plans.

2. What obstacles, problems, or delays did the project encounter?

   Some critical facility locations are too small or inadequate for generator installation. Other locations are privately owned and either leased/rented by the Cities. In these situations, generator installation is not permitted by the property owner. Continuity of Operations Planning has been steady moving forward for the City of Eugene but is often delayed due to conflicting projects and/or limited staff time.

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project, as is, is complete. Future Mitigation Action Items will focus on specific projects to mitigate further power disruptions.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#45: Undergrounding Utilities in New Developments	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☒ Project Completed ☐ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date: _______

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   Both Springfield Utility Board and Eugene Water and Electric Board underground utilities lines in new developments, within reason.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project, as is, is complete and is now part of day to day operations for both Cities and their respective utilities. Future Mitigation Action Items will focus on specific projects to mitigate further power disruptions.

4. Other comments;

   N/A

Mitigation Action Item Progress Report Form (From 2014)

Progress Report Period	From Date: 02-2015	To Date: 02-2020
Action Item title	#46: Ash Fall	
Responsible Agency	City of Eugene: Emergency Management, City of Springfield: Emergency Management	
Contact	Kevin Holman (Eugene) and Ken Vogeney (Springfield)	
Project Status	☐ Project Completed ☒ Project Canceled ☐ Project On Schedule	☐ Project Restructured ☐ Project delayed: Anticipated Completion Date: _______

Summary of Project Progress

1. What was accomplished for this project during this reporting period (2015-2020)?

   No specific mitigation item was identified in the 2014 NHMP. "All hazard" items helped to mitigate this natural hazard, however.

2. What obstacles, problems, or delays did the project encounter?

   N/A

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

   This project, as is, was removed from the 2020 NHMP update. Future Mitigation Action Items will focus on specific projects to mitigate the effects of ash fall.

4. Other comments;

   N/A

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Appendix F: Land Use and Development Trends

The Eugene/Springfield Metro Region is growing. To accommodate the next 20 years of population growth, Eugene and Springfield will have to expand their Urban Growth Boundaries (UGB), increase density within their UGB's, or both.

In 2009, ECONorthwest created the City of Springfield Commercial and Industrial Buildable Lands Inventory and Economic Opportunities Analysis.[1] Similarly, in 2010, ECONorthwest, Lane Council of Governments, the Ulum Group, and Winterbrook Planning prepared the Eugene Comprehensive Lands Assessment for the City of Eugene Planning and Development Department.[2]

Per Oregon House Bill 3337 requirements[3] the reports include a buildable lands inventory, an economic opportunity analysis, and for Eugene and Springfield, a housing needs analysis. The report also accounts for partially constrained lands related to natural hazards, such as slopes, 100-year floodplains, geologic hazards, and wetlands in looking at potential developable lands. The assessment will help Eugene and Springfield determine the amount of land needed to accommodate population and employment growth, as well as the amount of land within the current UGB that can accommodate this growth.

The Eugene Comprehensive Lands Assessment relies on population projections provided by Lane County that estimates Eugene will grow from 179,338 people in 2011 to 213,238 people in 2031 at an average annual growth rate of 0.88%.[4]

In January 2017, after several years of community input, research and analysis, public meetings, and revisions, the City of Eugene adopted a new UGB. The new UGB addresses Eugene's land needs for housing, jobs, parks, and schools from 2012-2032, and is based on the state land use planning framework, Envision Eugene pillars, and seven years of technical analysis, community input, and Council direction. Eugene anticipates approximately 34,000 new residents and 36,000 new jobs by 2032. While the majority of these residents and jobs can be accommodated on land inside the UGB,

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[1] ECONorthwest (2009). *City of Springfield: Commercial and Industrial Buildable Lands Inventory and Economic Opportunities Analysis.* Retrieved from http://www.springfield-or.gov/wp-content/uploads/2016/11/Draft_CIBL_Analysis_9_09.pdf, accessed August, 2019.
[2] ECONorthwest (2010). *Eugene Comprehensive Lands Assessment.* Retrieved from https://www.eugene-or.gov/index.aspx?NID=788, accessed August 2019.
[3] City of Eugene. *Oregon House Bill.* https://www.eugene-or.gov/DocumentCenter/View/581/Oregon-House-Bill-3337?bidId=. Accessed August 2019
[4] Portland State University (Population Research Center) 'Lane County Coordinated Population Forecast 2015-2065'. June 2015. https://www.pdx.edu/prc/sites/www.pdx.edu.prc/files/Lane_Forecast_Report_201506.pdf, accessed August 5, 2019

an expansion was necessary to accommodate additional jobs, park, and school needs. Major components of the UGB include:

- Clear Lake Road expansion area for 3,000 jobs, a park, and a school in the Bethel Neighborhood, and the proposed Clear Lake Overlay Zone.
- Santa Clara expansion area for a new community park.
- Development of a new Eugene-specific Comprehensive Plan with chapters addressing Economic Development, Transportation, Administration and Implementation (including growth monitoring), and the Urban Growth Boundary.
- Proposed housing strategies, including planning for 1,000 high density homes in downtown and 600 medium density homes in existing medium density areas.

The expansion areas do not include land with a slope of 25% or greater or land in the 100-year floodplain. The areas are partially constrained by the presence of wetlands. Development impacts in wetland-constrained areas will be mitigated through the development of "green infrastructure" practices described in the Eugene Stormwater Master Plan.[5]

The remainder of Eugene's housing need will be accommodated on existing vacant and partially vacant lands and through redevelopment. Additionally, the City Council provided direction committing the City to monitor and report on growth assumptions and outcomes, improve the land use code for needed housing development, and begin urban reserves planning for the long-term population growth.

The Springfield Residential Land and Housing Needs Analysis (RLHNA) documented that the land currently designated as High, Medium and Low Residential and Nodal Mixed-Use plan designations will accommodate the expected residential housing need. Therefore, Springfield is focused on the need for industrial and employment lands. The Commercial and Industrial Buildable Lands Inventory for Springfield concludes that there will be a 32% increase in the number of employees between 2010 to 2030, equaling roughly 13,000 new jobs.

The City of Springfield co-adopted an ordinance with Lane County to expand Springfield's UGB, and to change Economic and Urbanization land use policies and zoning to establish a 20-year supply of land for job creation. The expansion and land use policies and zoning changes became final after acknowledgement by the Oregon Department of Land Conservation and Development in 2019. In order to provide for this growth in employment, the City of Springfield will need to expand its UGB. The UGB expansion will provide the 257 acres needed for seven employment sites, on 223 suitable unconstrained acres.[6] The two areas being considered for UGB expansion are

[5] City of Eugene, 'Urban Growth Boundary', https://www.eugene-or.gov/2988/Urban-Growth-Boundary#howplan, accessed August 2019

[6] City of Springfield, 'Comprehensive Planning', *Springfield Ordinance 6361,* http://www.springfield-or.gov/city/development-public-works/comprehensive-planning/, accessed August 2019

the North Gateway Area and the Mill Race. The Springfield Commercial and Buildable Lands Inventory does not consider constrained land as part of the UGB expansion. Wetlands, floodways, slopes greater than 15 percent, and riparian areas will not be included as a possibility for development. However, though considered constrained, development can occur in the floodplain, the Willamette River Greenway, and BPA Easements.

Regarding new development in areas prone to natural hazards, the Oregon land use program explicitly prohibits or restricts development in said areas. With statutory authority granted under Oregon Revised Statute Chapter 197, Oregon Administrative Rules provide for needed housing that is, "…suitable, available and necessary for residential uses." Land that, "(a) [i]s severely constrained by natural hazards as determined under Statewide Planning Goal 7," "(c) [h]as slopes of 25 percent or greater," or "(d) [i]s within the 100-year floodplain," are not considered "suitable and available" under the buildable land definition.[7] In practice, development is either prohibited or restricted through development regulations. While the process of UGB expansion is ongoing in Eugene and Springfield, the proposed expansion sites are in compliance with the above statute. For more information on development trends in the community, see Appendix C, Community Profile.

[7] Oregon Secretary of State, 'Land Conservation and Development Chapter 660 Division 24, Urban Growth Boundaries', https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=3074 , accessed August 2019

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Appendix G: Economic Analysis of Natural Hazard Mitigation Projects

This appendix outlines three approaches for conducting economic analyses of natural hazard mitigation projects. They serve as a means for documenting how action prioritization shall include a special emphasis on the extent to which benefits are maximized according to the proposed projects and their associated costs. It describes the importance of implementing mitigation activities, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies. Information in this section is derived in part from: The Interagency Hazards Mitigation Team, State Hazard Mitigation Plan, (Oregon State Police – Office of Emergency Management, 2000), and Federal Emergency Management Agency Publication 331, Report on Costs and Benefits of Natural Hazard Mitigation. This section is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to evaluate local projects. It is intended to (1) raise benefit/cost analysis as an important issue, and (2) provide some background on how economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?

Mitigation activities reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs, which would otherwise be incurred. Evaluating possible natural hazard mitigation activities provides decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

Evaluating mitigation projects is a complex and difficult undertaking, which is influenced by many variables. First, natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, police, utilities, and schools. Second, while some of the direct and indirect costs of disaster damages are measurable, some of the costs are non-financial and difficult to quantify in dollars. Third, many of the impacts of such events produce "ripple-effects" throughout the community, greatly increasing the disaster's social and economic consequences.

While not easily accomplished, there is value, from a public policy perspective, in assessing the positive and negative impacts from mitigation activities and obtaining an instructive benefit/cost comparison. Otherwise, the decision to pursue or not pursue various mitigation options would not be based on an objective understanding of the net benefit or loss associated with these actions.

What are some Economic Analysis Approaches for Evaluating Mitigation Strategies?

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into three general categories: benefit/cost analysis, cost-effectiveness analysis and the STAPLE/E approach. The distinction between the three methods is outlined below:

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by the state Office of Emergency Management (OEM), the Federal Emergency Management Agency (FEMA), and other state and federal agencies in evaluating hazard mitigation projects, and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.

Benefit/cost analysis is used in natural hazards mitigation to show if the benefits to life and property protected through mitigation efforts exceed the cost of the mitigation activity. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later. Benefit/cost analysis is based on calculating the frequency and severity of a hazard, avoiding future damages, and risk. In benefit/cost analysis, all costs and benefits are evaluated in terms of dollars, and a net benefit/cost ratio is computed to determine whether a project should be implemented. A project must have a benefit/cost ratio greater than 1 (i.e., the net benefits will exceed the net costs) to be eligible for FEMA funding.

Cost-Effectiveness Analysis

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome. Hence, economic analysis approaches are covered for both public and private sectors as follows.

Investing in Public Sector Mitigation Activities

Evaluating mitigation strategies in the public sector is complicated because it involves estimating all the economic benefits and costs regardless of who realizes them, and potentially to a large number of people and economic entities. Some benefits cannot be evaluated monetarily, but still affect the public in profound ways. Economists have developed methods to evaluate the economic feasibility of public decisions which involve a diverse set of beneficiaries and non-market benefits.

Investing in Private Sector Mitigation Activities

Private sector mitigation projects may occur based on one or two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or landowner, whether a private entity or a public agency, required to conform to a mandated standard may consider the following options:

1. Request cost sharing from public agencies;
2. Dispose of the building or land either by sale or demolition;
3. Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
4. Evaluate the most feasible alternatives and initiate the most cost effective hazard mitigation alternative.

The sale of a building or land triggers another set of concerns. For example, real estate disclosure laws can be developed which require sellers of real property to disclose known defects and deficiencies in the property, including earthquake weaknesses and hazards to prospective buyers. Correcting deficiencies can be expensive and time consuming, but their existence can prevent the sale of the building. Conditions of sale, regarding the deficiencies and the price of the building can be negotiated between a buyer and seller.

STAPLE/E Approach

Considering detailed benefit/cost or cost-effectiveness analysis for every possible mitigation activity could be very time consuming and may not be practical. There are some alternate approaches for conducting a quick evaluation of the proposed mitigation activities which could be used to identify those mitigation activities that merit more detailed assessment. One of those methods is the STAPLE/E approach.

Using STAPLE/E criteria, mitigation activities can be evaluated quickly by steering committees in a synthetic fashion. This set of criteria requires the committee to assess the mitigation activities based on the Social, Technical, Administrative, Political, Legal, Economic and Environmental (STAPLE/E) constraints, and opportunities of implementing the particular mitigation item in your community. The second chapter in FEMA's How-To Guide "Developing the Mitigation Plan – Identifying Mitigation Actions and Implementation Strategies" as well as the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process" outline some specific considerations in analyzing each aspect. The following are suggestions for how to examine each aspect of the STAPLE/E approach from the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process."

Social: Community development staff, local non-profit organizations, or a local planning board can help answer these questions.

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would mean that one segment of the community is treated unfairly?
- Will the action cause social disruption?

Technical: The city or county public works staff and building department staff can help answer these questions.

- Will the proposed action work?
- Will it create more problems than it solves?
- Does it solve a problem or only a symptom?
- Is it the most useful action in light of other community goals?

Administrative: Elected officials or the city or county administrator, can help answer these questions.

- Can the community implement the action?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding, staff, and technical support available?
- Are there ongoing administrative requirements that need to be met?

Political: Consult the mayor, city council or county planning commission, city or county administrator, and local planning commissions to help answer these questions.

- Is the action politically acceptable?
- Is there public support both to implement and to maintain the project?

Legal: Include legal counsel, land use planners, risk managers, and city council or county planning commission members, among others, in this discussion.

- Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?
- Are there legal side effects? Could the activity be construed as a taking?
- Is the proposed action allowed by the comprehensive plan, or must the comprehensive plan be amended to allow the proposed action?

- Will the community be liable for action or lack of action?
- Will the activity be challenged?

Economic: Community economic development staff, civil engineers, building department staff, and the assessor's office can help answer these questions.

- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs taken into account?
- Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private?)
- How will this action affect the fiscal capability of the community?
- What burden will this action place on the tax base or local economy?
- What are the budget and revenue effects of this activity?
- Does the action contribute to other community goals, such as capital improvements or economic development?
- What benefits will the action provide? (This can include dollar amount of damages prevented, number of homes protected, credit under the CRS, potential for funding under the HMGP or the FMA program, etc.)

Environmental: Watershed councils, environmental groups, land use planners and natural resource managers can help answer these questions.

- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

The STAPLE/E approach is helpful for doing a quick analysis of mitigation projects. Most projects that seek federal funding and others often require more detailed benefit/cost analyses.

When to use the Various Approaches

It is important to realize that various funding sources require different types of economic analyses. The following figure (Figure G-1) serves as a guideline for when to use the various approaches.

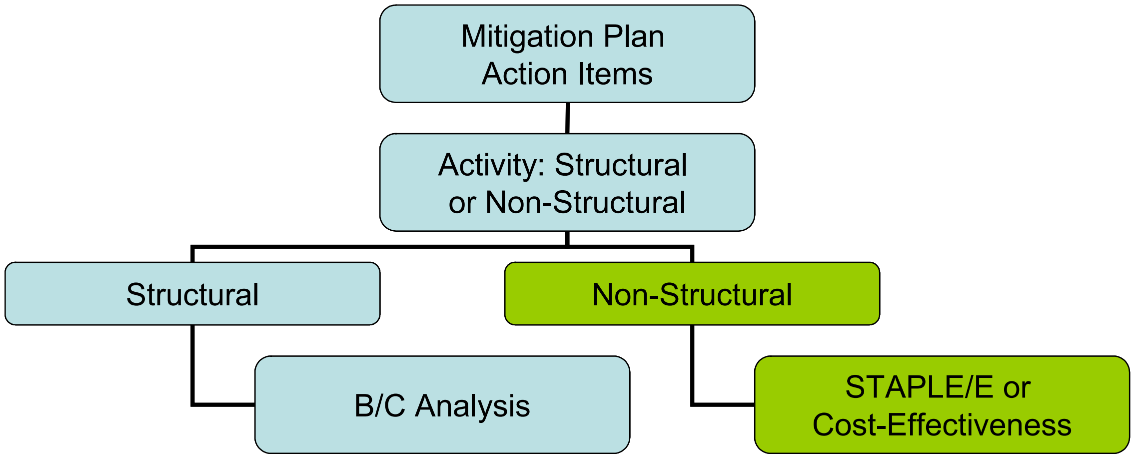

Figure G-1: *Economic Analysis Flowchart* Source: Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center, 2005

Implementing the Approaches

Benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E are important tools in evaluating whether to implement a mitigation activity. A framework for evaluating mitigation activities is outlined below. This framework should be used in further analyzing the feasibility of prioritized mitigation activities.

1. **Identify the Activities**
   Activities for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among others. Different mitigation projects can assist in minimizing risk to natural hazards but do so at varying economic costs.

2. **Calculate the Costs and Benefits**
   Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate activities. Potential economic criteria to evaluate alternatives include:

   - **Determine the project cost**. This may include initial project development costs, and repair and operating costs of maintaining projects over time.
   - **Estimate the benefits**. Projecting the benefits, or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and potential economic obsolescence of the investment.

This is difficult to project. These considerations will also provide guidance in selecting an appropriate salvage value. Future tax structures and rates must be projected. Financing alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.

- **Consider costs and benefits to society and the environment**. These are not easily measured but can be assessed through a variety of economic tools including existence value or contingent value theories. These theories provide quantitative data on the value people attribute to physical or social environments. Even without hard data, however, impacts of structural projects to the physical environment or to society should be considered when implementing mitigation projects.
- **Determine the correct discount rate**. Determination of the discount rate can just be the risk-free cost of capital, but it may include the decision maker's time preference and a risk premium. Including inflation should also be considered.

3. **Analyze and Rank the Activities**
Once costs and benefits have been quantified, economic analysis tools can rank the possible mitigation activities. Two methods for determining the best activities given varying costs and benefits include net present value and internal rate of return.

- **Net present value**. Net present value is the value of the expected future returns of an investment minus the value of the expected future cost expressed in today's dollars. If the net present value is greater than the projected costs, the project may be determined feasible for implementation. Selecting the discount rate and identifying the present and future costs and benefits of the project calculates the net present value of projects.
- **Internal rate of return**. Using the internal rate of return method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects. Projects may be feasible to implement when the internal rate of return is greater than the total costs of the project. Once the mitigation projects are ranked, based on economic criteria, decision-makers can consider other factors, such as risk, project effectiveness, and economic, environmental, and social returns in choosing the appropriate project for implementation.

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to building or land owners as a result of natural hazard mitigation, is difficult. Owners evaluating the economic feasibility of mitigation should consider reductions in physical damages and financial losses. A partial list follows:

- Building damages avoided
- Content damages avoided
- Inventory damages avoided
- Rental income losses avoided
- Relocation and disruption expenses avoided
- Proprietor's income losses avoided

These parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event will occur. The damages and losses should only include those that will be borne by the owner. The salvage value of the investment can be important in determining economic feasibility. Salvage value becomes more important as the time horizon of the owner declines. This is important because most businesses depreciate assets over a period of time.

Additional Costs from Natural Hazards

Property owners should also assess changes in a broader set of factors that can change as a result of a large natural disaster. These are usually termed "indirect" effects, but they can have a very direct effect on the economic value of the owner's building or land. They can be positive or negative, and include changes in the following:

- Commodity and resource prices
- Availability of resource supplies
- Commodity and resource demand changes
- Building and land values
- Capital availability and interest rates
- Availability of labor
- Economic structure
- Infrastructure
- Regional exports and imports
- Local, state, and national regulations and policies
- Insurance availability and rates

Changes in the resources and industries listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation activities.

Additional Considerations

Conducting an economic analysis for potential mitigation activities can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation activities.

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. Opportunity rises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability of project implementation.

Resources

CUREe Kajima Project, *Methodologies for Evaluating the Socio-Economic Consequences of Large Earthquakes*, Task 7.2 Economic Impact Analysis, Prepared by University of California, Berkeley Team, Robert A. Olson, VSP Associates, Team Leader; John M. Eidinger, G&E Engineering Systems; Kenneth A. Goettel, Goettel and Associates, Inc.; and Gerald L. Horner, Hazard Mitigation Economics Inc., 1997

Federal Emergency Management Agency, *Benefit/Cost Analysis of Hazard Mitigation* Projects, Riverine Flood, Version 1.05, Hazard Mitigation Economics, Inc., 1996

Federal Emergency Management Agency, *Report on the Costs and Benefits of Natural Hazard Mitigation*. Publication 331, 1996.

Goettel & Horner Inc., *Earthquake Risk Analysis Volume III: The Economic Feasibility of Seismic Rehabilitation of Buildings in the City of Portland*, Submitted to the Bureau of Buildings, City of Portland, August 30, 1995.

Goettel & Horner Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects* Volume V, Earthquakes, Prepared for FEMA's Hazard Mitigation Branch, October 25, 1995.

Horner, Gerald, *Benefit/Cost Methodologies for Use in Evaluating the Cost Effectiveness of Proposed Hazard Mitigation Measures*, Robert Olsen Associates, Prepared for Oregon State Police, Office of Emergency Management, July 1999.

Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon State Police – Office of Emergency Management, 2000.)

Risk Management Solutions, Inc., *Development of a Standardized Earthquake Loss Estimation Methodology*, National Institute of Building Sciences, Volume I and II, 1994.

VSP Associates, Inc., *A Benefit/Cost Model for the Seismic Rehabilitation of Buildings*, Volumes 1 & 2, Federal Emergency management Agency, FEMA Publication Numbers 227 and 228, 1991.

VSP Associates, Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program, Volume 3: Seismic Hazard Mitigation Projects*, 1993.

VSP Associates, Inc., *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model*, Volume 1, Federal Emergency Management Agency, FEMA Publication Number 255, 1994

Appendix H: Dam Failure

The probability of a dam failure impacting Eugene-Springfield is low; vulnerability to a dam failure event is high.

H.1 Characteristics of Dams

Dams are impervious structures that impound water by blocking the flow of a river or stream. Dams serve many purposes including water storage for potable water supply, flood control, hydroelectric power generation, agricultural irrigation, fire suppression, navigation, recreation, and others. Dams are typically multifunctional; however, the United States Army Corps of Engineers prioritizes flood control when operating Willamette Basin dams.[1]

Modern dams employ control mechanisms such as gated spillways or outlet pipes to manage the release of water, governing the natural variations in stream flow.[2] During periods of high flow, water is stored behind a dam then released to increase water levels during periods of low flow. Controlled releases results in lower peak flows and higher minimum flows than in uncontrolled streams. Water storage and release patterns vary from dam to dam, depending on the primary purpose(s) and a wide variety of economic, regulatory and environmental considerations.

Large modern dams usually fall into two categories embankment or concrete. Both are typically constructed on a foundation, which may be concrete, natural rock or soils, or compacted soils. The surrounding natural valley walls become the abutments of the dam structure itself and dams are often sited along a constricted part of a river valley to minimize cost.

Embankment dams are commonly termed earthfill or rockfill dams, depending on the primary material (soil or rock) used in their construction. Built as broad flat structures they are often twice as wide at the base to provide stability to the structure. Impervious layers may be added to the dam structure to reduce leakage. Subject to erosion by running water, embankment dams utilize erosion-resistant materials in the water release and control mechanisms of the dam. For example, concrete spillways with concrete or steel gates or outlet pipe systems with concrete or steel pipes as part of the water release control system help to reduce erosion.[3]

Modern concrete dams fall into three major classes: gravity, buttress and arch.[4] Concrete gravity dams are designed on principles similar to embankment dams. They are broad structures with a flat base and a narrow top; the upstream side is flat while the

[1] United States. Association of State Dam Safety Officials. *Benefits of Dams.* https://damsafety.org/dams101 Accessed August 2019.
[2] Ibid
[3] Paul Breeze. *Power Generation Technologies (Second Edition)* 2014.
[4] United States. Association of State Dam Safety Officials. *Benefits of Dams.* https://damsafety.org/dams101 Accessed August 2019.

downstream side is broadly sloping. Much of the dams' capacity to impound water arises from the weight of the structure. Gravity dams are often anchored into bedrock foundations and abutments to increase stability.

Concrete arch dams rely primarily on the strength of concrete to impound water. Much thinner in cross section than concrete gravity dams and they are always convex on the upstream side and concave on the downstream side because concrete is much stronger in compression than in tension. The arch design uses the pressure of impounded water to compress the concrete, making the dam stronger. Concrete arch dams are also keyed into bedrock foundations and abutments to provide stability. A less common variation of a concrete arch dam is a buttress dam. Buttress dams are arched or straight dams with additional strength provided by buttresses perpendicular to the long axis of the dam.

H.2 Causes of Dam Failure

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

Correspondingly the probability of dam failure is much lower when water levels are substantially below the design capacity for the reservoir.

For embankment dams, the most common failure mode is erosion during prolonged periods of rainfall and flooding. When dams are full and inflow rates exceed the capacity of the controlled release mechanisms, overtopping may occur. Overtopping can scour and erode either the dam itself and/or the abutments which may lead to partial or complete failure of the dam. Internal erosion, piping or seepage through the dam, foundation, or abutments can lead to failure. Willamette River Basin dams are designed for spillway opening only during infrequent severe events. Increased use can cause wear on spillway parts and lead to greater maintenance needs and an increased risk of failure. Twenty percent of dam failures have been caused by piping (internal erosion caused by seepage). Seepage often occurs around pips and spillways; through animal burrows; around roots or woody vegetation; and through cracks in dams.[5]

Earthquake activity may cause embankment dams to settle or spread laterally. Such settlement does not generally lead to immediate failure. However, if the dam is full, relatively minor amounts of settling may cause overtopping to scour and erode the dam leading to potential failure.

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[5] United States. Association of State Dam Safety Officials. *Dam Failures and Incidents.* https://damsafety.org/dam-failures Accessed August 2019.

Concrete dams are subject to failure due to seepage of water through foundations or abutments. Waterways with more than one dam have downstream dams that are subject to failure induced by the failure of an upstream dam. If an upstream dam fails, then downstream dams also fail due to overtopping or hydrodynamic forces.

The following may lead to failure for any type of dam:

- Improper design or construction.
- Inadequate preparation of foundations and abutments.
- Improper operation of a dam, such as failure to open gates or valves during high flow periods.
- Unusual hydrodynamic forces.
- Landslides may cause surge waves to overtop dams or create hydrodynamic forces.
- Earthquakes can cause seiches (waves) in reservoirs that may overtop or overload dam structures.
- High winds, in rare cases, may cause waves to overtop or overload dam structures.
- Deliberate damage via sabotage or terrorism.

The Association of State Dam Officials, using data collected from the Dam Incident Database between 2010-2017, indicated overtopping to be the most common cause of dam failure in the United States.

H.3 History of the Hazard in Eugene-Springfield

There have been no reported dam failures in Oregon that have impacted Eugene-Springfield.

H.4 Risk Assessment

H.4.1 How are Hazard Areas Identified?

Although the likelihood of failure is very low, all dams upstream from the Eugene-Springfield area have the potential of causing widespread flooding should they fail. All dams in the Eugene-Springfield area have been inventoried by the Army Corps of Engineers in the National Inventory of Dams (NID). The NID lists 26,983 dams[6] in the

[6] Army Corps of Engineers, 'National Inventory of Dams, *Interactive Map & Charts*, 2018, https://nid.sec.usace.army.mil/, (accessed 1 August 2019).

US that have significant or high hazard potential.[7] The NID rates each dam as either high, significant, or low hazard potential depending on the probable impacts if a dam fails. High hazard potential indicates loss of human life is likely if the dam fails.
In Lane County, there are 13 high hazard potential dams which are listed below in Table H-1. All dams, except Fern Ridge and Santa Clara, are upstream from the Eugene-Springfield area.

Table H-1 NID High Hazard Potential Dams Lane County

County	Dam Name	River	NID City	NID Height (feet)	NID Storage (acre feet)
Lane	Cottage Grove	Coast Fork Willamette River	COTTAGE GROVE	103	50,000
Lane	Dexter	Middle Fork Willamette River	EUGENE	117	29,900
Lane	Fall Creek	Fall Creek	SPRINGFIELD	205	125,000
Lane	Dorena	Row River	COTTAGE GROVE	154	131,000
Lane	Lookout Point	Middle Fork Willamette River	EUGENE	276	477,700
Lane	Blue River	Blue River	SPRINGFIELD	312	89,000
Lane	Hills Creek	Middle Fork Willamette River	OAKRIDGE	341	356,000
Lane	Cougar	South Fork McKenzie River	SPRINGFIELD	519	219,000
Lane	Fern Ridge	Long Tom River	EUGENE	49	121,000
Lane	Walterville Storage Pond	McKenzie River	WALTERVILLE	10	345
Lane	Leaburg Canal and Forebay	McKenzie River	LEABURG	15	459
Lane	Walterville Forebay	McKenzie River	SPRINGFIELD	24	275
Lane	Santa Clara	In System	SANTA CLARA	17	64

The extent of the flood hazard from these dams depends on which dam fails, amount of impounded water, time of day, degree of failure, and proximity to population centers. For example, if the Hills Creek Dam were to fail completely, the volume of water

[7] Ibid

released would breach Lookout Point and Dexter dams, increasing the potential impact to the Eugene-Springfield area.

In 2010 and 2011, the Portland District of the U.S. Army Corps of Engineers updated the Dam Failure Inundation Maps and the Emergency Action Plans for their projects in Lane County. Copies of these maps have been provided to Lane County and the cities of Eugene and Springfield for emergency planning purposes, however distribution of the maps is restricted because they contain sensitive information. Persons wishing to obtain copies of the maps should contact the Portland District of the U.S. Army Corps of Engineers.

H.4.2 Probability of Future Occurrence

To evaluate the probability of a collapse, the dam type for each high hazard potential dam in Lane County should be considered. Table H-2 provides additional information for each dam including type, year built, owner and Emergency Action Plan status.

Table H-2 Additional Data on NID High Hazard Potential Dams

County	Dam Name	River	Storage (acre feet)	Year Built	Dam Type	EAP	Owner
Lane	Cottage Grove	Coast Fork Willamette River	50,000	1942	RE	Y	Corps
Lane	Dexter	Middle Fork Willamette River	29,900	1955	RE	Y	Corps
Lane	Fall Creek	Fall Creek	125,000	1965	ER	Y	Corps
Lane	Dorena	Row River	131,00	1949	RE	Y	Corps
Lane	Lookout Point	Middle Fork Willamette River	477,700	1953	RE	Y	Corps
Lane	Blue River	Blue River	89,000	1968	RE	Y	Corps
Lane	Hills Creek	Middle Fork Willamette River	356,000	1962	RE	Y	Corps
Lane	Cougar	South Fork McKenzie River	219,000	1964	ER	Y	Corps
Lane	Fern Ridge	Long Tom River	121,000	1941	RE	Y	Corps
Lane	Walterville Storage Pond	McKenzie River	345	1951	PGRE	Y	EWEB

Table H-2 Additional Data on NID High Hazard Potential Dams

County	Dam Name	River	Storage (acre feet)	Year Built	Dam Type	EAP	Owner
Lane	Leaburg Canal and Forebay	McKenzie River	459	1930	PGRE	Y	EWEB
Lane	Walterville Forebay	McKenzie River	275	1911	CNPGRE	Y	EWEB
Lane	Santa Clara	In System	64	1976	RE	Y	EWEB

Source Army Corps of Engineers *National Inventory of Dams (NID)*

The NID dam type classification includes the following types of dams:

- **RE**: rockfill/earthfill embankment dams, primarily rockfill (fill >3" size)
- **ER**: rockfill/earthfill embankment dams, primarily earthfill (fill <3" size)
- **CN**: Concrete
- **PG**: Gravity

Lane County's high hazard potential dams were built between 1911 and 1976. All dams are rockfill/earthfill embankment dams, except Cougar which is an earthfill/rockfill embankment dam. All dams are operated by the US Army Corps of Engineers and Eugene Water & Electric Board (EWEB) and have emergency action plans in place. All dams are maintained on a regular schedule and undergo regular inspections, with major re-inspections every five years. Furthermore, the Corps is highly experienced in the construction, operation, and maintenance of dams.[8]

For embankment dams the most common failure modes are overtopping, structural failures, and seepage through the dam.[9] However, all the Corps dams were designed and built with specific flood capacities. In addition, the Hills Creek Dam likely has the capacity to withstand floods at least as large as a 1,000-year flood event without expected damage. The other Corps dams have similar margins of flood design safety. Under normal or flood conditions, the probability of failure of the Corps operated dams appears highly unlikely. However, all of Lane County's dams were designed and built before seismic design standards were put in place.

[8] Army Corps of Engineers, 'National Inventory of Dams, *Interactive Map & Charts*, 2018, https://nid.sec.usace.army.mil/, (accessed 1 August 2019).
[9] United States. Association of State Dam Safety Officials. *Earth Dam Failures.* 2019. https://damsafety.org/dam-owners/earth-dam-failures Accessed August 2019.

EWEB dams meet current standards and in compliance with state and federal regulations.[10] Regulators works with EWEB to perform annual inspections to ensure safe operating conditions. Each EWEB dam receives weekly, monthly, semi-annual, and annual inspections. Every five years, the Federal Energy Regulatory Commission requires EWEB to test emergency action plans for the dams.

As Table H-3 shows, seismic considerations were completely absent in the design of Dorena and Fern Ridge dams. The others were explicitly designed to ground shaking levels of 0.10 g, which is the maximum seismic design level for any of the Corps dams in western Oregon. In contrast, the current Corps seismic design levels for dams at these sites (i.e., if new dams were to be built today) would be 0.21 g to 0.24g for the dams in eastern Lane County and 0.35 g for Fern Ridge. Current seismic design requirements are for levels of ground shaking about two times higher than the probable design levels for most of these dams and about three times higher for Fern Ridge. To ensure that the probability of dam failures in Lane County remains low, the Army Corps of Engineers conducts regular seismic evaluations of each dams to ensure that all dams meet current safety requirements.[11]

Table H-3 Seismic Design, Evaluation and Inspection Data

Dam	Date of Last Seismic Evaluation	Seismic Design Basis		Date of Last Periodic Inspection
		Original	Current	
Cottage Grove	1981	None	0.21 g	1997
Dexter	1981	0.10 g	0.21 g	1996
Fall Creek	1981	0.10 g	0.21 g	1999
Dorena	1981	none	0.21 g	1997
Lookout Point	1981	0.10 g	0.21 g	1999
Blue River	1994	0.10 g	0.24 g	1996
Hills Creek	2000	0.10 g	0.22 g	1999
Cougar	1994	0.10 g	0.24 g	1997
Fern Ridge	2001	none	0.35 g	2000

Source: Army Corps of Engineers, Portland District, March 2001.

[10] Oregon. EWEB, 'Dam Safety', *Dam Safety is a Top Priority,* Eugene, OR, 2017, http://www.eweb.org/about-us/news/dam-safety-is-a-top-priority, Accessed August 2019.
[11] United States. Army Corps of Engineers, Portland District Office. *Seismic Design, Evaluation and Inspection Data for Corps of Engineers Dams.* March 2001.

The probability of catastrophic failure of these dams is impossible to estimate with any accuracy, from present data. The Army Corps of Engineers indicates that Lane County's Dams all meet seismic standards and flood standards and that the probability of a dam failure is low, meaning that one incident is likely in a 75 to 100 year period.

The 2020 NHMP Steering Committees agree with this assessment.

H.4.3 Vulnerability Assessment

Eugene and Springfield are both highly vulnerable to inundation from a flood should one of the dam's collapse. Both the Eugene and Springfield steering committees' rate both cities as highly vulnerable to flooding events caused by dam failure, meaning that more than 10% of the population or regional assets could be affected.

H.4.4 Risk Analysis

Detailed loss estimates for possible failures of these dams are beyond the scope of this mitigation plan. Detailed damage and casualty estimates have not been made for catastrophic dam failures affecting Lane County. However, given the large inundation areas, high water depths, and the logistical difficulties for evacuation, it is not difficult to imagine that a truly catastrophic dam failure could potentially result in loss of life and significant economic impact.

H.4.5 Existing Mitigation Activities

The Army Corps of Engineers and Eugene Water & Electric Board conducts annual inspections of all dams that it owns, has completed Emergency Action Plans for all dams should they fail, and completes thorough evaluations of each dam every five years. All these actions help to significantly reduce the probability that a dam will fail.

The following tables (Table H-4 and H-5) detail significant historic dam and levee failures.

Table H-4 Significant Dam Failures

Reference Number	Dam	Year	Location	Fatalities	Cause
1	Pantano De Puentes Dam	1802	Lorca, Spain	608	Heavy rain/ flooding
2	Bilberry Reservoir	1852	Holme Valley, United Kingdom	81	Heavy rain/ flooding
3	Dale Dike Reservoir	1864	South Yorkshire, United Kingdom	244	Structural deficiencies
4	Iruka Lake Dam	1868	Inuyama, Aichi Prefecture, Japan	941	Heavy rain/ flooding
5	Mill River Dam	1874	Williamsburg, VA, United States	139	Insufficient design
6	South Fork Dam	1889	Johnstown, PA, United States	2,209	Heavy rain and poor maintenance
7	Walnut Grove Dam	1890	Wickenburg, AZ, United States	100	Heavy snow, rain, and poor design
8	Austin Dam	1900	Texas, United States	8	Heavy rain/ flooding
9	Hauser Dam	1908	Helena, MT, United States	0	Heavy rain/ insufficient design
10	Broken Down Dam	1908	Fergus Falls, MN, United States	0	Insufficient design
11	Austin Dam	1911	Texas, United States	78	Insufficient design
12	Desana Dam	1916	Desana, Austria-Hungary	62	Structural deficiencies
13	Lake Toxaway Dam	1916	Transylvania County, NC, United States	0	Heavy rain/ flooding
14	Sweetwater Dam	1916	San Diego County, CA, United States	0	Heavy rain/ flooding
15	Lower Otay Dam	1916	San Diego County, CA, United States	14	Heavy rain/ flooding
16	Tigra Dam	1917	Gwalior, India	1,000	Heavy rain/ flooding and poor design
17	Gleno Dam	1923	Province of Bergamo, Italy	356	Structural deficiencies
18	Llyn Eigiau Dam and Coedty Reservoir	1925	Dolgarrog, United Kingdom	17	Heavy rain/ flooding and structural deficiencies

Table H-4 Significant Dam Failures

Reference Number	Dam	Year	Location	Fatalities	Cause
19	St. Francis Dam	1928	Santa Clarita, CA, United States	600	Insufficient design and operation
20	Secondary Dam of Stella Zerbino	1935	Molare, Italy	111	Heavy rain/ flooding, insufficient design and construction
21	Horonai Dam	1941	Omu, Hokkaido, Japan	60	Heavy rain/flooding.
22	Nat-y-Gro Dam	1942	Elan Valley, United Kingdom	0	World War II
23	Eder Dam	1943	Hesse, Germany	70	World War II
24	Möhne Dam	1943	Ruhr, Germany	1,579	World War II
25	Heiwa Lake Dam	1951	Kameoka, Kyoto Prefecture, Japan	117	Heavy rain/flooding.
26	Vega de Tera	1959	Rivadelago, Spain	144	Insufficient design and construction. Heavy Rain/flooding.
27	Malpasset Dam	1959	Côte d'Azur, France	423	Geologic, design, and structural deficiencies.
28	Kurenevka Mudslide	1961	Kiev, Ukraine	>1500	Heavy rain/flooding.
29	Panshet Dam	1961	Pune, India	>1000	Insufficient design and construction. Heavy Rain/flooding.
30	Baldwin Hills Reservoir	1963	Los Angeles, CA United States	5	Geologic, design, and structural deficiencies.
31	Spaulding Pond Dam	1963	Norwich, CT United States	6	Heavy rain/flooding. Structural deficiencies.
32	Vajont Dam	1963	Monte Toc, Italy	2,000	Landslide
33	Swift Dam	1964	Montana, United States	28	Heavy rain/flooding
34	Mina Plakalnitsa	1966	Vratsa, Bulgaria	>107	Insufficient design and construction

Table H-4 Significant Dam Failures

Reference Number	Dam	Year	Location	Fatalities	Cause
35	Sempor Dam	1967	Central Java Province, Indonesia	2,000	Heavy rain construction not complete.
36	Certej Dam Failure	1971	Certej Mine, Romania	89	Insufficient design and construction.
37	Buffalo Creek Flood	1972	West Virginia, United States	125	Insufficient construction. Heavy rain/flooding.
38	Canyon Lake Dam	1972	South Dakota, United States	238	Heavy rain/flooding.
39	Banqiao and Shimantan Dams	1975	Zhumadian, China	171,000	Heavy rain/flooding.
40	Teton Dam	1976	Idaho, United States	11	Insufficient design and construction.
41	Laurel Run Dam	1977	Johnstown, PA, United States	40	Heavy rain/flooding.
42	Kelly Barnes Dam	1977	Georgia, United States	39	Insufficient design, construction, or operation.
43	Machchu-2 Dam	1979	Morbi, India	5,000	Heavy rain/flooding.
44	Wadi Qattara Dam	1979	Benghazi, Libya	0	Heavy rain/flooding.
45	Lawn Lake Dam	1982	Rocky Mountain National Park, United States	3	Insufficient operation.
46	Tous Dam	1982	Valencia, Spain	8	Heavy rain/flooding. Insufficient operation.
47	Val di Stava Dam	1982	Tesero, Italy	268	Insufficient operation.
48	Upriver Dam	1986	Washington State, United States	0	Lightning
49	Kantale Dam	1986	Kantale, Sri Lanka	180	Insufficient operation.
50	Perućа Dam	1993	Split-Dalmatia County, Croatia	0	Destroyed by Serbian military forces.

Table H-4 Significant Dam Failures

Reference Number	Dam	Year	Location	Fatalities	Cause
51	Merriespruit Tailings Dam	1994	Free State, South Africa	17	Heavy rain/flooding.
52	Saguenay Flood	1996	Quebec, Canada	10	Heavy rain/flooding. Insufficient operation.
53	Meadow Pond Dam	1996	New Hampshire, United States	1	Heavy icing. Insufficient design and construction.
54	Opuha Dam	1997	Canterbury, New Zealand	0	Heavy rain/flooding during construction.
55	Donana Disaster	1998	Andalusia, Spain	0	Insufficient construction and operation.
56	Shihgang Dam	1999	Taiwan	0	Earthquake - 7.6 magnitude (partial failure)
57	Martin County Coal Slurry Spill	2000	Martin County, KY, United States	0	Insufficient operation and construction.
58	Vodni nádrz Sobenov	2002	Sobenov, Czech Republic	0	Heavy rain/flooding.
59	Zeyzoun Dam	2002	Zeyzoun, Syria	22	Insufficient operation and structural deficiencies.
60	Hope Mills Dam	2003	North Carolina, United States	0	Heavy rain/flooding.
61	Silver Lake Dam	2003	Michigan, United States	0	Heavy rain/flooding. Large frost depth.
62	Big Bay Dam	2004	Mississippi, United States	0	Insufficient operation and structural deficiencies.
63	Camará Dam	2004	Paraiba, Brazil	3	Insufficient operation and structural deficiencies.
64	Shakidor Dam	2005	Pakistan	70	Heavy rain/flooding.

Table H-4 Significant Dam Failures					
Reference Number	Dam	Year	Location	Fatalities	Cause
65	Taum Sauk Reservoir	2005	Lesterville, United States	0	Insufficient operation and structural deficiencies.
66	Campos Novos Dam	2006	Campos Novos, Brazil	0	Insufficient operation and structural deficiencies.
67	Gusau Dam	2006	Gusau, Nigeria	40	Heavy rain/flooding. Insufficient operation.
68	Ka Loko Dam	2006	Kauai, United States	7	Heavy rain/flooding. Insufficient operation.
69	Lake Delton	2008	Lake Delton, WI, United States	0	Heavy rain/flooding.
70	Koshi Barrage	2008	Koshi Zone, Nepal	250	Heavy rain/flooding.
71	Kingston Fossil Plant Coal Fly Ash Slurry Spill	2008	Roane County, TN, United States	0	Insufficient operation and structural deficiencies.
72	Algodoes Dam	2009	Piaui, Brazil	7	Heavy rain/flooding.
73	Sayano-Shushenskaya Dam	2009	Sayanogorsk, Russia	75	Insufficient operation and construction.
74	Situ Gintung Dam	2009	Tangerang, Indonesia	98	Heavy rain/flooding. Insufficient operation and structural deficiencies.
75	Kenmare Resources Tailings Dam	2010	Mozambique	1	Insufficient operation and structural deficiencies.
76	Kyzyl-Agash dam	2010	Qyzylaghash, Kazakhstan	43	Heavy rain/flooding. Insufficient operation.

Table H-4 Significant Dam Failures					
Reference Number	Dam	Year	Location	Fatalities	Cause
77	Hope Mills Dam	2010	North Carolina, United States	0	Sinkhole.
78	Testalinden Dam	2010	Oliver, BC, Canada	0	Heavy rain/flooding. Insufficient operation.
79	Delhi Dam	2010	Iowa, United States	0	Heavy rain/flooding.
80	Niedow Dam	2010	Lower Silesian Voivodeship, Poland	1	Heavy rain/flooding.
81	Ajka Alumina Plant Accident	2010	Ajka, Hungary	10	Insufficient operation and structural deficiencies.
82	Fujinuma Dam	2011	Sukagawa, Japan	8	Earthquake - 9.1 magnitude. Insufficient operation.
83	Campos dos Goytacazes	2012	Campos dos Goytacazes, Brazil	0	Heavy rain/flooding.
84	Ivanovo Dam	2012	Biser, Bulgaria	8	Heavy rain/flooding. Insufficient operation.
85	Köprü Dam	2012	Adana Province, Turkey	10	Insufficient operation.
86	Dakrong 3 Dam	2012	Quảng Trị Province, Zimbabwe	0	Heavy rain/flooding. Insufficient operation and structural deficiencies.
87	Tokwe Mukorsi Dam	2014	Masvingo Province, Zimbabwe	0	Heavy rain/flooding. Insufficient construction.
88	Mount Polley Tailings Dam Failure	2014	British Columbia, Canada	0	Insufficient construction and operation
89	Germano Mine Tailings Dams	2015	Mariana, Minas Gerais, Brazil	17	Insufficient operation

Table H-5 Significant Levee Failures					
Reference Number	Levee	Year	Location	Fatalities	Cause
1	St. Elizabeth's Flood	1421	Netherlands	2,000-10,000	Heavy rain/flooding
2	All Saints' Flood	1570	Netherlands	>20,000	Heavy rain/flooding
3	St. Peter's Flood	1651	Amsterdam, Netherlands	>15,000	Heavy rain/flooding
4	St. Martin's Flood	1686	Groningen, Netherlands	1558	Heavy rain/flooding
5	Great Strom of 1703	1703	Netherlands and Great Britain	8,000-15,000	Heavy rain/flooding
6	Christmas Flood of 1717	1717	Netherlands, Germany, and Scandinavia	14,000	Heavy rain/flooding
7	De Biesbosch Freeze	1809	Netherlands	N/A	Ice.
8	Alblasserwaard	1820	Alblasserwaard, Netherlands	N/A	N/A
9	Netherlands	1825	Netherlands	>800	N/A
10	Lower Rhine	1855	Netherlands	N/A	Ice.
11	Zuyderzee	1916	Netherlands	N/A	Heavy rain/flooding
12	Great Mississippi Flood of 1927	1927	United States	246	Heavy rain/flooding
13	Okeechobee Surge	1928	Florida	2,500	Heavy rain/flooding
14	1938 Yellow River Flood	1938	China	500,000	War
15	Feather River	1955	Yuba City, United States	38	Heavy rain/flooding
16	Vliet Dike Failure	1976	Belgium	N/A	Heavy rain/flooding
17	Yuba River	1986	United States	N/A	Heavy rain/flooding
18	Feather River	1997	United States	3	Heavy rain/flooding

Table H-5 Significant Levee Failures

Reference Number	Levee	Year	Location	Fatalities	Cause
19	Wilnis	2003	Netherlands	0	Insufficient operation.
20	Jones Tract	2004	United States	N/A	Insufficient operation.
21	Hurricane Katrina	2008	United States	1,833	Heavy rain/flooding
22	Fernley, Nevada	2008	Nevada, United States	0	Heavy rain/flooding
23	Munster, Indiana	2008	Indiana, United States	N/A	Heavy rain/flooding
24	Typhoon Morakot	2009	Taiwan	N/A	Heavy rain/flooding
25	Xynthia Storm	2010	France	N/A	Heavy rain/flooding
26	Black River	2011	Missouri, United States	N/A	Heavy rain/flooding

Appendix I: Hazardous Materials

The probability of a hazardous materials incident in Eugene-Springfield is high; vulnerability to such an event is moderate.

I.1 Causes and Characteristics of the Hazard

For mitigation planning, hazardous materials may be defined as any substance that may have negative impacts on human health. Exposure to hazardous materials may result in injury, sickness, or death. Negative health impacts from hazardous materials may be acute, causing harm after a single, episodic exposure or they may be chronic, occurring after prolonged exposure to the material. Certain hazardous materials may also threaten property and the environment.

Hazardous material toxicity varies widely. The term toxic is a synonym for the more common term poisonous. Highly toxic hazardous materials may cause harm or death even after brief exposures to small amounts. Other hazardous materials are much less toxic resulting in negative health effects only after exposure to large amounts over longer periods of time.

Hazardous chemicals are widely used in heavy industry, manufacturing, agriculture, mining, oil and gas industry, forestry, and transportation as well as in medical facilities and commercial, public, and residential buildings. There are numerous materials that may be hazardous to human health. A typical single-family home may contain dozens of potentially hazardous materials including fuels, paints, solvents, cleaning agents, pesticides, herbicides, medicines, and others.

For mitigation planning purposes, small quantities of low to moderately toxic hazardous materials utilized by residents are of limited interest due to low potential impact. The industrial use and transportation of hazardous materials are of significant interest for mitigation planning. Situations involving extremely toxic or large quantities of hazardous materials in locations where accidents or malevolent actions (terrorism or sabotage) may result in significant public health risk are of special concern for planning purposes.

The toxicity of a hazardous material is only one important measure of the potential impact on an affected community. The quantity of material and the ease of dispersal may be as important as toxicity in governing the level of potential threat to a community. For example, a small quantity of a very toxic solid hazardous material in a laboratory may pose a much smaller level of risk for a community than a large quantity of a less toxic gaseous hazardous material upwind from a populated area.

The severity of any hazardous material release for an affected community depends on several factors including the:

A. Toxicity of the hazardous material.
B. Quantity of the hazardous material released.
C. Dispersal characteristics of the hazardous material,
D. Local conditions such as wind direction, topography, soil and ground water characteristics, and proximity to vulnerable resources such as drinking water.
E. Population density in areas likely to be affected by hazardous materials incidents.
F. Efficacy of response and recovery actions.

The principal modes of human exposure to hazardous materials are:

A. **Inhalation** of gaseous or particulate materials via the respiratory (breathing) process.
B. **Ingestion** of hazardous materials via contaminated food or water.
C. **Direct contact** with skin or eyes.

Exposure to hazardous materials can result in a wide range of negative health effects on humans. Hazardous materials are generally classified by their health effects and the most common classes are summarized below.

Flammable materials are substances where fire is the primary threat, although explosive and chemical effects may also occur. Common examples include gasoline, diesel fuel, and propane.

Explosives are materials where explosion is the primary threat, although fire and chemical effects may also occur. Common examples include dynamite and explosives used in construction or demolition.

Irritants may inflame or burn the skin, eyes or airways after contact. Common examples of irritants are acids, solvents, or detergents.

Asphyxiants are substances which interfere with respiration by displacing oxygen. Nitrogen is a common atmospheric gas that when released in a confined space may result in asphyxiation. Chemical asphyxiants are substances that prevent the body from using oxygen or otherwise interfere with respiration. Common examples are carbon monoxide and cyanides.

Anesthetics and Narcotics are substances which depress the central nervous system. Signs and symptoms include drowsiness, weakness, fatigue, incoordination, unconsciousness, paralysis of the respiratory system and death. Examples include hydrocarbons and organic compounds.

Hazardous materials may also have a wide variety of more specialized impacts on human health. Other types of toxic effects are briefly summarized in Table I-1.

Table I-1 Other Types of Hazardous Materials

Type of Hazardous	Effects on Humans
Hepatotoxin	Liver damage
Nephrotoxin	Kidney damage
Neurotoxin	Neurological (nerve) damage
Carcinogen	May result in cancer
Mutagen	May produce changes in the genetic material of cells
Teratogen	May have adverse effects on sperm, ova, or fetal tissue
Radioactive materials	May result directly in radiation sickness at high exposure levels or act as carcinogen, mutagen, or teratogen
Infectious substances	Biological materials such as bacteria or viruses that may cause illness or death

I.2 History of the Hazard in Eugene-Springfield

Large-scale hazardous materials events have been rare. Small-scale or household spills or events are also deemed to be relatively uncommon.

I.3 Risk Assessment

At the present time, there isn't reliable data for assessing the level of risk posed by hazardous materials.

How are Hazard Areas Identified?

Any area within the Eugene-Springfield area may have hazardous materials present. The railroad passing through Eugene-Springfield transports hazardous substances in large quantities. The Extremely Hazardous Substance Plan is completed and identifies each area and associated risk in the pre-incident plan.

Probability of Future Occurrence

Hazardous materials incidents of varying magnitude have occurred in the Eugene-Springfield area over the last 5 years, totaling approximately 707 incidents.[1] The number of incidents may increase as the Eugene-Springfield population continues to grow.

The Eugene and Springfield Steering Committee listed the probability of a hazardous material incident as 'high'.

Vulnerability Assessment

The Eugene-Springfield areas most vulnerable to hazardous materials incidents are those where materials are transported or stored and any adjacent property. Transportation corridors include the railroads and any pipelines that pass through the cities of Eugene and Springfield.

The Eugene and Springfield Steering Committee estimate the vulnerability to hazardous material incidents as 'moderate'.

Risk Analysis

Due to insufficient data, Eugene and Springfield are unable to perform a quantitative risk assessment currently. As data and resources become available an assessment will be completed.

Community Hazard Issues

What is susceptible to damage during a hazard event?

The potential impacts of hazardous materials incidents on the Eugene-Springfield area are summarized below on Table I-2.

[1] Office of the State Fire Marshal, 'Annual Hazardous Substance Incident Report', *Hazardous Incident Search,* Salem, OR, 2014-2018, https://www.oregon.gov/osp/programs/sfm/Pages/Hazardous-Incident-Database.aspx, (accessed 30 July 2019).

Table I-2 Potential Impacts of Hazardous Material Incidents on the Eugene- Springfield Area

Inventory	Probable Impacts
Portion of Eugene-Springfield Metro Area affected	Would be localized, except for large spills which could have extensive evacuation zones and affect a significant portion of the Eugene-Springfield Metro Area.
Buildings	Are negligible except for incidents which involve explosive and flammable materials near structures.
Streets within Metro Area	Could include temporary closures.
Roads to/from Metro Area	Could include temporary closures.
Electric power	Would be negligible except for incidents involving explosive and flammable materials near utilities.
Other Utilities	Would be negligible except for incidents impacting rivers upstream from drinking water intakes for the both communities.
Casualties (deaths and injuries)	Would depend on location and identity of hazardous material, time of day, and evacuation effectiveness.

Existing Hazard Mitigation Activities

The single most critical factor in enhancing both mitigation and emergency response planning is specific inventory awareness of major hazardous materials sites within each jurisdiction. Specific inventory awareness maintains detailed knowledge of the types and locations of significant quantities of hazardous materials for every location in a jurisdiction. What constitutes a significant quantity varies depending on the toxicity of the material, dispersal characteristics, and the nature and population of the potential affected areas.

The Office of State Fire Marshal (OSFM) conducts an annual Hazardous Substance Information System Survey (HSIS) of Oregon facilities. The database created from the survey contains the inventories of hazardous materials at fixed locations in the Eugene-Springfield area. Transportation data of hazardous materials within or through the Eugene-Springfield area and the HSIS data are the foundation for the specific inventory awareness currently integrated into Eugene Springfield Fire Department.

Eugene and Springfield Fire has completed an Extremely Hazardous Substance (EHS) pre-incident plans for all EHS sites, excluding towers due to their low level of risk. Hazardous substance storage locations and transportation sites have been identified detailing worst-case scenarios for risk.

The City of Springfield obtains most of its water from wells and the best way to protect well heads is through the careful management of hazardous material and harmful chemical storage. The Springfield Utility Board has created a Wellhead Protection Program that identifies wellhead protection areas and limits hazardous materials and harmful chemicals from being stored near wellheads.