WHITMAN COUNTY COMMUNITY WILDFIRE PROTECTION PLAN

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May 1, 2025

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Data Product Disclaimer

The Whitman County Community Wildfire Protection Plan (CWPP) is a living document that is regularly updated as new information becomes available. Updated versions of the CWPP and associated maps can be found at https://www.whitmancounty.org/264/Emergency-Management, which is a central location to find the most updated version of all CWPP material.

Acknowledgments

The Whitman Community Wildfire Protection Plan Core Team members would like to thank all who contributed their time and expertise towards the development of this critical planning document, including individuals from Whitman County Emergency Management and other Whitman County officials and personnel, city government, city and rural fire departments, Washington Department of Natural Resources, Washington Department of Fish and Wildlife, Palouse Conservation District, Avista, Inland Power, National Oceanic and Atmospheric Administration, Bureau of Land Management, and many other engaged stakeholders and members of the public. These contributions were invaluable throughout the process and have created a well-rounded and effective document that will serve Whitman County for years to come.

List of Acronyms

Acronym	Definition
BLM	Bureau of Land Management
BLM	Bureau of Land Management
C-CEMP	Coordinated Comprehensive Emergency Management Plan
cNVC	Conditional Net Value Change
CWDGP	Community Wildfire Defense Grants Program
CWiRRZ	Community Wildfire Risk Reduction Zones
CWPP	Community Wildfire Protection Plan
E.O.	Executive Order
eNVC	Expected Net Value Change
EVT	Existing Vegetation Type
FEMA	Federal Emergency Management Agency
FLAME	Federal Land Management, Assistance and Enhancement Act
HFRA	Healthy Forests Restoration Act of 2003
HIFLD	Homeland Infrastructure Foundation-Level Database
HIZ	Home Ignition Zone
HVRA	High Value Resources and Assets
icNVC	Integrated Conditional Net Value Change
ieNVC	Integrated Expected Net Value Change
NEPA	National Environmental Policy Act
NFP	National Fire Plan
NWCG	National Wildfire Coordinating Group
ROS	Rate of Spread
USFS	United States Forest Service
WA DNR	Washington Department of Natural Resources
WAWUIC	Washington Wildland Urban Interface Code
WDFW	Washington Department of Fish and Wildlife
WUI	Wildland Urban Interface

Whitman County Community Wildfire Protection Plan

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Executive Summary

This document constitutes the first Community Wildfire Protection Plan (CWPP) for Whitman County. The Healthy Forests Restoration Act of 2003 (HFRA) encourages the development of CWPPs to help communities plan for, respond to, and recover from wildfire events.

This CWPP is a community-based plan focused on identifying and addressing the local threat of wildfire within Whitman County (also referred to as "the County"). This living document is updated as needed to utilize the best available information to characterize current conditions, identify resources and assets susceptible to wildfire, and identify and interpret wildfire risk throughout the County. Information regarding the CWPP can be found online at:

https://www.whitmancounty.org/264/Emergency-Management .

The successful development of the CWPP is the result of collaborative effort by an interdisciplinary CWPP "Core Team," the public, and other stakeholders who submitted feedback during public meetings, public engagement opportunities, and a formal public comment process. This feedback has resulted in a comprehensive CWPP that encompasses a wide variety of perspectives and experience.

Notable components of this CWPP include: identification and clarification of the Wildland Urban Interface (WUI), prioritized areas for wildfire risk mitigation within the County, a detailed implementation plan and action table, and recommendations to reduce structural ignitability and wildfire risk.

These elements of the CWPP fulfill HFRA requirements and provide decision-makers and stakeholders with a useful and current tool to address the local risk of wildfire. This CWPP also facilitates access for eligible projects that reduce wildfire risk, increase wildfire response capacity, and provide public education regarding wildfires and associated risk.

The CWPP also summarizes the regulatory environment surrounding the development of a CWPP along with a characterization of the County including demographics, government structure, land use, and the fire environment. An overview of the WUI development within Washington State is also included, detailing the nuanced and developing definitions of the WUI and its implications for the County.

The implementation plan developed for the CWPP consists of goals, objectives, strategies, and projects that align with federal, state, and local goals while also meeting the unique needs of the County. This implementation plan interfaces directly with a detailed action plan, consisting of individual projects collaboratively developed by the CWPP Core Team, the public, and stakeholders. The projects within the action plan are organized according to relative wildfire risk per fire district, which facilitates effective planning that aligns with resource allocation and current planning frameworks.

The Whitman County CWPP is a comprehensive resource that characterizes current conditions and available resources, identifies and interprets wildfire risk, and provides next steps intended to mitigate that risk and provide the public with recommendations to reduce structural ignitability. The updated elements developed throughout this process also facilitate access to a variety of funding opportunities to implement the goals, objectives, and strategies outlined within the CWPP.

How to Use This Plan

The CWPP is meant to be read and utilized by both technical and general audiences and is organized to allow intuitive navigation to sections of particular interest while also maintaining logical flow throughout the document. The following overview provides a brief summary of the three sections of the CWPP.

Section 1: Introduction and Background

This section provides relevant information characterizing Whitman County as it relates to topics addressed within Section 2 and Section 3 of the CWPP. Topics covered within this section relate to the purpose, need, and requirements of a CWPP document, the relationship of the CWPP to other active plans, policies, and regulations applicable to the County, and public engagement and collaboration.

Section 2: Wildland Urban Interface & Risk Assessment

Section 2 contains a summary of baseline information for Whitman County, including government, land use, and demographics. The fire environment is also characterized, including descriptions of topography, hydrology, climate, vegetation, fuels, fire history, and municipal watersheds. This section also contains a detailed description of the WUI in Washington state, including current development status and future integration with the Whitman County CWPP. Lastly, this section reviews wildfire risk assessment data across the County and provides context for interpretation. At-risk and underserved communities are also characterized with respect to federal definitions as it relates to the CWPP process.

Section 3: Implementation

This section explains how the CWPP integrates with the National Cohesive Strategy, outlines various resources for homeowners to reduce structural ignitability, characterizes the County's current capacity for wildfire response efforts, and provides a detailed action plan outlining applicable goals, objectives, strategies, and projects identified through the CWPP update process. This section also includes priority areas for wildfire risk reduction throughout the County.

Palouse Fire (Whitman County, WA)

Virtual CWPP Resources

For more information about Whitman County's CWPP and other useful resources, visit the Whitman County's Emergency Management Webpage by entering the URL below into your web browser or use your smartphone to scan the QR code below.

URL: https://www.whitmancounty.org/264/Emergency-Management

Wheat field in Whitman County

Section 1: Introduction and Background

1.1 Community Wildfire Protection Plans


Figure 1 2018 Palouse Fire

Following decades of fire suppression, changing climate, and subsequently increasing frequency of catastrophic wildfire events, lawmakers identified the need to equip individual communities with tools and funding to address the growing risk of wildfire. In 2003, HFRA was enacted, outlining a basic process for at-risk communities to do this by creating a CWPP. A CWPP is a planning document that assists communities in preparing for, responding to, and recovering from wildfire. CWPPs can vary widely across communities based on unique local needs and priorities. HFRA further encourages hazardous fuel management and community participation to reduce the risk of large wildfires and directs federal land management agencies to prioritize authorized hazardous fuel reduction projects that provide for the protection of at-risk and/or underserved communities that implement CWPPs. Communities are encouraged to create CWPPs to plan for wildfire mitigation activities and tailor the plans to their unique environment (Figure 1).

This document constitutes Whitman County's first CWPP document, which will guide current planners, fire departments, citizens, and other stakeholders in preventing, responding to, recovering from, and living with wildfire. The newly published CWWP is required for the County to be eligible for millions of dollars of federal funding to implement projects that mitigate wildfire risk.

At-Risk & Underserved Communities

At-Risk Communities

Low-income, minority, and rural communities have historically been excluded from wildfire planning processes and risk mitigation projects across the country and are often disproportionately affected by natural disaster events such as wildfire. Recognizing this, HFRA requires CWPPs to consider these communities in all essential aspects of the plan (Figure 2). Defined in the Act as "at-risk communities," these communities have the following characteristics:

- A group of homes and other structures with basic infrastructure and services
- Located within or adjacent to federal lands with conditions conducive to large-scale wildfire
- Wildfire poses a significant threat to human life or property

Per HFRA, all CWPPs must engage at-risk communities throughout the planning process, prioritize fuel projects around these communities, and recommend measures to reduce structure ignitability in these communities. At-risk communities were also identified in 2001 per 66 FR 43384, 'Urban Wildland Interface Communities Within the Vicinity of Federal Lands That Are at High Risk from Wildfire'. However, this list has not been updated and does not include any communities within Whitman County. Since 2001, the criteria for identifying at-risk communities has expanded to include a comprehensive range of potential characteristics that result in increased risk for a given community. The Community Wildfire Defense Grant Program[1] (CWDG) considers communities to be "at-risk" if the community area (i.e., County, neighborhood, state) has at least "moderate" wildfire risk. Moderate wildfire risk for this program is defined as having ≥40th percentile Wildfire Risk to Homes, as compared to the state or nation, or having ≥67th percentile Wildfire Hazard Potential as compared to the state or nation. Other data sources can also be used to satisfy this requirement, including local and state wildfire risk data.

Underserved Communities

Underserved communities are not explicitly defined within the HFRA, though federal and state guidance offers several metrics which can be implemented to determine if a community is underserved. The CWDG also considers "disadvantaged communities" to be underserved, defining these as Counties or communities which have at least one census tract identified as "disadvantaged" using the Climate and Economic Justic Screening Tool[2] or through meeting the low-income definition. The CWDG defines "low income" in Washington as a median household income that is 80% of the state or national median household income, whichever is higher (USFS 2024a). With a median household income between $45,626 and $53,064, Whitman County meets low income criteria for the state of Washington, which has a median income of $71,914 (USFS 2024a). The USDA Forest Service's (USFS) Wildfire Risk to Communities website provides maps illustrating areas within Whitman County that meet the criteria for underserved and/or vulnerable communities[3].The following census tracts are considered low income according to U.S. Census Bureau data: Tract 9, Tract 4, Tract 5, Tract 6.01, Tract 6.02, Tract 2.01 (USFS 2024b).

Vulnerable Populations

Together, at-risk and underserved communities are also included in what is referred to as "vulnerable" communities, a term which is often used in place of at-risk and underserved

Figure 2 Post-fire debris (Malden Fire)

[1] https://wildfirerisk.org/cwdg-tool
[2] https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5
[3] https://wildfirerisk.org/explore/

communities. The USFS Wildfire Risk to Communities website describes vulnerable communities as populations whose social and/or economic factors make it more difficult to prepare for, respond to, and recover from wildfire events (USFS 2024b). The capacity to cope with wildfire events and other natural disasters is largely rooted in social, economic, and political structures from which vulnerable populations may be marginalized or systematically excluded (Davies et al. 2018). The following U.S. Census Bureau variables are used to evaluate community vulnerability:

- Disabilities
- Limited English
- Mobile homes
- No car
- Over 65 years
- People of color
- Poverty
- Under 5 years

If a given census tract has values equal to or greater than the community median for the aforementioned variables, it is considered to be vulnerable to wildfire events (USFS 2024b). Table 1 provides an overview of potentially vulnerable populations within Whitman County, WA.

Table 1 Potentially Vulnerable Populations in Whitman County, WA compared to the U.S.

Populations, 2022*	Data Type	Whitman County, WA	United States
Families in poverty	*Count*	714*	7,151,167
	Percent of Total	8.3%	8.8%
Households with no car	*Count*	1,613	10,474,870
	Percent of Total	9.0%	8.3%
Mobile homes	*Count*	1,009	6,526,688
	Percent of Total	5.6%	5.2%
People under 5	*Count*	1,949	19,004,925
	Percent of Total	4.1%	5.7%
People over 65	*Count*	5,406	54,737,648
	Percent of Total	11.5%	16.5%
People with disabilities	*Count*	5,725	41,941,456
	Percent of Total	12.2%	12.9%
People with language barriers	*Count*	583*	12,781,871
	Percent of Total	1.3%	4.1%

*Confidence Value between 12-40%
Source: (USFS 2024a)

Severe Disaster Impacts

The CWDG application process also prioritizes communities with documented “severe” natural disasters within the prior 10 years. If the disaster increased wildfire risk and of sufficient scale and scope to create landscape impacts, additional priority is awarded. Typically, these disasters are documented through the Federal Emergency Management Agency’s (FEMA) Disaster Declarations Summaries dataset[4], though other events may be eligible if they are demonstrated to fit the criteria. Examples of severe natural disasters that may fit these criteria include: previous wildfire, drought, floods, storms, and wind (USFS 2024b). Table 2 provides an overview of severe disasters that have occurred in Whitman County (Figure 3).

Table 2 Severe Disaster Impacts in Whitman County

Declaration Title	Location	Year	Incident Type	FEMA Identification
Wildfires	Whitman County	2024	Fire	DR-4759-WA
Wildfires And Straight-Line Winds	Whitman County	2021	Fire	DR-4584-WA
Covid-19	Whitman County	2020	Biological	EM-3427-WA
Covid-19 Pandemic	Whitman County	2020	Biological	DR-4481-WA
Babb Fire	Whitman County	2020	Fire	FM-5355-WA
Severe Storms, Straight-Line Winds, Flooding, Landslides, And Mudslides	Whitman County	2016	Severe Storm	DR-4249-WA

Sources: (USFS 2024a), (Federal Emergency Management Agency 2024)

Figure 3 Aerial view of destruction after the Malden Fire

CWPP Requirements

[4] https://www.fema.gov/openfema-data-page/disaster-declarations-summaries-v2

Though the content in CWPPs can vary based on the landscape, needs, and values of a given county, HFRA identifies four basic requirements for counties seeking federal funding. These requirements include:

1) Collaboration
2) Prioritized Fuel Reduction
3) Recommendations to Reduce Structure Ignitability
4) Agreement on final CWPP contents by the local government, local fire departments, and the state entity responsible for forest management, such as the Washington Department of Natural Resources (WA DNR)

Collaboration

CWPPs must be developed through a collaborative process involving local and state representatives, federal agencies, and other interested parties. Ideally, this collaboration will engage a broad diversity of stakeholders to ensure the CWPP reflects the best local knowledge, receives broad community buy-in, and accounts for ongoing and planned future projects. The 2025 CWPP was developed collaboratively by an interdisciplinary team of local county, city, and fire department representatives, wildfire response personnel, subject matter specialists, state and federal agency representatives, key stakeholders and private consultants, hereafter referred to as the "Core Team" (see The Core Team).

The CWPP update process began in February 2024 and continued for one year, consisting of public engagement efforts such as building a representative CWPP Core Team, developing publicly available informational resources, creating a central online location for CWPP information, soliciting stakeholder feedback, and providing CWPP information and opportunities for engagement through social media, press, and public meetings. Public engagement efforts provided multiple opportunities for public engagement, both virtually and in-person, to ensure inclusivity of all interested stakeholders. The draft CWPP was made available to the public during a 45-day public comment period. Substantive public comments were incorporated into the final CWPP.

The Core Team

The Core Team consists of a diverse group of individuals representing Whitman County, local city governments, local fire departments, the WA DNR, the Washington Department of Fish and Wildlife (WDFW), the Bureau of Land Management (BLM), the National Weather Service (NWS), the Palouse Conservation District, and local utility providers, with support from DJ&A, an environmental consulting firm. Table 3 provides detailed information about the Core Team and their affiliations.

Throughout the development of the CWPP, the Core Team met regularly to discuss important components of the plan via an in-person workshop and virtual meetings. An in-person Core Team workshop occurred on April 23, 2024, in Colfax, WA.

Table 3 Core Team Members

Name	Role
Local Government	
Bill Tensfeld	Director of Emergency Management/ Director of Parks and Recreation—Whitman County, WA
Matthew Floyd	Deputy Director of Emergency Management—Whitman County, WA
Tom Handy	District 2 Commissioner—Whitman County, WA
Jeff Marshall	GIS Manager—Whitman County, WA
Michael Brown	Emergency Management Project Manager—Whitman County, WA
Mike Webb	Mayor—St. John, WA
Local Fire	
Mike Heston	Fire Chief—Pullman, WA
Steven Engles	Fire Chief—St. John, WA
WA Department of Natural Resources	
Robert Boles	Community Resilience Coordinator
Rose Beaton	Community Resilience Coordinator
WA Department of Fish and Wildlife	
Garrett LaCivita	Land Use Planner, WDFW Region 1
Melissa MacKelvie	Habitat Biologist
Federal	
Whitney Machado	Fire Management Specialist—Bureau of Land Management
Char Dewey	National Weather Service
Washington State Local Conservation District	
Bradley Johnson	Palouse Conservation District—Middle Snake Watershed Manager
Chuck Svendgard	Palouse Conservation District—Firewise USA®/Fire Resiliency Program
Utilities	
Paul Kimmel	Avista
Matt Ugaldea	Avista
Patrick Larsen	Inland Power

Prioritized Fuel Reduction

CWPPs must include prioritization of fuel reduction projects by identifying priority areas and treatment methods to protect at-risk communities and essential infrastructure. Often, CWPPs will include a list or action table of recent, ongoing, and planned future projects which serve as an implementation plan for years to come. The 2025 CWPP provides recommendations for fuel reduction where appropriate to meet the unique characteristics and needs of Whitman County. These prioritized recommendations are illustrated in Appendix C. Recommended treatment methods and mitigations are incorporated into the CWPP via the inclusion of strategies (Appendix A) and proposed projects within the Action Table (Appendix B)

Reduce Structural Ignitability

CWPPs must recommend measures to reduce structural ignitability. Private citizens can implement these measures to prevent loss and damage to their property in the event of a wildfire. The 2025 CWPP provides an overview of the concepts and recommendations useful for reducing structural ignitability in the Fire Adapted Communities and Living with Fire sections.

Final Approval & Signatures

The CWPP must be approved and signed by the Whitman County commissioners, the President of the Whitman County Fire Chiefs Association, representatives from the WA DNR, and the Washington State Forester. The 2025 CWPP received signatures from all required parties.

Timeline of the Community Wildfire Protection Plan Update Process

The update process was initiated in February of 2024 and concluded in May of 2025. The final CWPP was signed into effect by all signatories in May of 2025.

Table 4 Community Wildfire Protection Plan Update Timeline

Milestone/Event	Date
CWPP Process Begins	February 12, 2024
CWPP Core Team Workshop	April 23, 2024
Open House Public Meeting (Colfax, WA)	July 16, 2024
Preliminary Draft CWPP	November 11, 2024
Draft CWPP for Public Review	January 13, 2025
Virtual Public Meeting	January 22, 2025
Public Comment Period (45 days)	January 22, 2025–March 8, 2025
Final Draft CWPP	March 19, 2025
Final CWPP Completed	April 30, 2025
CWPP Signed into Effect	May 2025 (see Signatures, page i)

1.2 Relationship to Other Plans, Policies, and Regulations

Conformance with relevant plans, policies, and regulations at federal, state, and local levels are important components of an effective CWPP. The 2025 CWPP conforms with the following plans, laws, and policies in order to maintain consistency and standardization.

National

National Fire Plan

Established in 2000, the National Fire Plan (NFP) addresses five key points: firefighting, rehabilitation, hazardous fuel reduction, community assistance, and accountability. In order to implement actions related to these five key points, the NFP seeks to ensure sufficient firefighting resources for the future, rehabilitate and restore fire damaged ecosystems, reduce the amount of flammable fuels in forests, and established the Wildland Fire Leadership Council (Council on Environmental Quality 2000). The National Fire Plan also encourages the creation of a CWPP. The 2025 CWPP aligns with the key points and actions of the NFP by enabling Whitman County to mitigate the risk of wildfire using resources available as a result of the NFP and in conformance with its key points.

Healthy Forests Restoration Act

The Healthy Forest Restoration Act (HFRA) of 2003 (P.L. 108-148) encourages hazardous fuel management and community participation to reduce the risk of large wildfires. HFRA directs federal land management agencies to prioritize authorized hazardous fuel reduction projects that provide the protection of at-risk communities that implement CWPPs and their watersheds. HFRA includes a definition for the WUI and provides standards or criteria for designating the WUI. It also provides flexibility for communities to delineate the WUI based on their risk and needs. Communities are encouraged to create CWPPs to plan for wildfire mitigation activities and tailor the plans to their unique environment. HFRA requires CWPPs to meet three requirements: collaboration, prioritized fuel reduction, and treatment of structural ignitability. Collaboratively developed CWPPs must also be approved by the local government, local fire department, and the state. The 2025 CWPP has been prepared in compliance with HFRA requirements and recommendations.

Federal Land Assistance, Management, and Enhancement (FLAME) Act and The National Cohesive Strategy

The Federal Land Assistance, Management, and Enhancement (FLAME) Act of 2009 (P.L. 111-88) establishes the need for hazardous fuel reduction funding and community wildfire risk assessments across the nation. The FLAME Act also created the National Cohesive Wildland Fire Management Strategy (National Cohesive Strategy) to manage wildland fire more effectively across the nation. The National Cohesive Strategy outlines three goals to restore and maintain landscapes, create fire adapted communities, and improve wildfire response (Wildland Fire Leadership Council 2023; US DOI and USDA 2014). The 2025 CWPP aligns with the three goals established by the National Cohesive Strategy (see Section 3: Implementation).

Washington State

Washington State Wildland Fire Protection 10-year Strategic Plan

The Washington State Wildland Fire Protection 10-year Strategic Plan provides a detailed blueprint to facilitate effective wildland fire protection throughout Washington, while also providing information to support policy and resource decisions. This plan also integrates with the Washington 20-Year Forest Health Strategic Plan and the National Cohesive Wildland Fire Management Strategy. CWPP planning is supported as an effective mitigation measure to address wildfire risk.

20 Year Forest Health Strategic Plan, Central and Eastern Washington

The 20-Year Forest Health Strategic Plan is a phase of the broader Washington State strategic plan and provides a coordinated and focused course of action to address forest health in eastern Washington. This plan identifies the development and integration of CWPPs with state and federal resources and priorities as an important strategy to reduce wildfire risk.

2020 Washington State Forest Action Plan

The 2020 Washington State Forest Action Plan outlines strategic goals and actions to address threats to forested areas throughout the state and integrates with existing strategic plans. The action plan fosters coordinated management activities at the landscape scale. Priority landscapes are identified within the action plan to identify areas where active allocation of resources can improve forest health conditions. The action plan identifies “Community Wildfire Preparedness and Wildfire Suppression” as a key theme, including the following goals which align with the CWPP:

- Reduce risk of wildfire to lives, communities, property, ecosystems, and working forests and ensure wildfire suppression response is safe and effective.
- Communities are prepared and adapted for wildfire.
- Washington's wildfire preparedness, response, and recovery systems are fully capable, integrated, and sustainable.
- Develop post-wildfire recovery and restoration strategies. Assess high-risk burned areas for risks to public safety and adverse impacts to public resources.

Plan for Climate Resilience

The Plan for Climate Resilience developed by WA DNR integrates with other statewide and regional plans and strategies in order to achieve climate resilience. Addressing the increasing risk of wildfire and associated costs are acknowledged as climate-driven risks which can be mitigated through the reduction of human-causes wildfire ignitions, reducing wildfire risk within the WUI, and supporting increased wildfire response capacity. The plan also recommends the development of post-wildfire recovery and restoration strategies and treatments which improve forest health and reduce wildfire risk on eastern Washington forestlands.

Local

Whitman County Emergency Management

This CWPP aligns and conforms with all emergency management plans developed by Whitman County including the Coordinated Comprehensive Emergency Management Plan (C-CEMP), the 2020 Hazard Mitigation Update, and the 2004 Hazard Mitigation Identification and Vulnerability Analysis.

Whitman County Comprehensive Plan

Whitman County's Comprehensive Plan details goals which guide future development and construction. These goals include requirements which would accommodate and improve wildfire response efforts and provide further opportunities for reducing wildfire risk through proactive planning.

Whitman County Shoreline Master Program

Washington's Shoreline Management Act (SMA; RCW 90.58) was passed by the State Legislature in 1971 and adopted by the public in a referendum. The SMA was created in response to a growing concern among residents of the state that serious and permanent damage was being done to shorelines by unplanned and uncoordinated development. The goal of the SMA was "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines." While protecting shoreline resources by regulating development, the SMA is also intended to provide for appropriate shoreline use by encouraging land uses that enhance and conserve shoreline functions and values. The SMA has three broad policies:

1) Encourage water-dependent and water-oriented uses: "uses shall be preferred which are consistent with control of pollution and prevention of damage to the natural environment, or are unique to or dependent upon use of the states' shorelines...."
2) Promote public access: "the public's opportunity to enjoy the physical and aesthetic qualities of natural shorelines of the state shall be preserved to the greatest extent feasible consistent with the overall best interest of the state and the people generally."
3) Protect shoreline natural resources, including "...the land and its vegetation and wildlife, and the water of the state and their aquatic life...."

Whitman County's Shoreline Master Program (SMP) document ensures comprehensive planning for the County's shoreline while ensuring conformance with Washington State regulations and policies adopted in relation to the SMA.

Whitman County Voluntary Stewardship Program – Work Plan

The Washington State Growth Management Act (GMA), as amended, facilitates coordination between citizens, communities, local governments, and the private sector in comprehensive land-use planning. The GMA requires county and local government to adopt development regulations that protect designated critical areas. Amendments in 2011 established the Voluntary Stewardship Program (VSP), which is a non-regulatory, incentive-based approach to balance the protection of critical areas on agricultural lands while also promoting agricultural viability. Within the VSP Work Plan, wildfire is acknowledged as a disturbance with potential to affect baseline conditions outside the jurisdiction of the VSP and exacerbate effects of water erosion (Figure 4). Firebreaks are also evaluated and scored as a resource concern. The VSP is an alternative to management of agricultural activities under the Critical Areas Ordinance (CAO). Lands used for non-agricultural purposes are regulated under the County's Critical Areas Ordinance. Per the Revised Code of Washington [State] 36.70A.020(5), Critical Areas include: wetlands, fish and wildlife habitat conservation areas, critical aquifer recharge areas, geologically hazardous areas, and frequently flooded areas. In Whitman County, Critical Areas are defined in Whitman County Code (WCC) 19.03.175 and designated within Title 9, Ordinance No. 81462. Critical Areas within the County include wetlands (WCC § 9.05.1100), critical aquifer recharge areas (WCC §9.05.1300), and fish and wildlife habitat conservation areas (WCC § 9.05.1200).

Figure 4 Wildfire burning in agricultural lands (Malden Fire)

Section 2: Wildland Urban Interface & Risk Assessment

2.1. Wildland Fire and Whitman County

County Overview

Located in southeastern Washington, Whitman County is bordered by Idaho to the east and is adjacent to Spokane, Lincoln, Adams, Franklin, Garfield, Columbia, and Asotin counties.

Totaling 2,159 square miles, Whitman County is the 10th largest county in the state of Washington and predominantly consists of privately held lands, with smaller portions of state, BLM, and other land ownership (Tweedy 2022; U.S. Department of Commerce 2022). Privately owned lands primarily consist of agricultural fields and family farms (Tweedy 2022) and represent 96.8% of Whitman County's area, with the remainder consisting of Federal lands (0.7%), BLM lands (0.7%), State lands (2.6%), State Trust lands (2.3%), and other state lands (0.2%) (U.S. Department of Commerce 2022).

Table 5 Acreage of Fire Districts and Land Ownership in Whitman County, WA

Fire District	BLM	Private	State of WA	Undefined	Grand Total
Lacrosse—Fire District 8	942	231,653	14,762	47	**247,404**
St John—Fire District 2	1,876	163,331	4,362	0	**169,570**
Endicott—Fire District 6	5,288	108,181	3,012	0	**116,481**
Dusty/Almota/Onecho-FD13	0	110,234	3,237	0	**113,471**
Fire District 12	0	107,652	422	0	**108,075**
Colton/Uniontown—FD14	89	94,896	605	115	**95,705**
Rosalia—Fire District 7	14	87,674	899	0	**88,587**
Oakesdale/Farmington-FD10	0	73,516	254	0	**73,771**
Lamont—Fire District 5	924	63,994	4,024	0	**68,942**
Colfax—Fire District 11	0	52,558	1,268	0	**53,826**
Garfield—Fire District 3	0	46,524	168	0	**46,692**
Tekoa—Fire District 1	49	43,228	937	0	**44,215**
Palouse—Fire District 4	0	39,574	326	0	**39,900**
Steptoe—Fire District 11	0	38,409	369	0	**38,778**
Diamond—Fire District 11	0	35,432	648	0	**36,079**
Albion—Fire District 11	0	33,757	67	0	**33,824**
Pullman Fire Station 1	0	3,583	0	0	**3,583**
Pullman Fire Station 2	0	3,231	0	0	**3,231**
Colfax FD	0	2,539	36	0	**2,575**
Garfield FD & FD 3	0	605	0	0	**605**
Malden FD & FD 7	0	440	0	0	**440**
Pullman Moscow Airport FD	0	434	0	0	**434**
Farmington Fire Dept	0	246	0	0	**246**
Lacrosse FD & FD 8	0	209	0	0	**209**
Total	**9,183**	**1,341,900**	**35,396**	**162**	**1,386,643**

Pullman, the largest city in Whitman County, is home to two-thirds of the county's total population, totaling 32,901 residents, and is the most heavily developed area largely due to the presence of Washington State University (U.S. Census Bureau 2021; Tweedy 2022; U.S. Department of Commerce 2022). The county seat and second largest city in the county is Colfax with a population of 2,782. Table 6 summarizes incorporated and unincorporated communities within the County.

Table 6 Summary of Communities in Whitman County, WA

Incorporated Communities	Unincorporated Communities
Albion	Diamond
Colfax	Dusty
Colton	Ewan
Endicott	Hay
Farmington	Hooper
Garfield	Johnson
LaCrosse	Lancaster
Lamont	Pine City
Malden	Steptoe
Oakesdale	Sunset
Palouse	Thornton
Pullman	Winona
Rosalia	
St.John	
Tekoa	
Uniontown	

Economy

Overall employment in Whitman County is closely tied to education, with Washington State University serving as the largest employer and accounting for 30% of local jobs (Tweedy 2022). In recent years, manufacturing employment has slowly increased which shows signs of diversification of employment opportunities in the county. Moreover, the county's robust agricultural sector is strongly influenced by price fluctuations of wheat and other crops. Crop prices therefore have significant impact on retail, wholesale sales, and overall economic activity.

Government

At the County level, The Whitman County Board of Commissioners serves as the executive and legislative authority for Whitman County, representing three districts as of November 2024. The Board is responsible for emergency services, parks and recreation systems, land planning and zoning, public health services, public roads, and public works programs (Whitman County 2024). Local government also includes a variety of officials and decision-makers such as mayors, department directors, and board and commission members.

Land Use

As of 2019, approximately 71.8% of Whitman County's land is classified as mixed cropland used for agricultural. The remaining land is classified as grassland (16%), shrubland (6.1%), urban (3.3%), water (0.9%) and forest (0.8%) (U.S. Department of Commerce 2022). The county's top crops include grains, oilseeds, dry beans, and dry peas (USDA 2022).

Critical Infrastructure

Within Whitman County, critical infrastructure was identified through the Homeland Infrastructure Foundation-Level Database (HIFLD). Types of critical infrastructure within the County include:

- Interstates
- Highways
- Railroads
- Transmission lines
- Communications sites
- Substations
- Essential facilities

Key transportation routes throughout the county include U.S. Route 195 (US-195), State Route 270 (SR-270), and State Route 26 (SR-26). Recreation opportunities feature hiking, picnicking, fishing, and other outdoor activities at Whitman County's several parks, RV parks/campgrounds, and a few state parks including Kamiak Butte County Park, Palouse Falls State Park, and Steptoe Butte State Park.

Demographics

Table 7 provides a summary of selected demographic statistics within Whitman County (U.S. Census Bureau 2023). More information about Whitman County census data can be found through the U.S. Census Bureau's database[5].

Table 7 Summary of Selected Demographic Metrics for Whitman County, WA

U.S. Census Bureau Metric	Value
Population	
Population estimates, July 1, 2023, (V2023)	48,012
Population estimates base, April 1, 2020, (V2023)	47,970
Population, percent change, April 1, 2020 (estimates base) to July 1, 2023, (V2023)	0.10%
Population, Census, April 1, 2020	47,973
Population, Census, April 1, 2010	44,776
Age and Sex	
Persons under 5 years, percent	4.10%
Persons under 18 years, percent	15.70%
Persons 65 years and over, percent	11.70%
Female persons, percent	49.20%
Race and Hispanic Origin	
White alone, percent	83.40%
White alone, not Hispanic or Latino, percent	76.70%
Hispanic or Latino, percent	8.00%
Asian alone, percent	7.90%
Two or More Races, percent	4.80%
Black or African American alone, percent	2.50%

[5] https://data.census.gov/

U.S. Census Bureau Metric	Value
American Indian and Alaska Native alone, percent	1.10%
Native Hawaiian and Other Pacific Islander alone, percent	0.30%
Housing	
Housing Units, July 1, 2023, (V2023)	21,813
Owner-occupied housing unit rate, 2018–2022	45.20%
Median value of owner-occupied housing units, 2018–2022	$298,500
Median selected monthly owner costs -with a mortgage, 2018–2022	$1,729
Median selected monthly owner costs -without a mortgage, 2018–2022	$539
Median gross rent, 2018–2022	$959
Building Permits, 2023	258
Families & Living Arrangements	
Households, 2018–2022	17,963
Persons per household, 2018–2022	2.28
Living in same house 1 year ago, percent of persons age 1 year+, 2018–2022	70.60%
Language other than English spoken at home, percent of persons age 5 years+, 2018–2022	12.70%
Computer and Internet Use	
Households with a computer, percent, 2018–2022	96.00%
Households with a broadband Internet subscription, percent, 2018–2022	84.70%
Health	
With a disability, under age 65 years, percent, 2018–2022	8.80%
Persons without health insurance, under age 65 years, percent	6.70%
Income & Poverty	
Median household income (in 2022 dollars), 2018–2022	$49,345
Per capita income in past 12 months (in 2022 dollars), 2018–2022	$30,287
Persons in poverty, percent	19.50%

Fire Environment

Evaluating factors that influence fire behavior and activity is a critical component of an effective CWPP and serves to provide a characterization of the fire environment within Whitman County. Fire behavior is influenced by physical characteristics that vary across the landscape such as topography, hydrology, climate, and vegetation. These characteristics, combined with ignition sources, constitute the fire environment.

Topography & Hydrology

Physical characteristics such as elevation, topography, and slope angle influence fire behavior in the landscape. A thorough understanding of these components informs effective and proactive fire management and fire suppression.

Elevations range throughout the County from 538–3,999 ft (164–1,219 m). With no prominent mountain ranges in the county, the landscape is characterized by rolling hills, interspersed with small ravines and shallow canyons. Slope angle varies throughout the County between 0°–58°. Portions of the County adjacent to the Snake River are notably steeper than other areas, with slope angles approaching 55° and steeper. Slope angle influences fire behavior, with steeper slopes encouraging faster rates of spread by bridging the gap between fuels and flame. Steeper slopes can also increase risk to firefighting personnel and reduce options for fuels treatments due to difficulty accessing and operating in rugged terrain. Ridgelines associated with steep slopes can also facilitate the spread of fire via wind-driven embers and firebrands.

Hydrology within the County is largely characterized by small perennial and intermittent streams, with no major rivers except for the Snake River that constitutes the southern border. The Snake River runs along the entire southern border of Whitman County and is one of the most prominent rivers in the state of Washington and Whitman County. Near the southwest corner of the county the Palouse River meets the Snake River and then the Palouse River runs along a portion of the southwest corner of the county. Rock Lake is a large freshwater lake located in the northwest near the town of Ewan and is popular for fishing and recreation. A network of perennial, intermittent, and ephemeral streams persist throughout the County, with scattered wetlands.

Climate

Annual precipitation at the Moscow Regional Airport weather station located in Pullman averaged 18.35 inches between 1990 and 2020 (PRISM Climate Group 2020). November through January are the wettest months on average, with July through September being the driest. Average annual temperatures range from 37.7–60.4°F, with a 30-year annual average of 49°F (PRISM Climate Group 2020). Wind activity throughout eastern Washington is variable and localized, with high winds often occurring due to a funneling effect from the Cascade mountains to the west. Whitman County maintains generally higher relative wind speeds than much of the surrounding area, with the highest wind velocities typically originating from the west and southwest. High winds, coupled with high temperatures and low humidity, can result in rapid reductions in fuel moisture, increasing wildfire risk. Though fire season in Washington is generally referenced as May through October, fires can occur at any point throughout the year when conducive conditions arise.

Fire History

Understanding fire history is essential to placing current fire activity in context and preparing for future wildfires. Fire history consists of the spatial and temporal patterns of fire on the landscape as well as the interaction between fire and the built environment. Factors including ignitions, vegetation, fuels, and fire regimes are useful for describing fire history within a given area.

Historically, Whitman County has experienced few wildfires, with relatively low fire frequency and severity. Though infrequent, wildfires in the County have resulted in the loss of life and property. In the last 18 years, a total of 45,341 acres of the County have burned in large wildfire events, with a notable peak in 2020 of 17,276 acres (38% of all acres burned) (Figure 5).

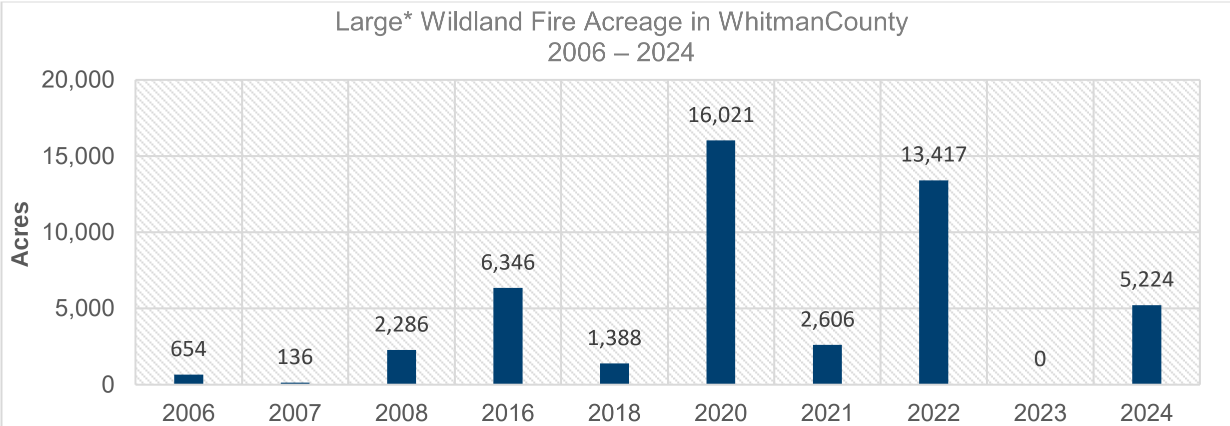

Figure 5 Large Wildland Fire Acreage in Whitman County, WA (2006–2024)*

**WA DNR datasets include "large" fires typically greater than 100 acres, though smaller perimeters are included if data are available. Some data may be missing or inaccurate.*
Note: Acreage for 2023 and 2024 is not complete due to reporting lags and unavailable data. Data reported for 2024 includes the 4,000 acre perimeter of the Long Hollow Fire.

Figure 6 Fireline construction using farm equipment

Over time, fire frequency has steadily increased throughout the County and eastern Washington as a whole. Changing weather patterns have facilitated hotter, drier, and windier conditions, resulting in increased wildfire risk. Land use patterns also drive risk by increasing ignition, particularly associated with agricultural harvest during the late summer, when fire risk is often highest (Figure 6). Abundant invasive grasses have also facilitated more frequent and fast-moving fires, by providing a receptive fuel bed, often located along roadways where ignition sources are numerous. Together, these factors have coincided to result in current conditions outside the normal range of variability. Ignitions, vegetation, fuels, and fire regimes within the County are discussed in detail below.

Ignitions

In addition to natural lightning strikes, the primary sources of wildfire ignitions in Whitman County are human-caused, including unattended campfires, fallen power lines, sparks from dragging chains or other metal along roadways, vehicle collisions, and agricultural activity. In the event of an ignition, the local emergency dispatch center, Whitcom, quickly alerts and mobilizes available fire response resources and personnel, which can include law enforcement, local fire departments, or emergency medical services as well as local residents in some cases. Figure 7 depicts all wildfire dispatches made within Whitman County, which can be used as a general proxy for ignitions and where they occur. Figure 8 illustrates the number of dispatches made by month within Whitman County between 2014 and 2023, showing significant peaks in July and August.

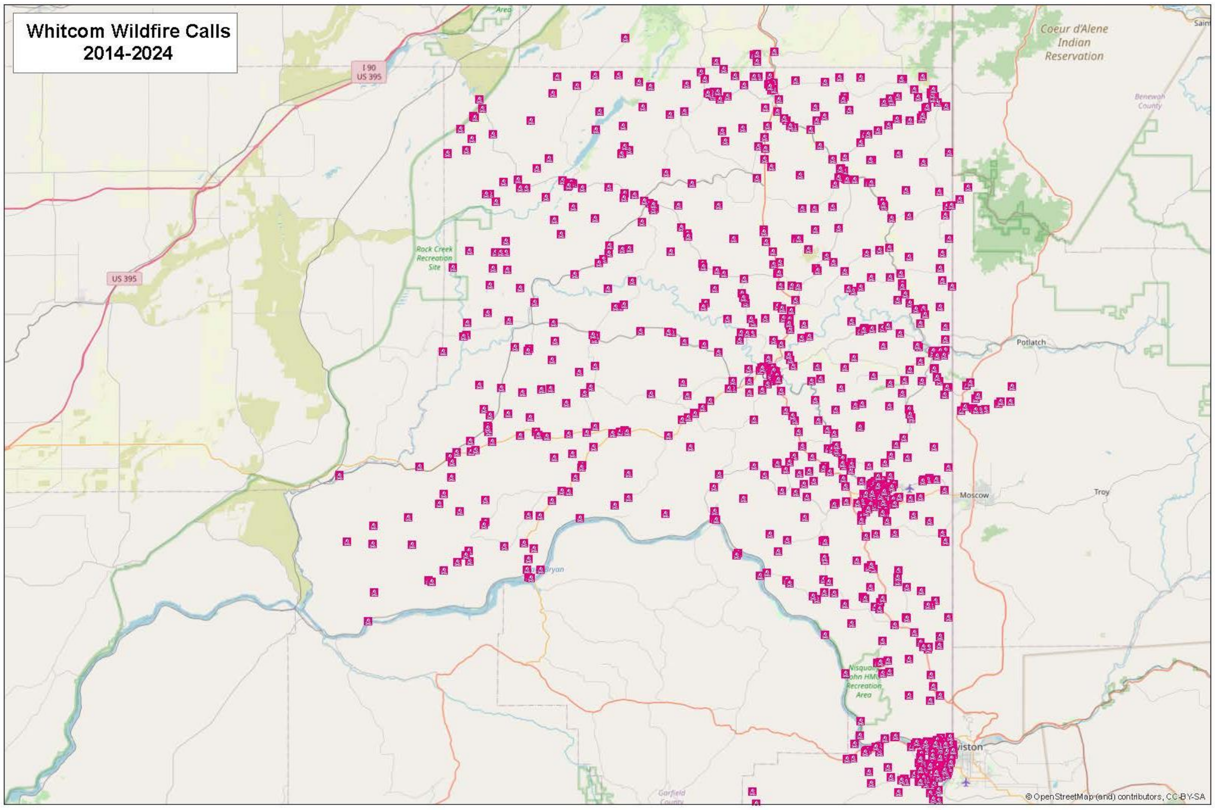

Figure 7 Map of Wildfire Calls in Whitman County (Source: Whitcom Dispatch Center)

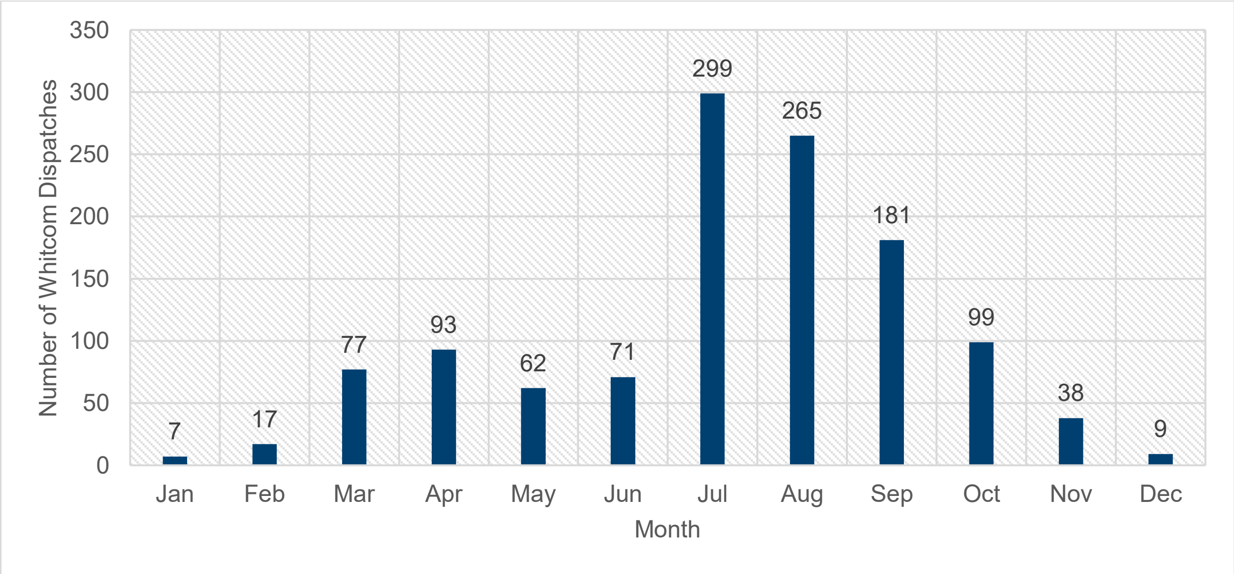

Figure 8 Number of Wildland Fire Dispatches by Month in Whitman County, WA (1/1/2014–11/3/2023)

Vegetation

In the context of fire management, vegetation is often referred to as fuels, and the type, amount, and configuration of vegetation influences fire behavior, intensity, and severity. Vegetation in the County can be characterized using the Existing Vegetation Type (EVT) dataset developed by the LANDFIRE project, which classifies groups of vegetation communities based on field data, modelling, and satellite imagery (LANDFIRE 2023).

Whitman County is represented by 51 different EVT communities, but it primarily consists of the eight EVTs listed in Table 8. Existing Vegetation Type models that cover less than 5% of the County's land area or represent non-burnable fuels such as urban pavement or scree are included as "other". The models described in detail below in Table 8 represent the majority of land cover and burnable fuels within Whitman County.

Table 8 LANDFIRE Existing Vegetation Types (EVT) >3%

LANDFIRE Existing Vegetation Type	Acres	Percent of Total
Western Cool Temperate Wheat	587,627	42%
Western Cool Temperate Fallow/Idle Cropland	151,890	11%
Western Cool Temperate Row Crop	108,658	8%
Western Cool Temperate Row Crop–Close Grown Crop	89,372	6%
Columbia Plateau Steppe and Grassland	76,837	6%
Other[1]	373,304	27%
Total	**1,387,688**	**100%**

[1] Models representing less than 5% of land area or non-burnable fuels are classified as "Other".

Fuels & Fire Regime

In the context of fire, fuels are defined as any combustible vegetative material and are a primary driver of fire behavior. Fuel models are used to predict fire behavior based on specific fuelbed characteristics such as size, quantity, density, moisture content, and composition (Scott and Burgan 2005). The USDA Standard Fire Behavior Fuel Models are a comprehensive set of models used to define and quantify fuel types and their impacts on fire behavior (Scott and Burgan 2005). These fuel models correspond to predicted fire behavior and effects through variables such as spread rate or Rate of Spread (ROS) and flame length, which influence fire intensity.

Figure 9 Burning tree during the Snake River Fire

Whitman County is represented by 25 fuel models, with the fuel models listed in Table 9 representing the majority of Whitman County. Majority fuel models representing greater than 5% of the County are described in additional detail below.

Table 9 Fuel Model Acreage in Whitman County

Fuel Model (Scott and Burgan 2005)	Area (acres)	Percentage of Whitman County
NB3—Agricultural	810,429	58%
GR2—Low Load, Dry Climate Grass (Dynamic)	345,352	25%
GS2—Moderate Load, Dry Climate Grass-Shrub (Dynamic)	51,201	4%
NB1—Urban/Developed	46,634	3%
GR1—Short, Sparse Dry Climate Grass (Dynamic)	38,652	3%
GS1—Low Load, Dry Climate Grass-Shrub (Dynamic)	37,147	3%
Other[1]	58,031	4%
Total	**1,387,444**	**100%**

[1] Models representing less than 3% of land area or non-burnable fuels are classified as “Other”.

NB3—Agricultural

This fuel model consists of agricultural lands which are assumed to be kept in a nonburnable condition. In areas where agricultural lands do not maintain nonburnable conditions, alternate fuel models may be utilized to capture potential fire behavior. Most agricultural lands in Whitman County practice dryland farming without extensive irrigation (Table 8). Resulting crop yields create an abundant supply of continuous fuels with extremely low fuel moisture, increasing wildfire risk. Harvesting in late summer and early fall also poses a risk via increased ignition potential during the hottest, driest, and windiest time of year.

GR2—Low Load, Dry Climate Grass (Dynamic)

The primary fuel for GR2 consists of grass, with smaller amounts of fine, dead fuels. The fuelbed of grasses is often continuous, and the presence of shrubs does not affect resulting fire behavior. In Whitman County, grasses are abundant, particularly along roadways where invasive species often establish quickly after disturbance. These fine fuels can create large, continuous fuelbeds that can quickly carry fire across the landscape.

2.2. The Wildland Urban Interface

WUI Overview

Figure 10 WUI fire in Colfax, WA

The concept of the WUI has a variety of definitions ranging widely in detail and extent according to federal, state, and local sources. At its simplest, the WUI has been described as the area where wildland fuels meet human development, representing an area of increased risk to life, property, and infrastructure. However, the definition of the WUI has evolved in various ways to encompass local community characteristics and values. In recent years, the definition of the WUI has been at the forefront of various legal challenges as it relates to Federal agencies' use of the streamlined National Environmental Policy Act (NEPA) processes permitted through HFRA. The precedent set by such cases suggests that communities define the WUI according to HFRA requirements, with deviations from this definition clearly justified within the CWPP. These cases have also acknowledged the right of a community to extend the boundaries of the WUI beyond the HFRA WUI requirements in order to meet their needs, though such deviations must be clearly justified.

Defining and delineating the WUI serves to ensure that areas with increased risk to life, property, and infrastructure are appropriately accounted for during decision-making processes. The delineation of the WUI also facilitates access to funding for projects intended to reduce that risk.

Washington State WUI Code

The state of Washington's WUI Code (WAWUIC) applies to all areas designated as WUI by the WA DNR. The current WUI delineation is under development, with associated final maps created by WA DNR anticipated to be available in late 2026 (WA DNR 2024).The WAWUIC is intended to reduce wildfire risks to people and property by requiring fire protection standards for structures with potential to ignite during a wildfire event. Certain provisions within the WAWUIC may be amended locally if the amendment is additive to the baseline code requirements.

Whitman County WUI

Within Whitman County, the definition and delineation of the WUI tiers to the state-delineated WUI associated with the implementation of associated code requirements. This is intended to facilitate consistency across governments and to align with WA DNR.

In the event that a proposed project on federal lands does not fall within the state WUI, but the project area has characteristics that meet other federally accepted WUI criteria, the County supports the use of a condition-based WUI. This version of the WUI would be implemented by federal agencies as-needed to illustrate how the conditions of a given project area meet federally accepted WUI criteria. If those criteria are clearly met, such proposed projects may be eligible for streamlined NEPA processes.

2.3. Wildfire Risk

Wildfire risk is made up of several components that together characterize the total risk posed to a structure, community, or resource. Wildfire risk is “the combination of likelihood and intensity (together called “hazard”) and exposure and susceptibility (together called “vulnerability”)”. The relationships of these interrelated concepts are illustrated by Figure 11 below.

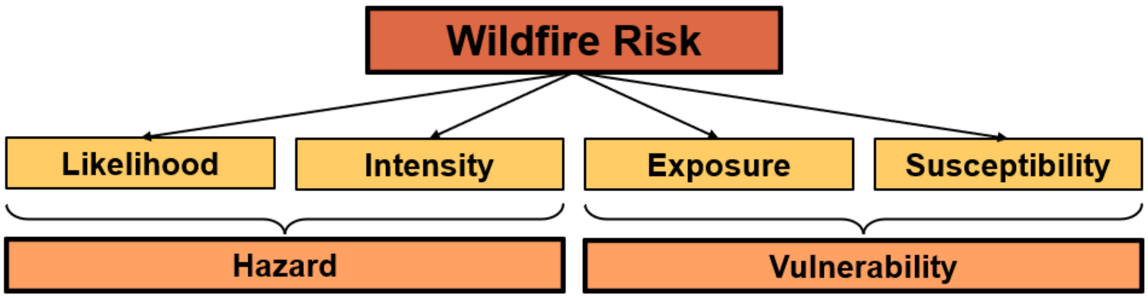

Figure 11 Components of Wildfire Risk

The concept of wildfire hazard is focused on wildlands themselves. Wildfire likelihood is driven by factors such as topography, weather conditions, and potential ignition sources. Wildfire intensity is a measure of the energy expected from a wildfire and is predicted based on total fuel types, fuel load, and topography. Together, likelihood and intensity represent wildfire hazard.

The concept of wildfire vulnerability, meanwhile, is focused on the communities and structures located within or adjacent to wildlands. Homes and structures located in areas where direct or indirect wildfire impacts may occur are considered to be exposed to wildfire. The characteristics and materials of the structures themselves, however, determine the likelihood of damage when exposed to wildfire, known as wildfire susceptibility. Together, wildfire exposure and susceptibility characterize the total vulnerability of communities and associated life and property when a wildfire does occur.

As a composite of several discrete but interrelated concepts, wildfire risk provides a single key metric for understanding the real-world threat of wildfire to homes, communities, and resources.

Community Base Map

Using the best available data, local knowledge, and input, the CWPP Core Team developed a community base map that includes the boundaries of Whitman County and represents the extent of the landscape to which the CWPP applies (Appendix C).

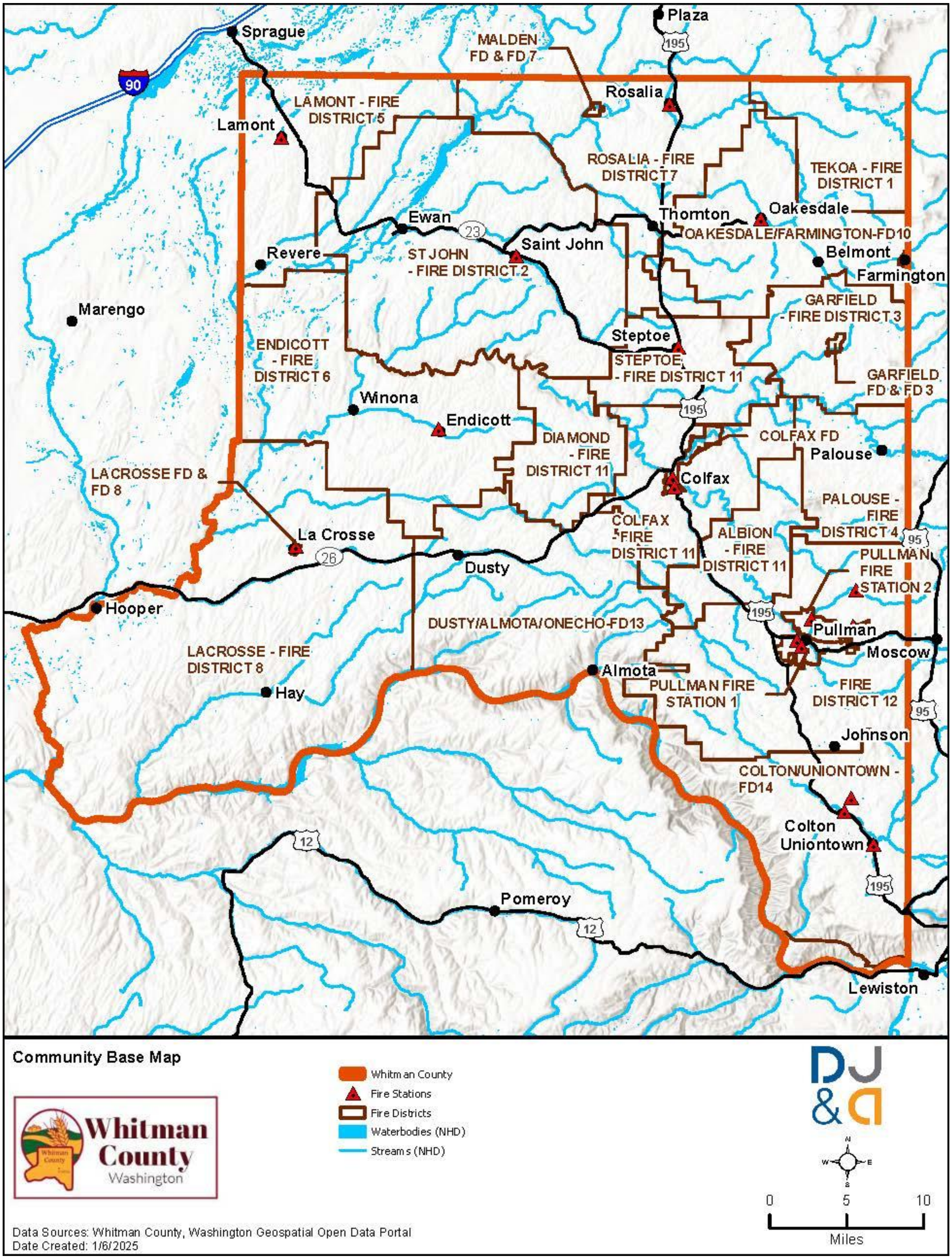

Figure 12 Community Base Map

Wildfire Risk Assessment

Wildfire risk within the community base map was evaluated using data and findings from the 2023 Pacific Northwest Quantitative Wildfire Risk Assessment (hereafter referred to as the 2023 QWRA). The 2023 QWRA provides objective, science-based risk analytics that can be used to support strategic risk management across Oregon and Washington. Analytics produced as part of the 2023 QWRA support community wildfire protection planning, fuels planning, active fire response and myriad other land management needs at regional and sub-regional scales. Appendix E includes the entirety of the 2023 QWRA. Wildfire risk metrics are mapped across the County in Appendix C.

The primary metrics used to characterize and interpret wildfire risk consisted of "expected net value change (eNVC)" and "conditional net value change (cNVC)". Net value change is used to demonstrate the consequence of fire on a given asset or resource, if the consequence is adverse, the net value change results in negative values, and if the consequence is beneficial, the net value change results in positive values. Neutral net value change is represented by zero. These metrics can then be applied to individual highly valued resources or assets (HVRAs) (i.e., non-integrated), or they can be compared to all of the known HVRAs within a given area (i.e., integrated). Integrated expected net value (ieNVC) change is calculated as the product of burn probability and conditional net value change. Integrated conditional net value change (icNVC) is calculated as the sum-product of flame-length probability and net value change to an HVRA over a range of wildfire intensity classes. Burn probability is not included in cNVC.

These metrics can be used in different ways to achieve priority objectives; for example, icNVC tells us where wildfire will create adverse or beneficial impacts and the degree of that impact (Figure 14), whereas ieNVC supplements icNVC by providing context for how likely that impact is to occur (Figure 15). For the purposes of fire planning throughout the County, icNVC is most often used as it assumes the presence of fire and subsequent consequences (Figure 13). Also, ieNVC is rooted in long-term patterns of fire behavior, which can be misleading when addressing rapidly developing fire environments, such as in Whitman County (Figure 13).

Figure 13 Outskirts of Malden, WA after the Malden Fire

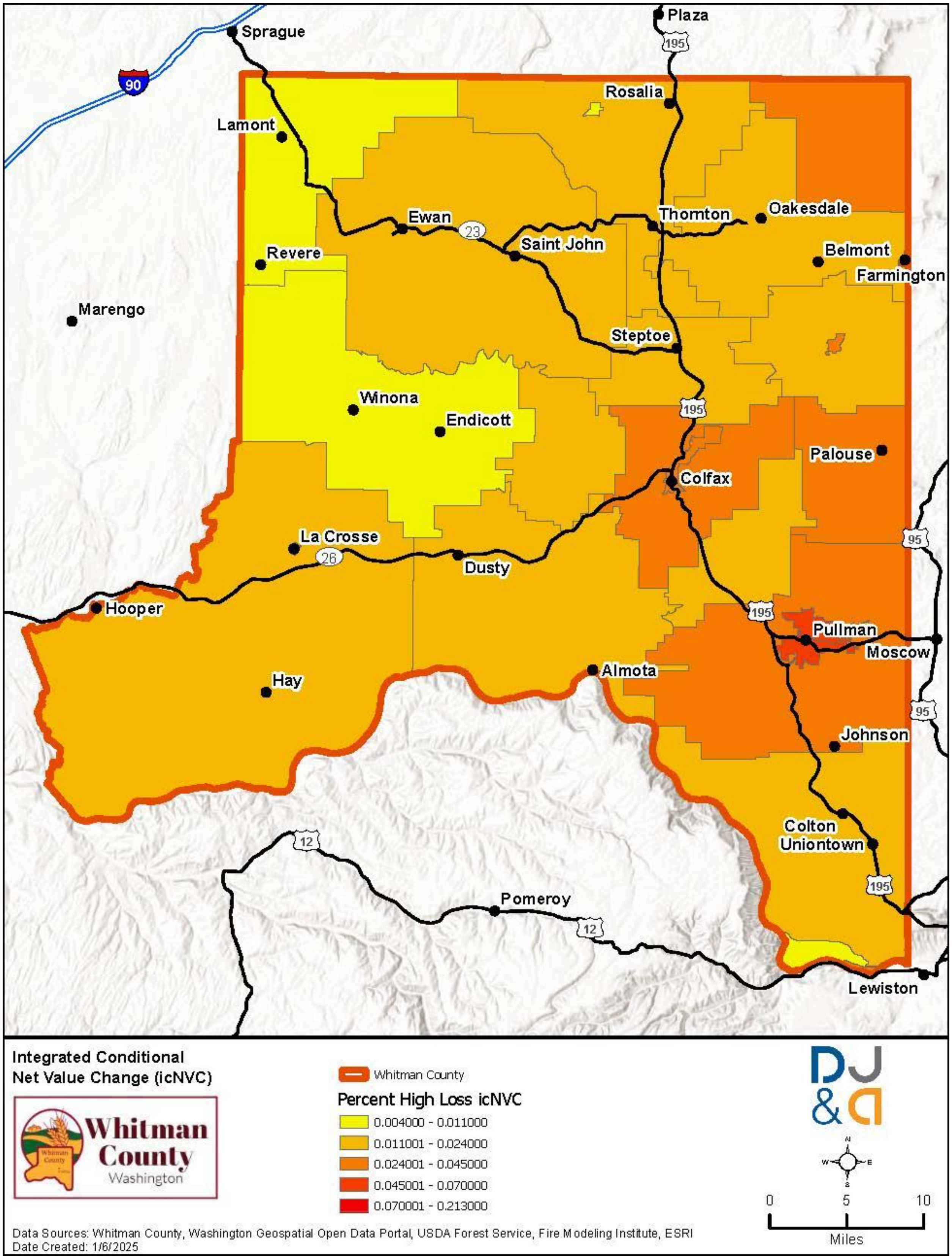

Figure 14 Proportion of High Loss icNVC per Fire District

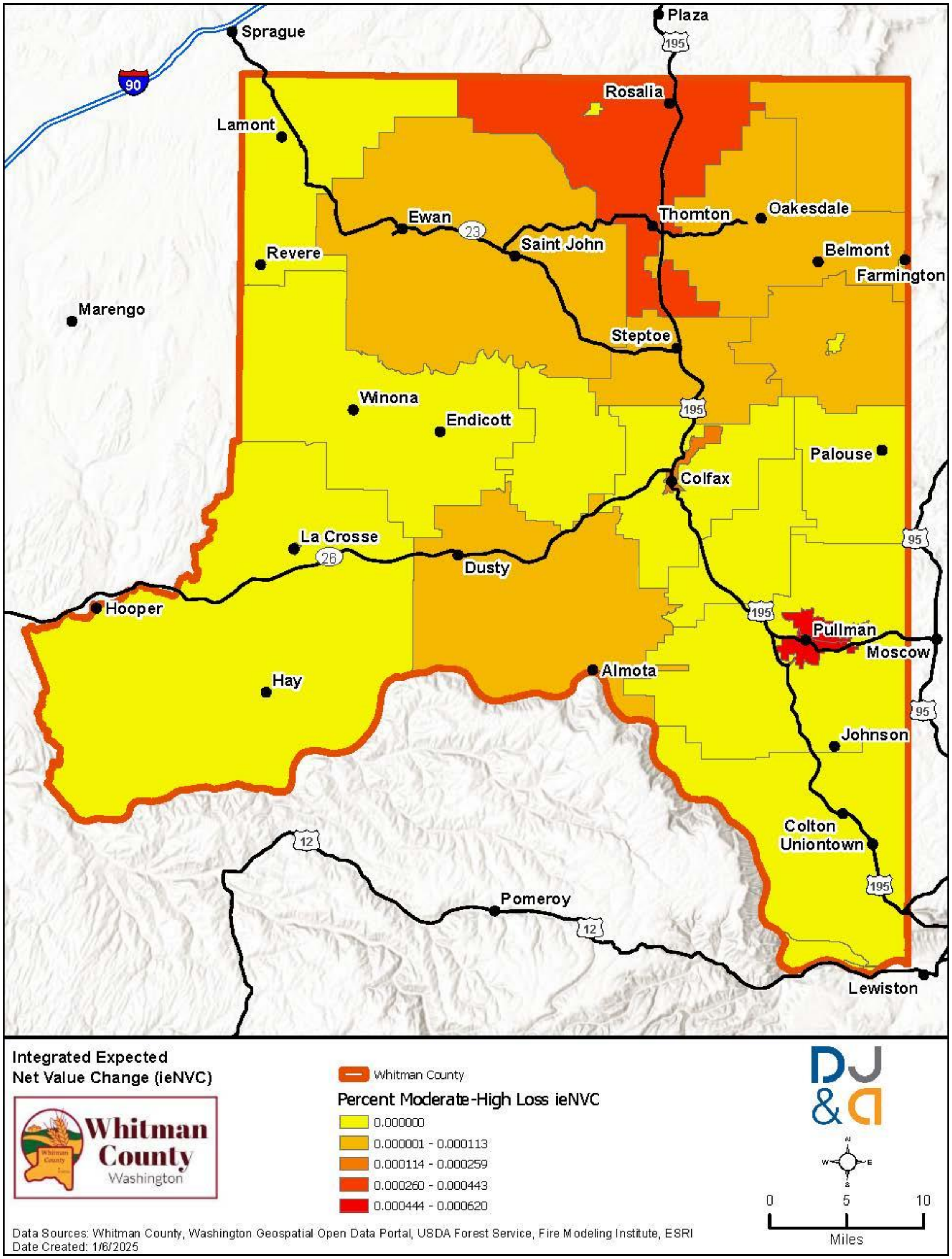

Figure 15 Proportion of Moderate-High Loss ieNVC per Fire District

Another metric that can be used to characterize wildfire exposure is the Community Wildfire Risk Reduction Zones (CWiRRZ). These zones represent areas where mitigation activities can be the most effective at reducing the risk of structure losses from wildfire (Dillon et al. 2024). There are four Risk Reduction Zones in total, consisting of Minimal Exposure Zones, Indirect Exposure Zone, Direct Exposure Zones, and Wildfire Transmission Zone. The Wildfire Transmission Zone can be broken out into more specific fuel types including Tree, Shrub, Grass, Agriculture, Non-Vegetated, Water, and Outlying Wildlands (i.e., area beyond 2.4 km from buildings) (Figure 16). These zones can be used to identify areas where certain types of mitigations may be the most effective. More information about CWiRRZ can be found at the USFS Wildfire Risk to Communities webpage[6]. Figure 17 provides an overview of the Zones throughout the County, with corresponding acreages in Table 10.

Table 10 CWiRRZ in Whitman County

Community Wildfire Risk Reduction Zones (CWiRRZ)	Acres
Outlying Wildlands	53,554
Direct Exposure	53,122
Indirect Exposure	22,035
Water	14,071
Minimal Exposure	5,530
Wildfire Transmission Zone: Agriculture	741,222
Wildfire Transmission Zone: Grass	365,866
Wildfire Transmission Zone: Shrub	89,543
Wildfire Transmission Zone: Non-Vegetated	30,677
Wildfire Transmission Zone: Tree	12,068
Total	**1,387,687**

Figure 16 Burning grass-dominated fuel during the Snake River Fire

[6] https://wildfirerisk.org/

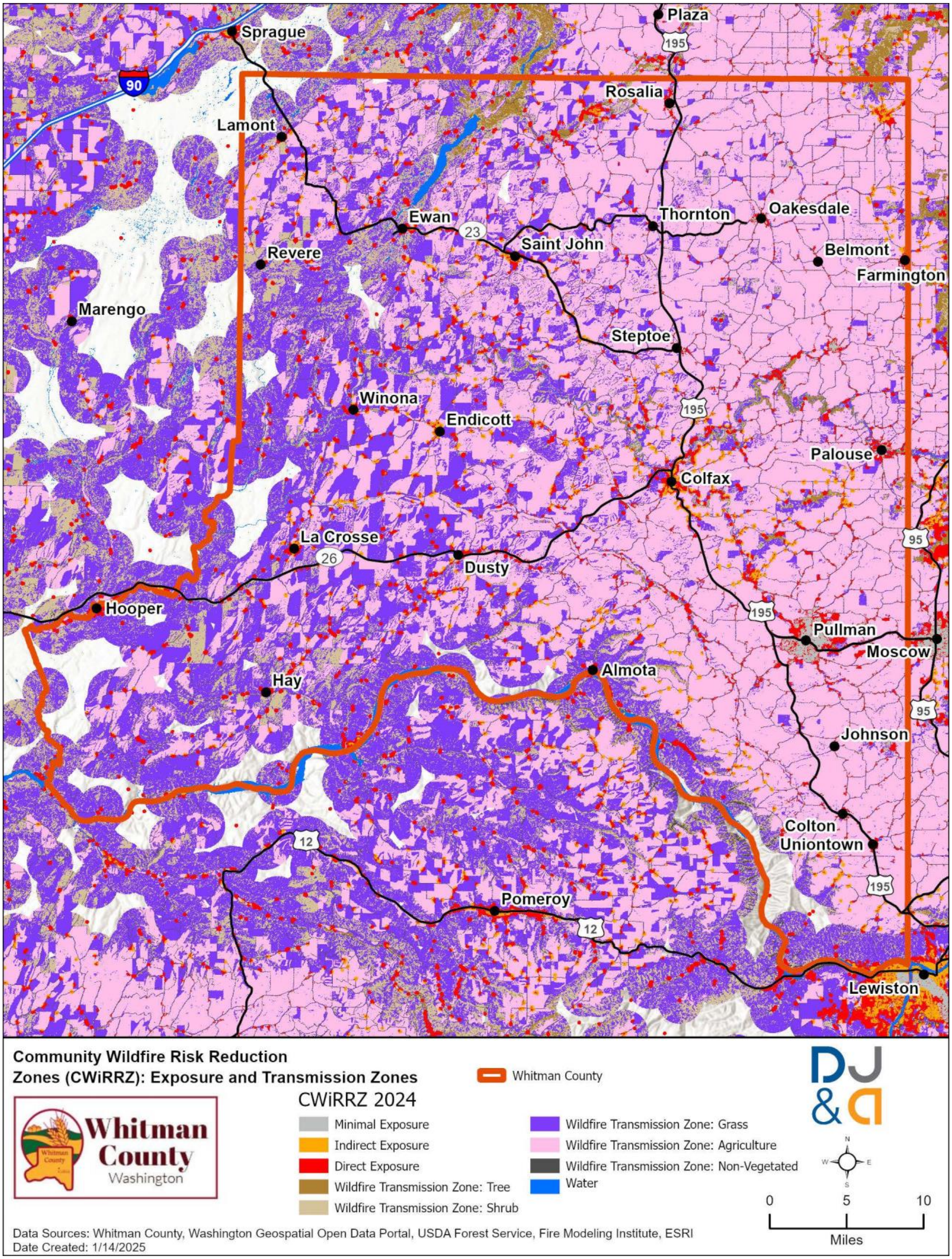

Figure 17 CWiRRZ: Exposure & Transmission Zones

Section 3: Implementation

3.1. Integrating the National Cohesive Strategy

The Federal Land Assistance, Management, and Enhancement Act of 2009 (FLAME) aimed to provide improved resources and funding opportunities for wildfire suppression on federal lands (43 USC § 1748). As part of this effort, Congress required the development of a cohesive strategy to ensure nationwide consistency of wildfire management on federal, state, local, and tribal lands. Known simply as the National Strategy, it was developed cooperatively by a wide variety of governments and land management agencies, wildfire experts, and public stakeholders. The National Strategy guides wildfire planning efforts by establishing core guidelines to be used when developing CWPPs and emergency responses, prioritizing projects, and educating and equipping the public to protect their property from wildfire.

The National Cohesive Strategy focuses on three goals, listed below:

1) Restoring and Maintaining Resilient Landscapes
2) Fire Adapted Communities
3) Safe and Effective Wildfire Response

The interdisciplinary team incorporated each of these national priorities when preparing the CWPP, thereby ensuring consistency with the National Strategy. The result is a CWPP which prioritizes healthy and functional ecosystems through treatment activities, equips property owners with the knowledge and resources to protect their homes against wildfire, and identifies wildfire response capacity.

Restore and Maintain Resilient Landscapes

Though a natural and essential component of the ecosystem, the role of wildland fire has been altered through fire suppression, changing climatic conditions, declining forest health, increasing human activity, and human development and alteration of the landscape. These changes have resulted in conditions that reduce landscape resiliency and increase the potential for increased wildfire activity and severity. Landscape restoration through proactive management reinstates resiliency and promotes natural fire activity across the landscape to maintain the beneficial ecological impacts of wildfire while mitigating risk. Once restored, ongoing maintenance through management is essential to perpetuate healthy, resilient landscapes.

Restoration and maintenance on the landscape can be achieved through various management actions related to vegetation and fuels, including: prescribed fire, managing wildfire for resource objectives, and mechanical, biological, and chemical fuels treatments. Mechanical, biological, and chemical fuels treatments include: thinning, commercial harvest, slash and underburning, slash and pile burning, herbicide application, reseeding, replanting, and more. Given the scale of fuels treatments needed to restore resilient landscapes, prioritization is critical to allocate resources effectively. These various treatment types can be implemented in priority areas where feasible and sustainable to reduce wildfire risk, improve ecological conditions, and achieve fire adapted and resilient landscapes.

Fire Adapted Communities

The National Wildfire Coordinating Group (NWCG) defines a fire adapted community as a community that "takes mitigation actions so they can live with wildfire without harm and without extensive wildfire suppression efforts." Promoting fire adapted communities focuses on adaptation through fire mitigation strategies, public education and applicable policies and regulations. Fire mitigation strategies may include using fuel treatments and individual homeowner action to help protect life and property during a wildfire event. Public education and outreach about wildfire preparedness can help the public understand their role in promoting fire adapted communities and protecting private property. Updating policies and regulations like building and subdivision codes can ensure fire resilience for future development.

Living with Fire

Building fire adapted communities is a constantly evolving process that includes taking actions to reduce the risk of wildfire, educating residents about becoming fire adapted, and designing tools that support the community. Fire is a natural part of the ecosystem, but communities at risk can take steps to reduce negative impacts when a wildfire does occur.

Steps that homeowners can take to become more fire adapted include reducing the ignition potential of their home and the 100–200 feet of area surrounding it, called the Home Ignition Zone (HIZ). This involves home hardening (using ignition resistant construction materials and techniques) and maintaining adequate defensible space within the HIZ through management of vegetation and other combustible materials on the property (Figure 18). An ignition resistant HIZ reduces the risk of loss by creating a home and property that is better able to defend itself from wildfire. The National Fire Protection Association's Firewise USA® Program provides guidelines that help inform homeowners about specific actions for home hardening and HIZ treatments. The WA DNR provides a variety of recommendations for specific actions homeowners can take to reduce their vulnerability to wildfire.

Figure 18 Burnt vegetation next to destroyed structure (Malden Fire)

Recommendations to Reduce Structural Ignitibility

Resource managers reduce the risk of wildfire damage to private property through fuel reduction projects on state and federal lands, establishing fuel breaks and buffers, and wildfire suppression. However, property owners are responsible for helping create fire adapted communities by reducing the structural ignitability of their own property. In many cases, these efforts incorporate the same techniques used by local, state, and federal resource managers.

Measures to reduce structural ignitability vary from property to property depending on parcel size, the location of structures within the parcel, building age, construction and materials, existing vegetation and fuel loads, access to water, and more. Despite property-level variation, the same basic concepts apply in all cases.

Fire propagation requires fuel. Reducing the ignition potential within the HIZ, with priority given to the home/structure and the first five feet surrounding it, is the most effective way for structures to withstand a wildfire. One of the most common ways that homes catch fire is by wind-driven embers which can travel up to a mile away from active wildfires and ignite buildings by landing on flammable exterior materials. These embers can also indirectly ignite flammable vegetation or materials located close to the home, resulting in direct flame contact or radiant heat exposure to the home (Restiano et al. 2020). As such, property owners can reduce structural ignitibility by preventing flames and embers from accessing fuels within the building itself, a technique known as “hardening.” Implementing hardening and creating ignition resistant homes and properties, collectively, saves homes and creates fire adapted communities (Figure 19).

Figure 19 Burned residential areas after the Malden Fire

Common techniques for reducing structural ignitability include:

- Building or retrofitting structures with ignition resistant materials and techniques (i.e., Class A roofing, ignition resistant siding, boxed eaves, covered gutters, metal gutters kept clear of debris, screened vents, etc.)
- Maintaining a non-combustible zone within the five feet surrounding the home by removing all flammable materials and vegetation, using ignition resistant ground cover (e.g., decorative rock instead of wood mulch), and sparsely placed fire adapted plants if vegetation is desired.
- Keeping the area 5–30 feet from the home clean and green by providing adequate spacing between trees, removing ladder fuels and ground litter, keeping vegetation healthy and hydrated, and using walkways, patios, or driveways to create fuel breaks.
- Pruning trees 6–10 feet up from the base of the tree and keeping lawns well-watered and mowed.
- Clearing flammable materials away from propane tanks and firewood stacks and ensuring that both are located at least 30 feet away from the home.

Homeowner Resources

Because each property is unique, organizations such as Firewise USA®[7] and Ready, Set, Go![8] provide resources to help residents determine the best options for reducing structural ignitibility. These resources include further reading and recommendations, illustrations, step-by-step guides, evacuation checklists, and more that can be used when planning, completing projects, or discussing wildfire preparedness within a community.

In Washington, property owners can also receive professional assessments regarding wildfire risk and forest health from the USFS and WA DNR foresters as well as wildfire mitigation specialists. The WA DNR provides free wildfire risk assessments and site visits to provide tailored recommendations for property owners to better prepare for wildfire[9]. The WA DNR also provides guidance for homeowners interested in mitigating wildfire risk within their communities including suggestions for home hardening, evacuation planning, and reducing ignition potential. WA DNR provides a number of resources that can help communities and individuals become resilient to wildfire events. In Whitman County, local conservation districts offer technical and financial assistance related to wildfire risk mitigation for homeowners residing within respective district boundaries. Visit the following websites to learn more:

- Whitman Conservation District[10], Rock Creek Conservation District[11], Pine Creek Conservation District[12], Palouse Conservation District – Wildfire Resiliency[13]
- Landowner Assistance Portal[14]
- Cost-Share for Wildfire Resilience and Forest Health Treatments[15]

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[7] https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA
[8] https://www.wildlandfirersg.org/s/?language=en_US
[9] https://www.dnr.wa.gov/programs-and-services/wildfire/wildfire-preparedness
[10] https://whitmancd.org/
[11] https://www.rocklakecd.org/
[12] https://pinecreekcd.org/
[13] https://www.palousecd.org/wildfire-resiliency
[14] https://www.dnr.wa.gov/LandownerAssistancePortal
[15] https://www.dnr.wa.gov/cost-share

- Community Resilience Resource Library[16] & Forest Resilience Digital Library[17]
- Washington State Fire Adapted Communities Learning Network[18]Wildfire Ready Neighbors[19]

Grants and Funding

There are several opportunities for grants and funding opportunities available to communities and organizations to promote fire adapted communities. As of 2025, the Washington Department of Natural Resources Firewise USA® Site Micro Grant became available. This grant assists communities with implementation of mitigation strategies identified in their Firewise USA® Action Plans. Cost-share opportunities also exists for qualifying forested areas within Central and Eastern Washington through WA DNR. Although there is not currently a grant program available to assist individual homeowners with home hardening, local governments can use grant funds to support the development of programs that serve this purpose in addition to providing funding for projects that mitigate wildfire risk in adjacent federal and state lands.

Education and Outreach

Wildfire mitigation strategies are most effective when there is robust participation from all stakeholders. It is important to engage the community through education and outreach to mitigate the human hazards of wildfire. Public education campaigns such as Ready, Set, Go! and Firewise USA® bring communities together to prepare for wildfire. Becoming a Firewise USA® community gives residents access to resources, funding, and community support (Firewise USA 2022). There are currently no Firewise USA® communities in Whitman County, but residents can take action to organize a Firewise USA® community at any time (Firewise USA 2022). Similar education and outreach efforts are already underway in the County through local conservation districts.

Safe and Effective Wildfire Response

One of the most important roles of a CWPP is to identify wildfire response capacity and processes. The interdisciplinary team that developed the CWPP included members of the Whitman County Office of Emergency Management, community preparedness and wildfire prevention specialists, and both federal and local fire department representatives (Figure 20). As a result, the CWPP has identified specific strategies to increase wildfire response capacity and improve communication across various resource groups.

[16] https://www.dnr.wa.gov/community-wildfire-resilience-resource-library
[17] https://www.dnr.wa.gov/DigitalLibrary
[18] https://www.fireadaptedwashington.org/
[19] https://wildfireready.dnr.wa.gov/

Figure 20 2018 Palouse Fire

Resources & Capacity

Local firefighting resources are skilled, trained, and equipped to respond to WUI wildfire incidents and often work closely with federal wildland firefighting resources supplied by the BLM and WA DNR. Mutual aid agreements are also in place among local fire departments and federal agencies throughout the County as well as adjacent counties. Fire resources are currently insufficient to meet suppression needs, and increased capacity is essential to ensure that wildfire response can effectively respond to, confine, and manage wildfire incidents. The CWPP includes detailed strategies and projects that support increased fire response capacity. Whitman County contains 18 Fire Districts and three Fire Departments, as listed below and illustrated in Appendix C.

- Albion - Fire District 11
- Colfax - Fire District 11
- Colfax Fire-Department
- Colton/Uniontown - Fire District14
- Diamond - Fire District 11
- Dusty/Almota/Onecho-Fire District13
- Endicott - Fire District 6
- Fire District 12
- Garfield - Fire District 3
- Lacrosse - Fire District 8
- Lamont - Fire District 5
- Malden Fire Department
- Oakesdale/Farmington-Fire District10
- Palouse - Fire District 4
- Pullman Fire Station 1
- Pullman Fire Station 2
- Pullman Moscow Airport Fire Department
- Rosalia - Fire District 7
- St John - Fire District 2
- Steptoe - Fire District 11
- Tekoa - Fire District 1

Preparation & Prevention

In the County, wildfire preparation and prevention activities are a cooperative effort between city, county, state, and federal agencies. Fire preparedness actions may include: public education, home hardening, clearing of the home ignition zone, or planning for evacuation. Fire prevention actions include campaigns to educate the public about the dangers of human-caused fires and risk reduction measures, such as fire restrictions or burn bans. Although fire is a natural part of the ecosystem, some fires may pose a threat to human life or property. The CWPP facilitates the development of new programs to support wildfire preparedness and prevention throughout the County.

Figure 21 2018 Palouse Fire

Wildfire Response

When a wildfire occurs in the County, a crew staffed by a local fire department is dispatched to the incident via the local dispatch center: Whitcom. In the event that an incident will extend beyond one operational period, and all local resources have been expended, or an immediate resource need is required, a “State Mobilization” request for assistance is made.

Emergency Management

The Whitman County Comprehensive Emergency Management Plan (CEMP provides a detailed overview of how the County has planned to respond to emergencies ranging from flood to wildfire. Within the CEMP, an evacuation strategy is outlined which can include both sheltering in-place or evacuations from a defined area, such as would apply in the case of a wildfire event. Coordination of firefighting, emergency medical services, and technical rescue activities in the event of an emergency such as wildfire is also outlined within the CEMP. The Office of Emergency Management’s website also provides extensive resources to help individuals throughout the County learn more about available resources and proactively plan for emergency events.

Post-Fire

Recovering from a wildfire is a difficult task for the community. Homes, businesses, and other community assets may have been lost or damaged during the fire. Residents returning to their homes may face significant property damage even if the home did not burn (Figure 22). Soil in burned areas is unstable, often causing flash flooding and slides. Post-fire recovery planning helps mitigate safety hazards to the community and identifies resources to help residents recover from wildfire. Although the County does not currently have a post-fire recovery plan, the CWPP promotes the development of a plan, along with other public education and wildfire response strategies. Resources useful after a disaster can be found via the County Office of Emergency Management website[20].

Figure 22 Post-fire debris from the Malden Fire

[20] https://www.whitmancounty.org/264/Emergency-Management

3.2. Implementation

Goals, Objectives, & Strategies

The CWPP implementation plan (Appendix A) and associated action table (Appendix B) were developed to clearly outline roles, responsibilities, and timelines for various projects that will facilitate the implementation and achievement of the goals, objectives, and strategies outlined within the CWPP. The CWPP defines goals, objectives, and strategies as follows:

Goal: A broad, long-term desired result

Objective: A measurable, specific action that serves to achieve a **Goal**

Strategy: A method to achieve specific **Objectives.** Multiple **Projects** can be related to a given Strategy.

Action Plan

The action plan consists of various projects with assigned types, responsibilities, and timeframes. Each strategy involves at least one stakeholder but often requires the collaborative efforts of multiple interested stakeholders from the County, federal and state agencies, local fire departments, and other entities. Other stakeholder groups may be integrated into the action plan as new strategies are developed in the coming years and roles are further defined. Wherever possible, timelines to complete each strategy are included within the action table in order to best capture the overarching timeline to facilitate achievement of larger goals and objectives defined for the CWPP.

3.3. Future Actions

The CWPP is designed to function as a living document with updates occurring as-needed. It is anticipated that additional goals, objectives, and strategies will be added as conditions and needs change for the County. The format of the action plan will facilitate easy integration of these elements.

CWPP Monitoring

In order to monitor progress accurately and consistently towards the goals, objectives, and strategies outlined within the CWPP, the action plan will be reviewed annually. The Whitman County Department of Emergency Management will lead this effort. During this review, any completed strategies will be updated and any pending additions or revisions to the CWPP document or supporting resources will be implemented. In order to remain relevant and useful, CWPPs should be fully updated once every five to ten years (WA DNR 2023).

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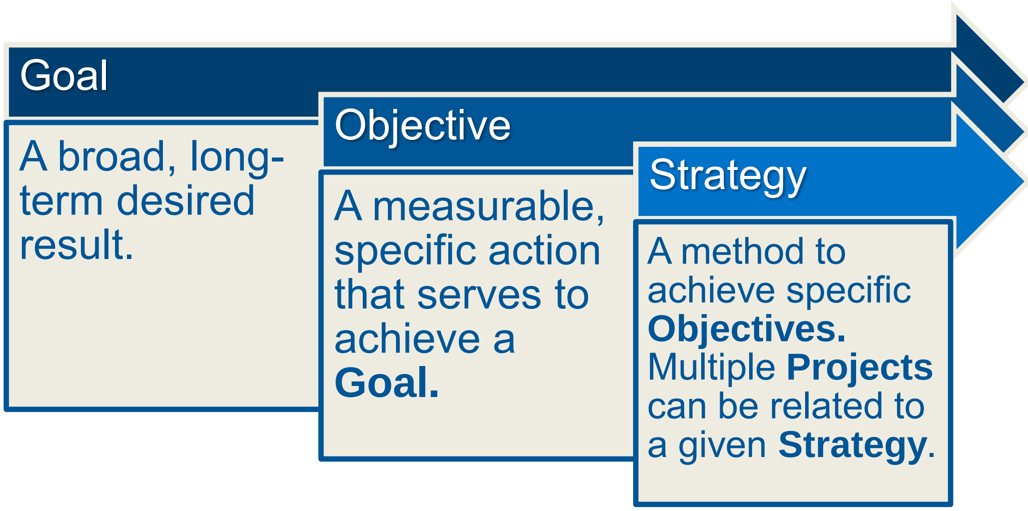
Appendices

Appendix A: Implementation – Goals, Objectives, and Strategies



Goal 1: Restore and Maintain Landscapes

Objective 1.1 Reduce fuel loading by supporting and implementing fuels treatments

Strategy 1.1.1 Implement the following fuels treatments to accomplish resource objectives: thinning, prescribed fire, commercial harvest, slashing, underburning, pile burning, chipping, thinning, prescribed/targeted grazing, herbicide

Objective 1.2 Promote characteristic wildfire activity appropriate to natural fire regimes and resource objectives

Strategy 1.2.1 Identify strategic locations for new fuel breaks and buffers

Strategy 1.2.2 Improve and maintain existing fuel breaks and buffers

Strategy 1.2.3 Identify, improve, and maintain road buffers

Strategy 1.2.4 Facilitate and maintain cross-boundary collaboration to implement fuels reduction projects across multiple jurisdictions including privately-held lands

Strategy 1.2.5 Implement treatments that promote characteristic wildfire activity on the landscape

Objective 1.3 Implement post-fire recovery activities

Strategy 1.3.1 Support the implementation of recovery and restoration activities such as reseeding and replanting following wildfire events

Strategy 1.3.2 Support the development and implementation of a Post-Fire Recovery Plan that provides a framework for efficient and effective allocation of resources after a wildfire event

Strategy 1.3.3 Increase local capacity for post-fire response personnel and resources

Objective 1.4 Reduce insect and disease outbreaks and spread

Strategy 1.4.1 Support and implement projects that use approved methods to control insect and disease such as: micronutrients, pesticides, attractants, aggregants, anti-aggregants, and pheromones

Objective 1.5 Use the best available science to inform CWPP goals, objectives, and strategies

Strategy 1.5.1 Facilitate the collection and/or analysis of updated data such as aerial imagery, surveys, etc. that would improve the implementation of projects associated with this CWPP

Goal 2: Fire Adapted Communities

Objective 2.1 Improve and maintain public education to reduce wildfire risk and structural ignitability

Strategy 2.1.1 Improve public access to existing educational resources

Strategy 2.1.2 Develop new educational opportunities/programs for residents

Strategy 2.1.3 Support and implement efforts to increase capacity for additional personnel, groups, or programs to implement and coordinate services that support fire adapted communities within the County.

Strategy 2.1.4 Provide an updated platform for public access to CWPP resources that integrates with existing resources

Strategy 2.1.5 Establish a CWPP Monitoring Committee to ensure that the CWPP remains updated, relevant, and is communicated effectively among stakeholders

Objective 2.2 Support and implement mitigation treatments within priority areas within the County

Strategy 2.2.1 Continue to develop projects within priority areas within the County

Objective 2.3 Support and implement county policies, land use planning, and regulations that reduce wildfire risk

Strategy 2.3.1 Incorporate the CWPP and associated recommendations to reduce structural ignitability into applicable subdivision regulations

Strategy 2.3.2 Integrate the CWPP with developing land use planning documents

Objective 2.4 Reduce human-caused ignitions.

Strategy 2.4.1 Work with utility companies to reduce ignition risk and identify opportunities for mitigation

Strategy 2.4.2 Improve and maintain public communication to reduce human-caused ignitions

Strategy 2.4.3 Provide training and resources for utilizing prescribed fire on private lands

Goal 3: Wildfire Response

Objective 3.1 Increase/improve water supply for fire suppression

Strategy 3.1.1 Identify alternate water resources

Strategy 3.1.2 Support the implementation of design alternatives that improve fire suppression and response capabilities within subdivision planning documents

Strategy 3.1.3 Construct additional water resources for fire suppression

Objective 3.3 Improve emergency notification and information communications

Strategy 3.3.1 Identify methods to increase communication efficacy and accessibility in the event of a wildfire

Strategy 3.3.2 Ensure communication and notification methods are inclusive of vulnerable populations

Strategy 3.3.3 Support the development of mitigation actions and planning related to wildfire smoke public health issues

Strategy 3.3.4 Support the development of a Public Health Response for Wildfire Smoke Events Plan

Strategy 3.3.5 Consider wildfire smoke responses in future planning efforts

Strategy 3.3.6 Support the procurement and designation of funding to mitigate public health risks and issues related to wildfire smoke

Objective 3.4 Facilitate and maintain cross-boundary collaboration to improve wildfire response efforts.

Strategy 3.4.1 Coordinate with neighboring agencies and landowners to identify potential opportunities for collaboration

Strategy 3.4.2 Establish a Wildfire Response Working Group to improve communications and collaborative response efforts across groups and jurisdictions

Objective 3.5 Improve emergency response and mobilization efforts

Strategy 3.5.1 Develop an evacuation plan that identifies evacuation routes, reception/distribution areas, shelter locations, staging areas, and access control points.

Objective 3.6 Increase response capacity

Strategy 3.6.1 Obtain funding for additional personnel, training, and equipment to improve wildfire response capacity and efficacy

Strategy 3.6.2 Identify and fund additional positions within volunteer fire departments or other key wildfire response personnel

Appendix B: Implementation – Action Table

Whitman County Community Wildfire Protection Plan – Action Table

Jump To:

Table B-10 Infrastructure & Business Action Items

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Infrastructure & Business					
Infrastructure & Business	Utility Infrastructure Hardening	Coordinate with utility providers and support the implementation of projects that reduce ignition potential and wildfire risk surrounding utility infrastructure. Potential projects may include: reducing spark-ignition events, grid hardening, vegetation management, public safety power shutoffs, utility relocation and retrofitting (i.e., buried power lines, replacement of wooden power poles), equipment upgrades, personnel training, inspections, data integration and collection, and other project activities that reduce the risk of wildfire in Whitman County.	TBD	Whitman County[21]	**Lead**: Whitman County Department of Emergency Management **Support**: Inland Power and Light Company, Avista, other utility providers
Infrastructure & Business	Power System Redundancy	Implement alternate/supplemental power system redundances to maintain service if disrupted by wildfire.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management **Support**: Inland Power and Light Company, Avista, other utility providers

[21]The location 'Whitman County' includes, but is not limited to, the following communities: Colfax, Pullman, Tekoa, Palouse, Farmington, Oakesdale, Colton, Garfield, Uniontown, Rosalia, St. John, Endicott, Malden, Albion, Lamont, LaCrosse, Steptoe, Pine City, Thornton, Sunset, Ewan, Elberton, Diamond, Winona, Dusty, Hooper, Hay, Almota, and Johnson.

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Infrastructure & Business					
Infrastructure & Business	Insurance Coverage	Identify opportunities to coordinate wildfire risk mitigation strategies or policies that improve insurance protections. Provide resources for individuals to review their respective insurance coverage and understand its provisions, limitations, and requirements pertaining to wildfire and smoke damage.	TBD	Whitman County	**Lead**: Whitman County
Infrastructure & Business	Crop Insurance Coverage	Consider insurance for agricultural commodities with potential to be damaged by wildfire. Identify opportunities for improved insurance protections through wildfire risk mitigations.	TBD	Whitman County	**Lead**: Whitman County
Infrastructure & Business	Targeted & Prescribed Grazing	Implement innovative grazing techniques to reduce fuel loading and reduce wildfire risk. Identify strategic locations to implement targeted and prescribed grazing activities using a variety of livestock types, as appropriate.	TBD	Whitman County	**Lead**: Whitman County

Table B-11 Landscape Treatments Action Items

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Landscape Treatments					
Landscape Treatments	Debris Removal	Support fuels reduction activities that remove accumulated natural and artificial fuels from public and private lands. Consider funding and cost-share to subsidize costs to homeowners.	TBD	Whitman County	**Lead**: Whitman County
Landscape Treatments	Conservation Planning & Easements	Coordinate with local conservation districts, state, federal, and county entities to promote landscape resiliency through fuels treatments, vegetation management, prescribed fire, and restoration practices that reduce the risk of uncharacteristic wildfire events while maintaining ecological function.	TBD	Whitman County	**Lead**: Whitman County
Landscape Treatments	Roadside Wildfire Hazard Reduction	Fuels treatments along roadways with substantial invasive grasses and other flammable fuel sources.	TBD	Whitman County	**Lead**: Whitman County
Landscape Treatments	Fire-resistant Plantings	Provide educational and training opportunities to implement fire-resistant species (e.g., FireResistantPlantsEastWA2021.pdf (wsu.edu)).	TBD	Whitman County	**Lead**: Palouse Conservation District

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Landscape Treatments					
Landscape Treatments	Fuels Reduction & Funded Mitigation Work	Identify appropriate mitigations for vegetation communities found in Whitman County. Fund positions to implement mitigation measures such as seasonal field crews.	TBD	Whitman County	**Lead**: Palouse Conservation District
Landscape Treatments	Resilient Landscapes	Open space management of community spaces; consider wildfire in landscape management and/or landscaping decisions in publicly owned properties.	TBD	Whitman County	**Lead**: Whitman County
Landscape Treatments	Wind Break Maintenance	Prioritize wind break maintenance to reduce wildfire risk.	TBD	Whitman County	**Lead**: Whitman County

Table B-12 Partnership & Community Engagement Action Items

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Partnerships & Community Engagement					
Partnerships & Community Engagement	Landscape Restoration	Connect with collaborative groups and other community-based groups that foster landscape level restoration.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Partnerships & Community Engagement	Develop Partnerships	Connect and/or support non-government and other community-based groups to foster collective action through educational programs on wildfire preparedness, response, and recovery.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Partnerships & Community Engagement	Support Ongoing Partnerships	Support the ongoing partnership between Whitman County and the Palouse Conservation to provide home and structure wildfire risk assessments and recommendations, home hardening and defensible space projects, fuels reduction, restoration activities, and community events.	TBD	Whitman County	**Leads**: Whitman County & Palouse Conservation District
Partnerships & Community Engagement	Coordination with NOAA	Support the implementation of the Weather-Ready Nation Ambassador Program.	TBD	Whitman County	**Lead**: NOAA

Table B-13 Prevention Action Items

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Prevention					
Prevention	Ignition Prevention	Conduct an ignition prevention campaign that communicates best practices to avoid human-caused ignitions. Focus public messaging during fire season and around holidays and harvesting. Identify common ignition sources such as: fireworks, heavy machinery/farm equipment use, debris pile burning, dragging trailer chains, off-road vehicle use, and mowers. Provide recommendations to reduce the risk of ignitions such as installing spark arrestors.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Prevention	Ignition Prevention	Evaluate the need for additional tools to address ignition risk and implement as-needed. These tools may include burn permits, fire restrictions, reduced motorized travel during high fire risk weather, and direct communication methods for reporting ignitions.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Prevention	Ignition Prevention	Modify burn restrictions to include the use of fireworks county-wide. Coordinate with local fire departments to determine appropriate seasonal fire restrictions.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management **Support:** Local Fire
Prevention	Fire Prevention	Work with partners to conduct County-wide fire prevention messaging campaigns to provide resources and communicate prevention actions.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Prevention					
Prevention	Fuel Breaks	Evaluate potential to utilize agricultural lands as fuel breaks, particularly those adjacent to communities or highly valued resources and assets. Consider irrigation, fuel moisture content, presence of volatile organic compounds, and harvest timing as key factors related to fuel break efficacy.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management

Table B-14 Public Health Action Items

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Public Health					
Public Health	Smoke Preparedness	Partner with public health, medical centers, and other medical providers and educators to provide education and resources for the community, individuals, and outdoor workers during periods of wildfire smoke exposure. Support the development of clean air shelters, improves/upgraded air filtration systems, residential HEPA filter programs, and public information regarding wildfire smoke and mitigations.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Public Health	Smoke Preparedness – Outdoor Workers & Personal Protective Equipment	Partner with public health, medical centers, and other medical providers and educators, to provide education and resources for individual and outdoor worker smoke protection. Support the use of personal protective equipment for outdoor workers during periods of high smoke exposure.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Public Health	Social Services & Mental Health	Utilize existing social programs and partner with mental health services to provide mental health services to populations affected by wildfires.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Public Health					
	Social Services	Utilize existing programs to help relocate, provide housing, and meet the needs of populations affected by wildfire. Consider potential impacts and needs of unhoused populations affected by wildfire.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Public Health	Wildfire Smoke Communication	Maintain clear communication with the public regarding wildfire smoke and associated air quality.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management

Table B-15 Recovery Action Items

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Recovery					
Recovery	Post-fire Recovery Program	Support post-fire recovery program development in Whitman County thru VOAD's or other similar Long-Term Recovery Groups.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Recovery	Post-fire Landscape Management	Implement restoration and natural resource management actions such as re-seeding, erosion-control, replanting, and hazard tree removal.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Recovery	Post-fire Assessment	Assessment of recovery—private lands BAER assessments or community assessments on housing, infrastructure, economic and/or other essential functions.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Recovery	Resources for Fire-affected Populations	Residents, community members, and others impacted by wildfire assistance programs (e.g., temporary housing, partnerships, and program development).	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Recovery					
Recovery	Suppression Rehabilitation	Support suppression rehabilitation with Incident Management Teams to incorporate work for private lands rehabilitation during different recovery periods (dozer line rehab, water bars, and other measures).	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management

Table B-16 Regulations, Policy, & Plans Action Items

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Regulations, Policy, & Plans					
Regulations, Policy, & Plans	Codes, Ordinances, & Land Use Standards	Support the development of building codes, ordinances, and land use standards that reduce wildfire risk.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management

Table B-17 Resident Mitigation Action Items

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Resident Mitigation					
Resident Mitigation	Wildfire Education Program	Develop a public wildfire education program for Whitman County residents and visitors focused on safety, public engagement, and community resilience.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)
Resident Mitigation	Public Education—Education & Resources	Compile available educational resources pertaining to structure hardening, commercial building preparedness, defensible space, sprinklers/water supply, fuel mitigations, Firewise USA® and other community-based initiatives, homeowner and renter guidance, mitigation incentives, training opportunities, insurance, and potential secondary income streams that promote residential mitigation.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)
Resident Mitigation	Public Education—Community Events & Engagement	Host community events that provide the public with relevant information for mitigating wildfire risk on their properties and in their communities. Support engagement between local government, local fire, federal and state agencies, and interested stakeholders.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC) **Support**: Palouse Conservation District

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Resident Mitigation					
Resident Mitigation	Public Education—Landowner Skills	Develop and host skills training events to promote safe and effective mitigation activities such as prescribed burning, thinning, pile burning, stay and defend practices, and vegetation restoration.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC) **Support**: Palouse Conservation District
Resident Mitigation	Funding/Cost-share Wildfire Risk Mitigations Programs	Develop County programs to provide funding and/or cost-share for individuals to implement recommended wildfire risk mitigations.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)
Resident Mitigation	Funding/Cost-share & Resources for New Construction & Retrofitting	Develop a program to assist homeowners and developers with the construction or retrofitting of buildings and landscapes that reduce wildfire risk and promote resilient communities. Provide information and pursue cost-share/funding for structure hardening, home hardening, and defensible space.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Resident Mitigation					
Resident Mitigation	Home Ignition Zone/Landscape Assessment Programs	Support the continued development of programs that provide home ignition zone and landscape assessments. Continue to develop long-term partnerships among interested stakeholders, Whitman County, and local fire departments to support the implementation of these programs. Increase program services to recruit, train, assess properties for wildfire risk, provide recommendations, and connect homeowners to available resources to mitigate wildfire risk and promote resilient communities.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management – Emergency Communications Advisory Committee (ECAC)
Resident Mitigation	Firewise USA®® Communities /Community-led Mitigation	Support the establishment of Firewise USA® Programs and/or the implementation of Firewise USA®-recommended practices to reduce community wildfire risk. Plan and implement community-wide clean-up, chipper, and debris/vegetation removal events. Provide free chipping and debris disposal services, and provide the landfill with compensation for composting the material.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management – Emergency Communications Advisory Committee (ECAC)

Table B-18 Safety & Evacuation Action Items

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Safety & Evacuation					
Safety & Evacuation	Coordination with the C-CEMP	Coordinate all safety & evacuation actions with the *Whitman County Coordinated Comprehensive Emergency Management Plan* (C-CEMP).	N/A	Whitman County	**Lead**: Whitman County Department of Emergency Management
Safety & Evacuation	Mass Care Shelters	Designate additional mass care shelters within communities (e.g., schools, fairgrounds, sports facilities, churches) and implement upgrades as-needed to ensure functionality (e.g., generators, Wi-Fi, kitchens, air filters, sleeping areas, restrooms, showers, parking).	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Safety & Evacuation	Community Safety Zones	Identify areas within the community, surrounding area, and which meet the NWCG definition of 'safety zone'. Ensure that these areas are clearly delineated and communicated through public messaging and physical signage. Designate safety zones along evacuation routes (i.e., "sheltering points"). Explore options such as harvested fields, parking lots, gravel quarries, etc.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Safety & Evacuation	Evacuation Route Evaluation & Improvements	Evaluate existing evacuation routes and individual communities for efficacy and redundancy. Upgrade and/or construct additional evacuation routes and ingress/egress routes as-needed. Implement physical signage if appropriate.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Safety & Evacuation					
Safety & Evacuation	Evacuation Routes & Emergency Communications	Develop and publish information about evacuation routes, evacuation alternatives, and emergency communications that clearly explain what to expect and how to safely react to emergency situations.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Safety & Evacuation	Emergency Communications—Improvements	Support improvements to emergency communication systems via: acquisitions, construction, design, equipping, financing, improvement, maintenance, operations, remodeling, testing, training, and/or repairs. Ensure accessibility across all emergency communications.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)
Safety & Evacuation	Emergency Communications—Operations	Support the development of detailed emergency communication protocols that integrate with the C-CEMP. Encourage communities to develop backup, redundant communication systems such as phone trees, social media, and/or specific community signals. Support implementation of periodic evacuation drills and post-drill discussions.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)
Safety & Evacuation	Individual Emergency Preparation	Provide examples and information for GO bags/Ready Kits and individual Preparedness Plans. Purchase and distribute supplies locally for the community and/or during public events.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)

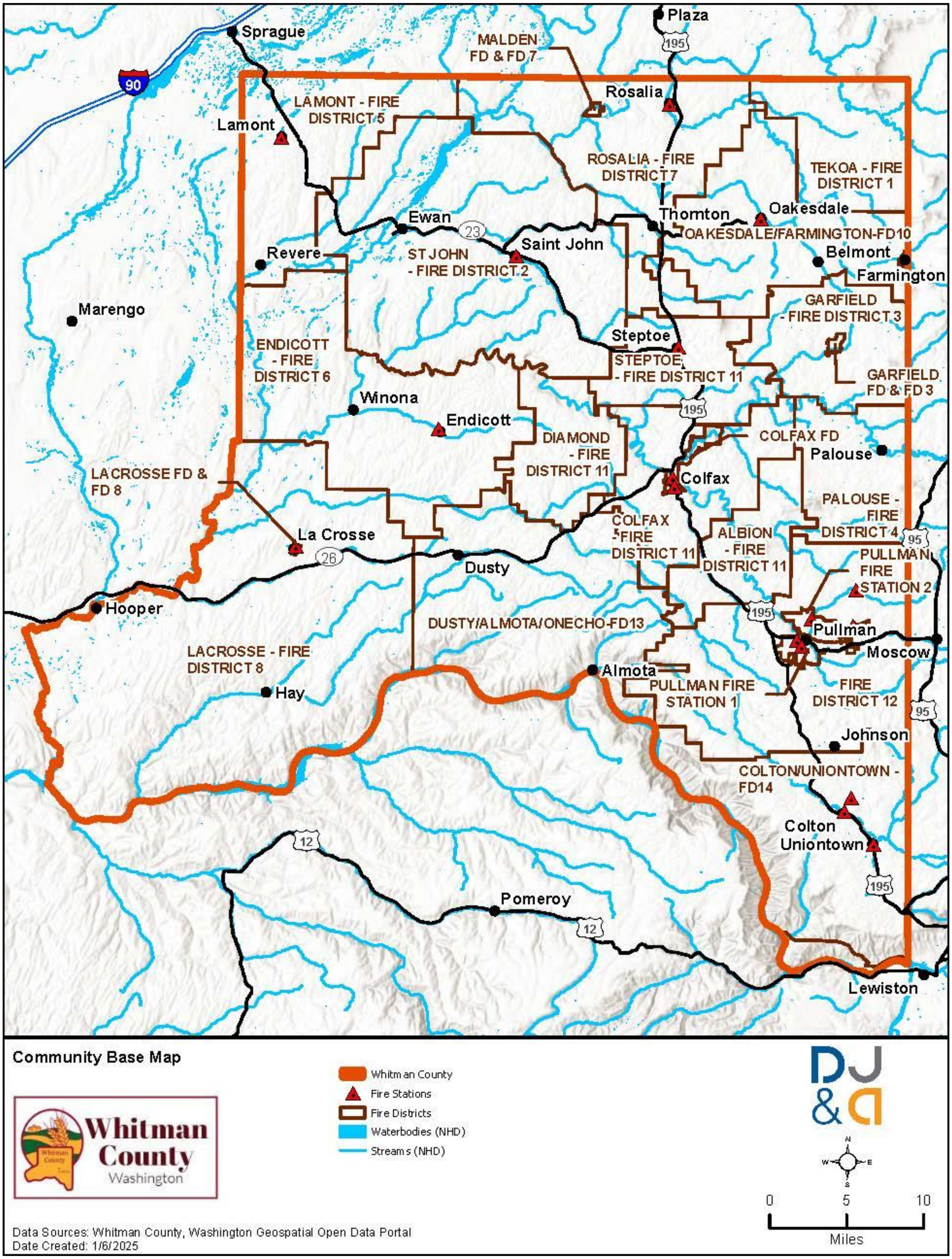
Table B-19 Wildfire Response Action Items

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Wildfire Response					
Wildfire Response	Contracting Pathways—Air Support/Mutual Aid	Support the development of a county-wide contract for air support to facilitate quick, local air support when needed.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)
Wildfire Response	Capacity—Personnel	Increase funding for permanent, seasonal, part-time, and temporary positions as needed to increase response capacity.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)
Wildfire Response	Capacity—Equipment	Increase funding for equipment purchases to increase capacity and reduce response times.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Wildfire Response					
Wildfire Response	Communication Equipment Improvements	Update and improve communication towers. Support the construction of new communication towers to address dead zones throughout the County.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)
Wildfire Response	Communication Equipment Efficiency	Improve communication efficiency by updating equipment, coordinating with supporting entities, and rehearsing response scenarios to identify, mitigate, and avoid communication breakdowns.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)
Wildfire Response	Capacity Detection	Purchase and/or upgrade equipment to improve wildfire detection and subsequent mobilizations. Consider partnerships with utility providers or landowners or lessees to secure funding.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management—Emergency Communications Advisory Committee (ECAC)
Wildfire Response	Fire Protection District Combination	Evaluate Fire Protection Districts and determine where merging may confer increased benefit to the County through efficient allocation of resources. Support the merging of appropriate FPDs if necessary.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management

Project Type	Project Name	Description	Estimated Cost	Location	Responsibility
Wildfire Response					
Wildfire Response		Fund paid Fire Chief positions within Volunteer Fire Departments.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management
Wildfire Response	Critical Infrastructure GIS Data	Utilize existing data sources and County data to develop a GIS map layer of critical infrastructure for planning. Include infrastructure with adverse response to wildfire events such as: transmission lines, substations, combustible bridges, above-ground fiber backbone, and emergency communications infrastructures.	TBD	Whitman County	**Lead**: Whitman County Department of Emergency Management

Appendix C: Maps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ROSALIA - FIRE DISTRICT 7
TEKOA - FIRE DISTRICT 1
Thornton
Oakesdale
Ewan
OAKESDALE/FARMINGTON-FD10
Saint John
Revere
ST JOHN - FIRE DISTRICT 2
Belmont
Farmington
GARFIELD - FIRE DISTRICT 3
Marengo
Steptoe
ENDICOTT - FIRE DISTRICT 6
STEPTOE - FIRE DISTRICT 11
GARFIELD FD & FD 3
Winona
Endicott
DIAMOND - FIRE DISTRICT 11
COLFAX FD
Palouse
LACROSSE FD & FD 8
Colfax
PALOUSE - FIRE DISTRICT 4
COLFAX - FIRE DISTRICT 11
ALBION - FIRE DISTRICT 11
La Crosse
PULLMAN FIRE STATION 2
Dusty
Hooper
DUSTY/ALMOTA/ONECHO-FD13
Pullman
Moscow
LACROSSE - FIRE DISTRICT 8
Almota
PULLMAN FIRE STATION 1
FIRE DISTRICT 12
Hay
Johnson
COLTON/UNIONTOWN - FD14
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Uniontown
Pomeroy
Lewiston
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Community Base Map
Whitman County
Fire Stations
Fire Districts
Waterbodies (NHD)
Streams (NHD)
Whitman County Washington
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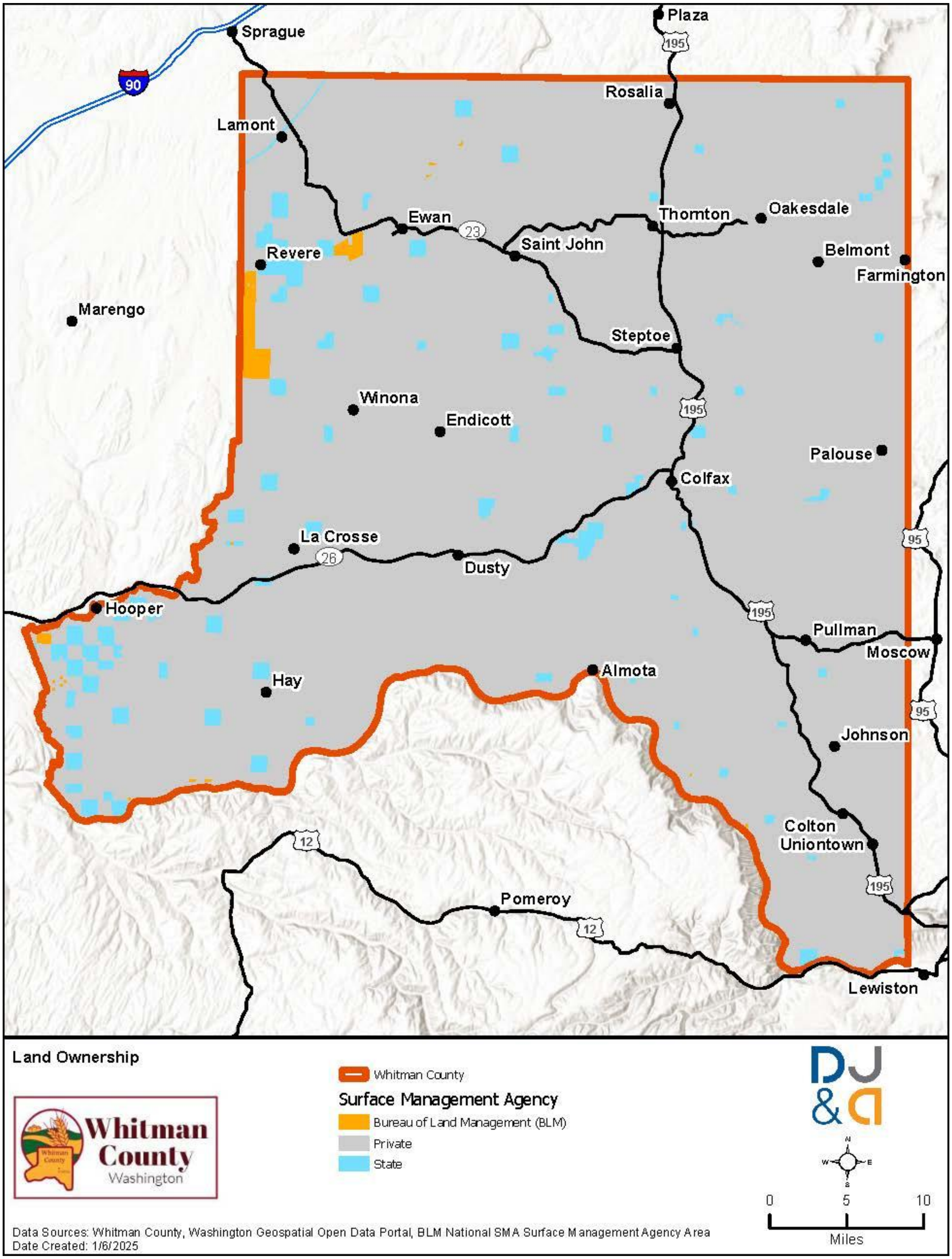
Miles
Data Sources: Whitman County, Washington Geospatial Open Data Portal
Date Created: 1/6/2025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Dusty
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Almota
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Pomeroy
Lewiston
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Whitman County
Surface Management Agency
Bureau of Land Management (BLM)
Private
State
Whitman County Washington
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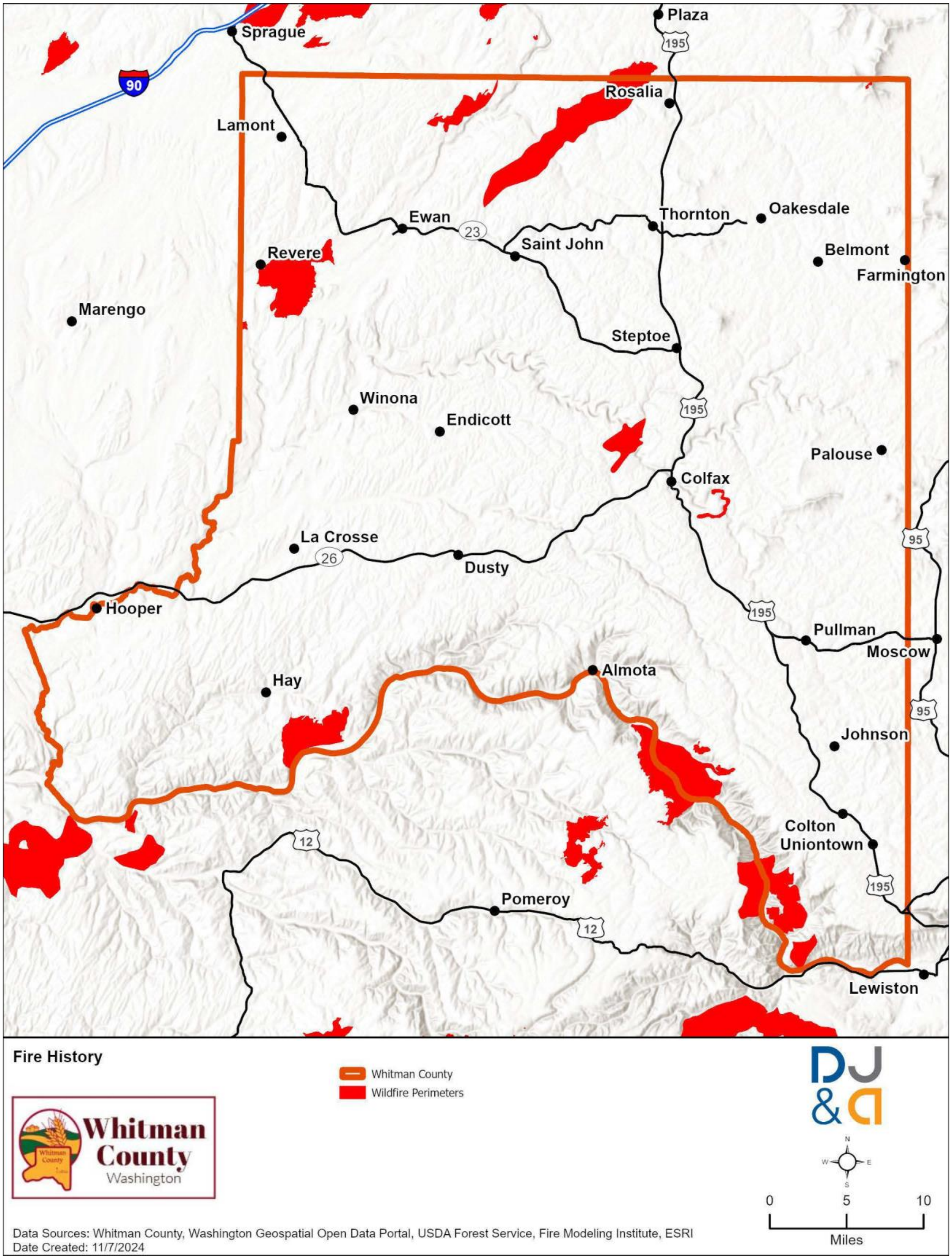
Date Created: 1/6/2025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Fire History
Whitman County
Wildfire Perimeters
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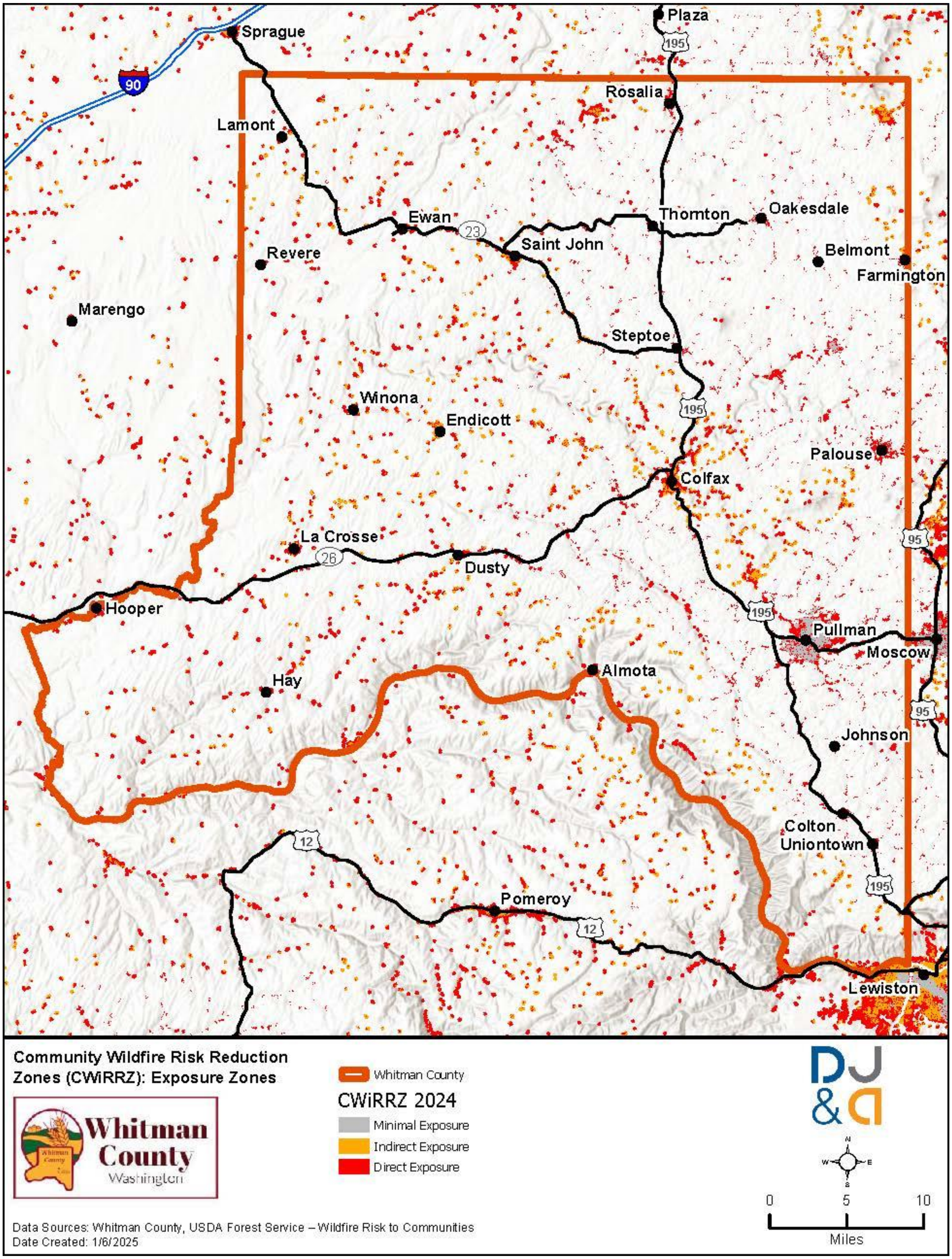
Date Created: 11/7/2024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Lewiston
Community Wildfire Risk Reduction Zones (CWiRRZ): Exposure Zones
Whitman County
Washington
Whitman County
CWiRRZ 2024
Minimal Exposure
Indirect Exposure
Direct Exposure
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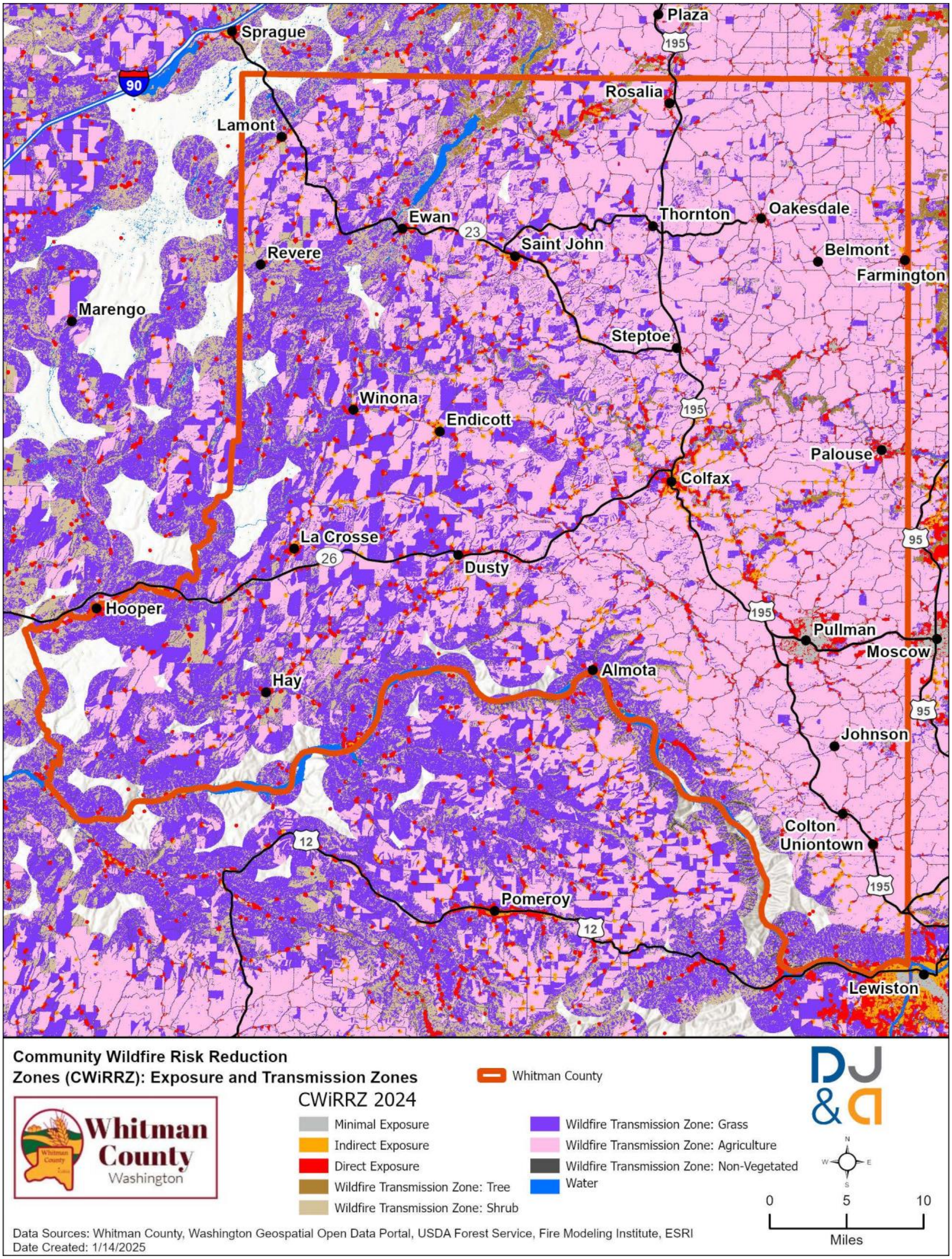
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Lewiston
Community Wildfire Risk Reduction Zones (CWiRRZ): Exposure and Transmission Zones
Whitman County
CWiRRZ 2024
Minimal Exposure
Indirect Exposure
Direct Exposure
Wildfire Transmission Zone: Tree
Wildfire Transmission Zone: Shrub
Wildfire Transmission Zone: Grass
Wildfire Transmission Zone: Agriculture
Wildfire Transmission Zone: Non-Vegetated
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Whitman County Washington
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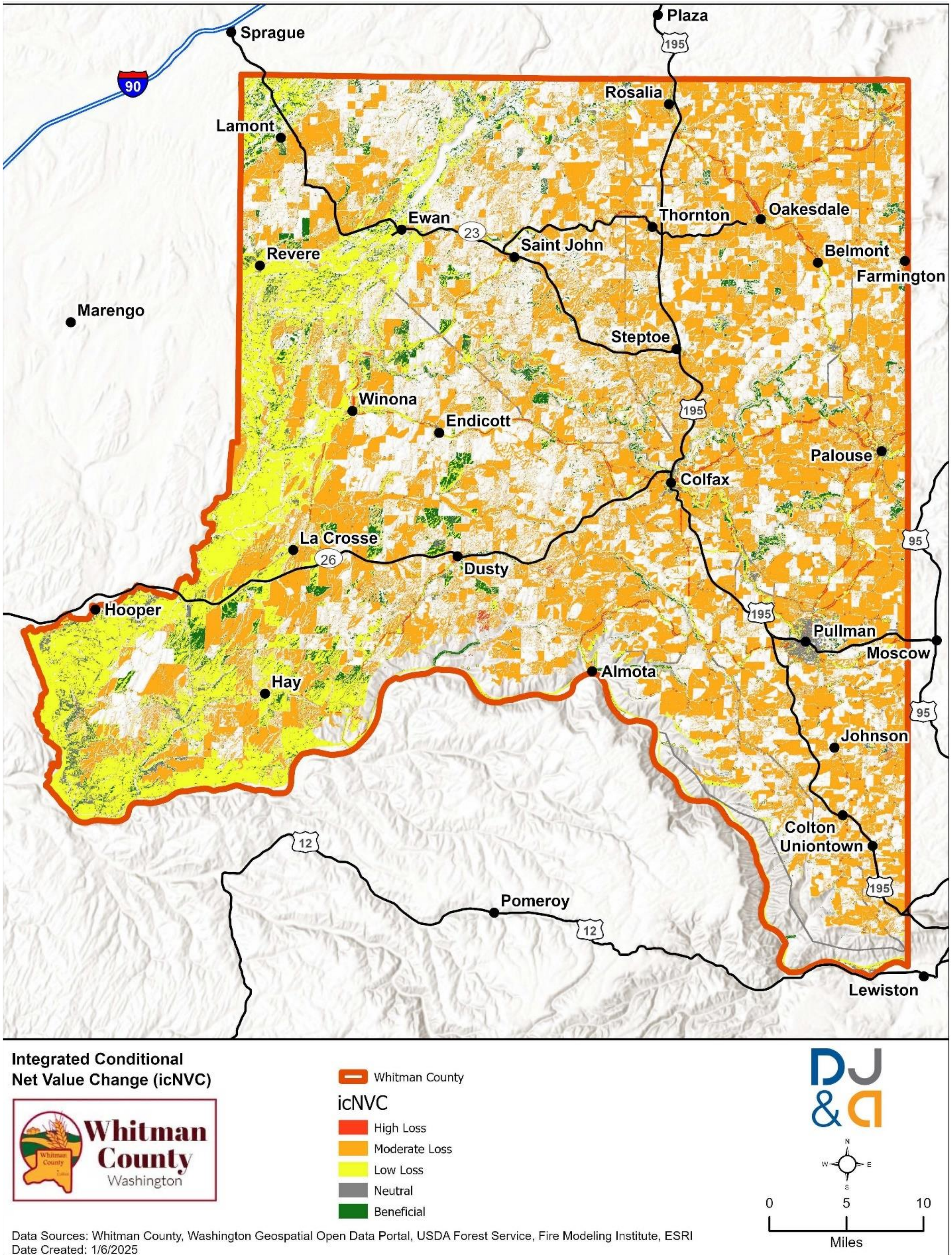
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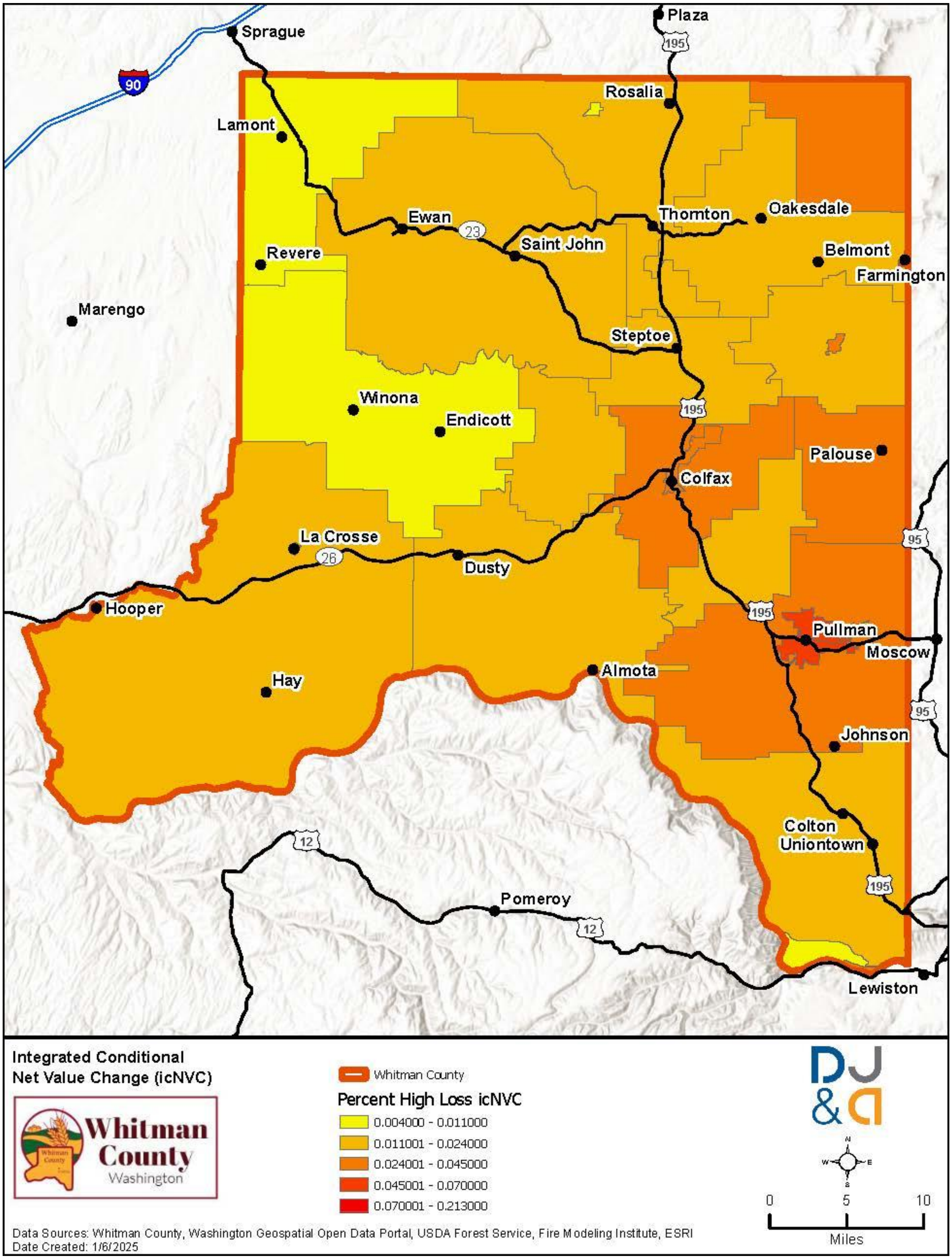
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Whitman County
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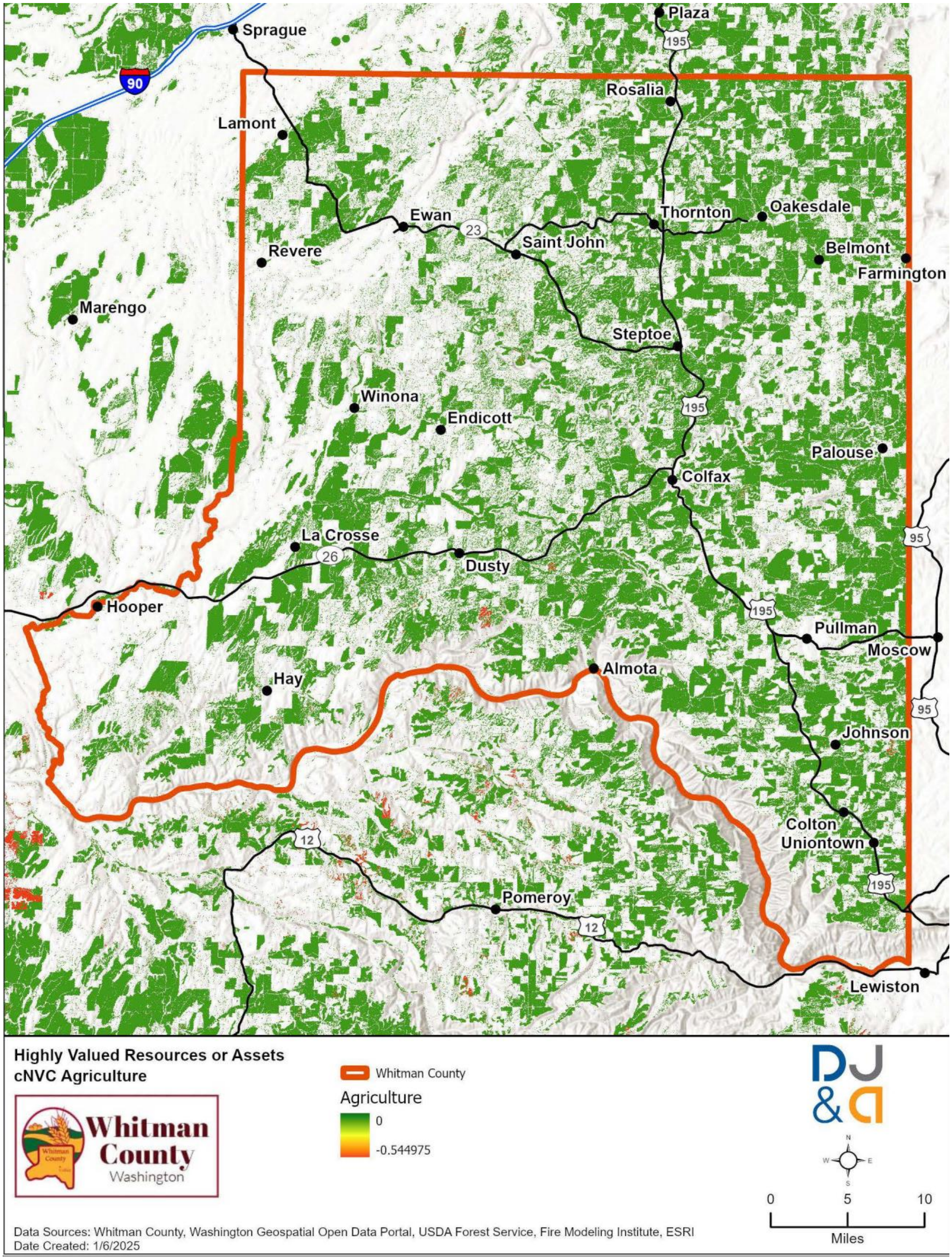
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Highly Valued Resources or Assets
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Whitman County
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Data Sources: Whitman County, Washington Geospatial Open Data Portal, USDA Forest Service, Fire Modeling Institute, ESRI
Date Created: 1/6/2025


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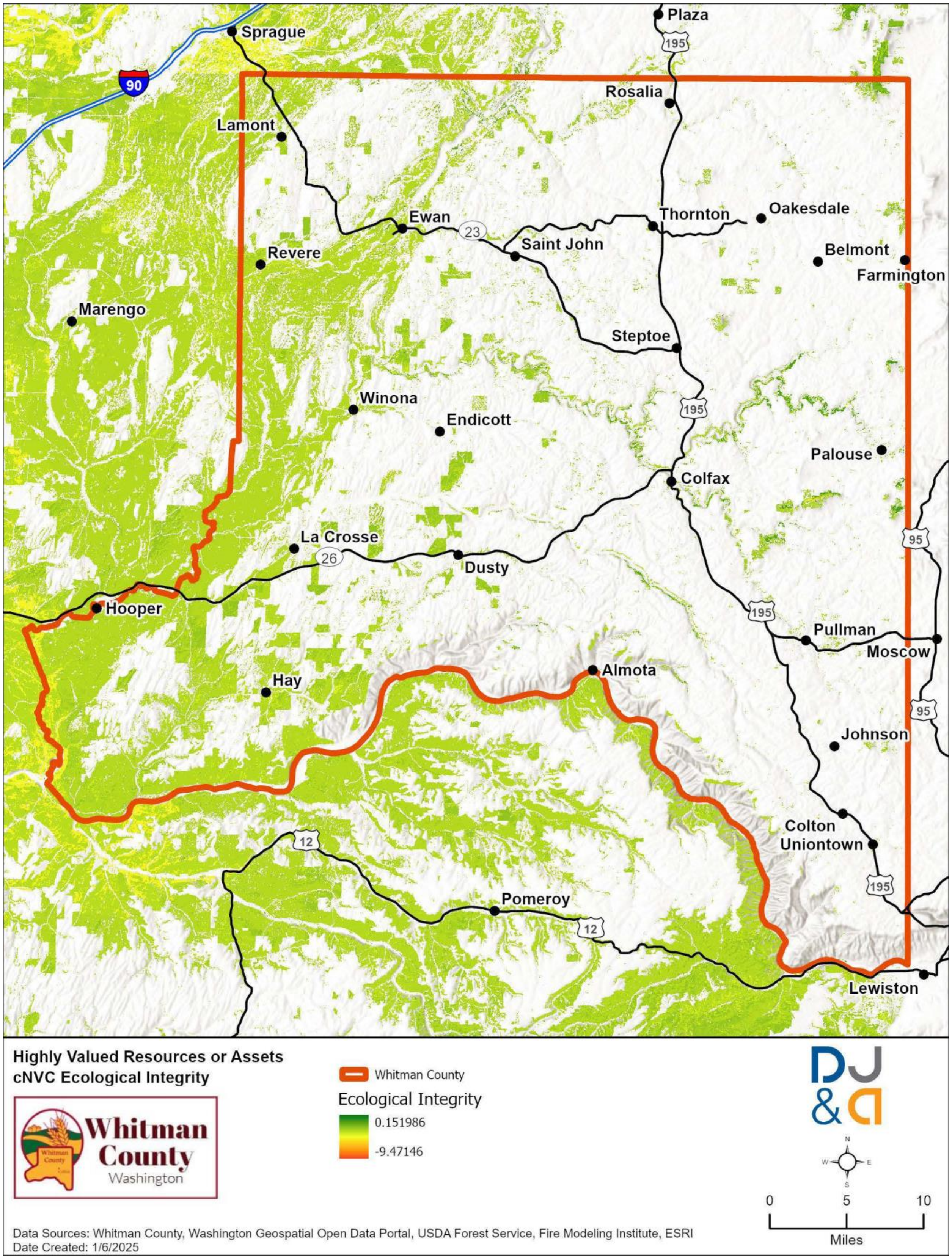
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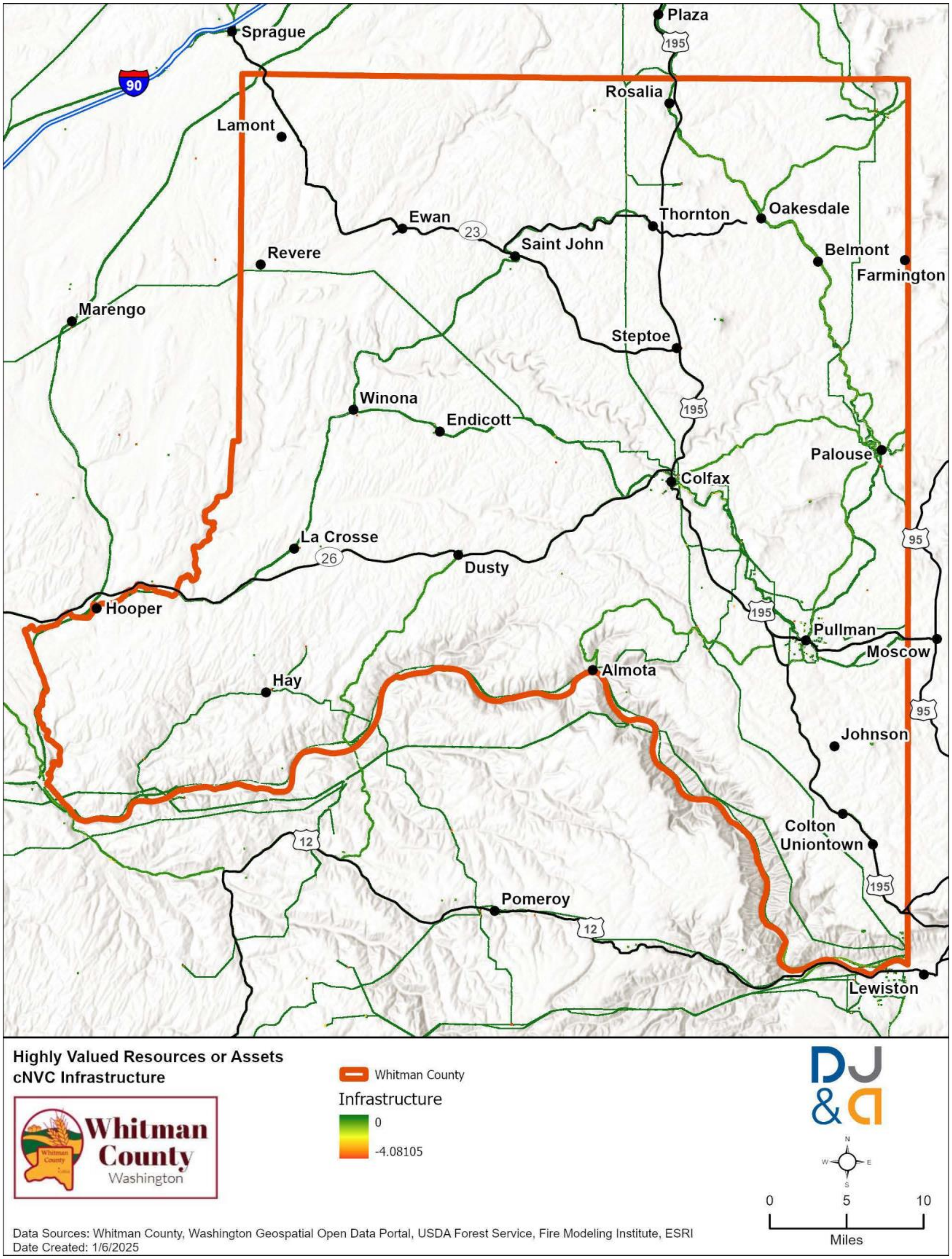
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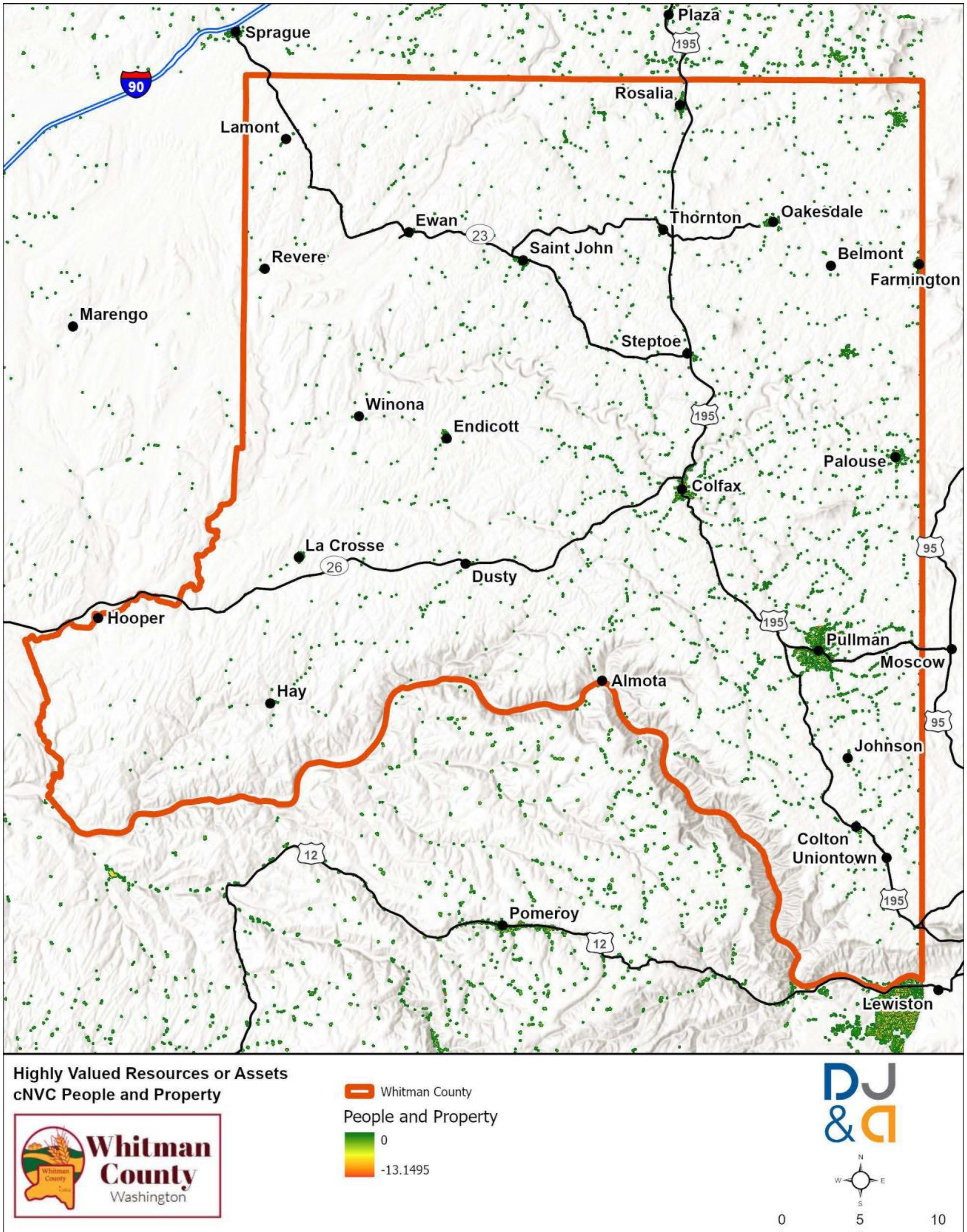

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Highly Valued Resources or Assets
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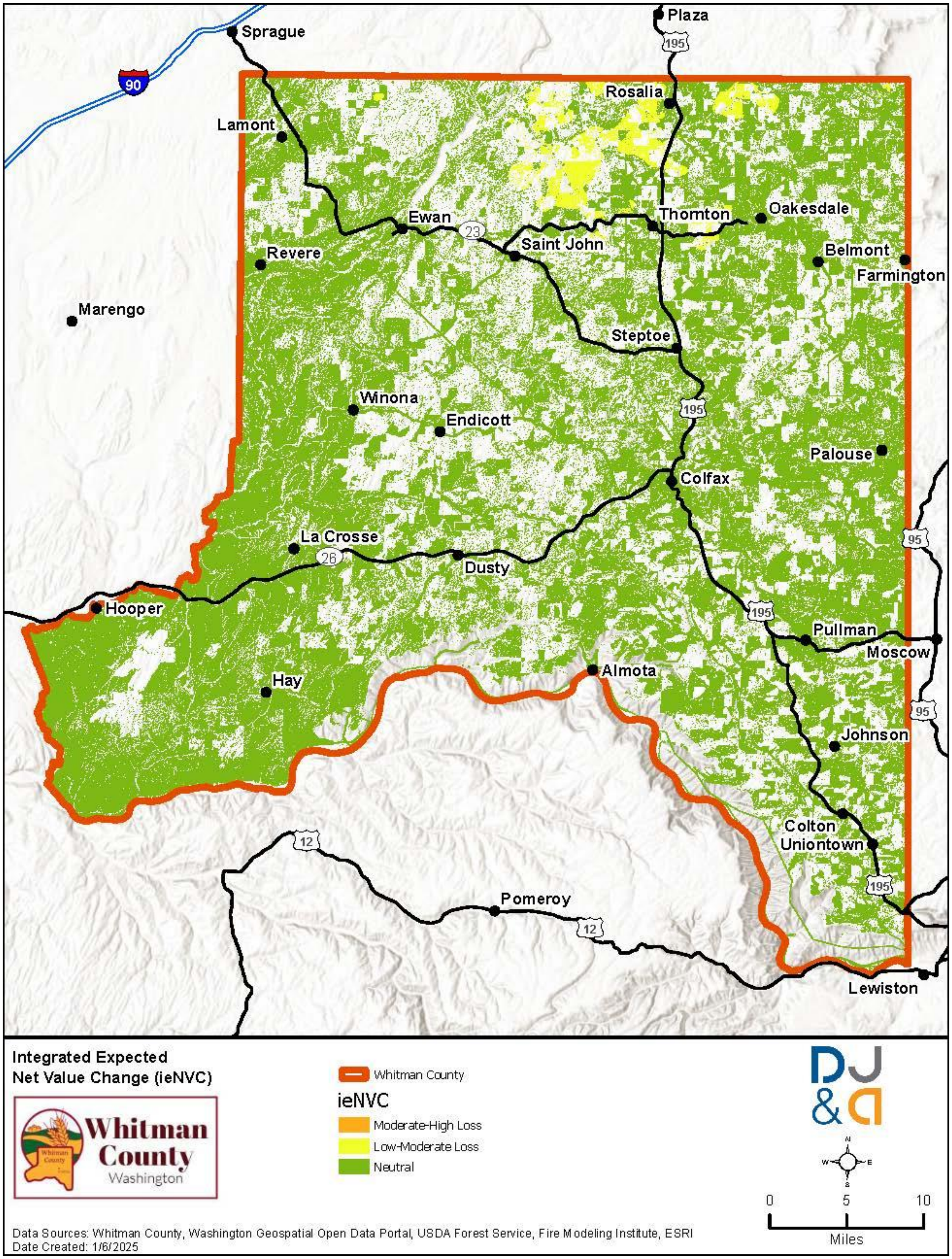
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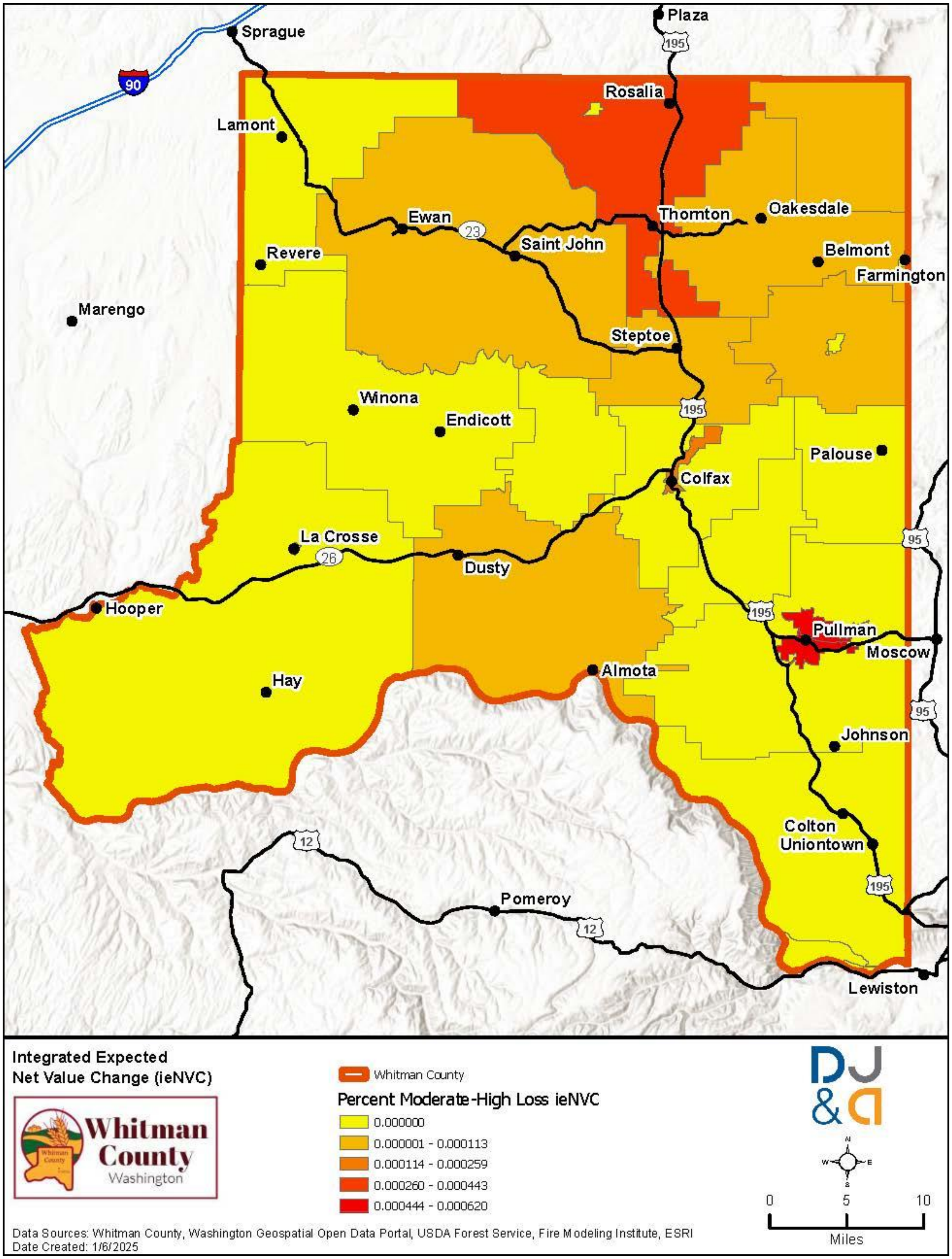
Date Created: 1/6/2025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Integrated Expected
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Percent Moderate-High Loss ieNVC
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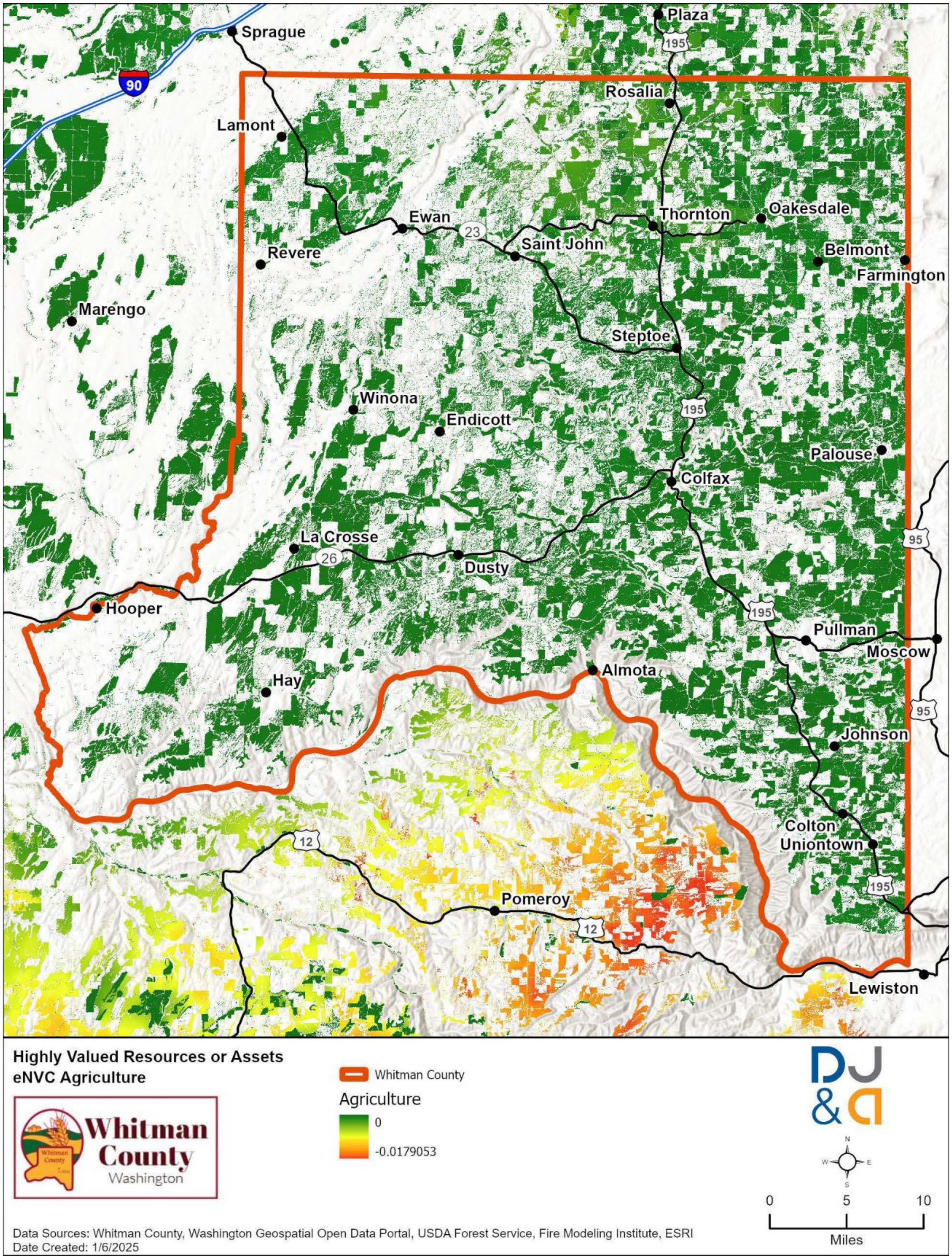
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Date Created: 1/6/2025


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Highly Valued Resources or Assets
eNVC Drinking Water
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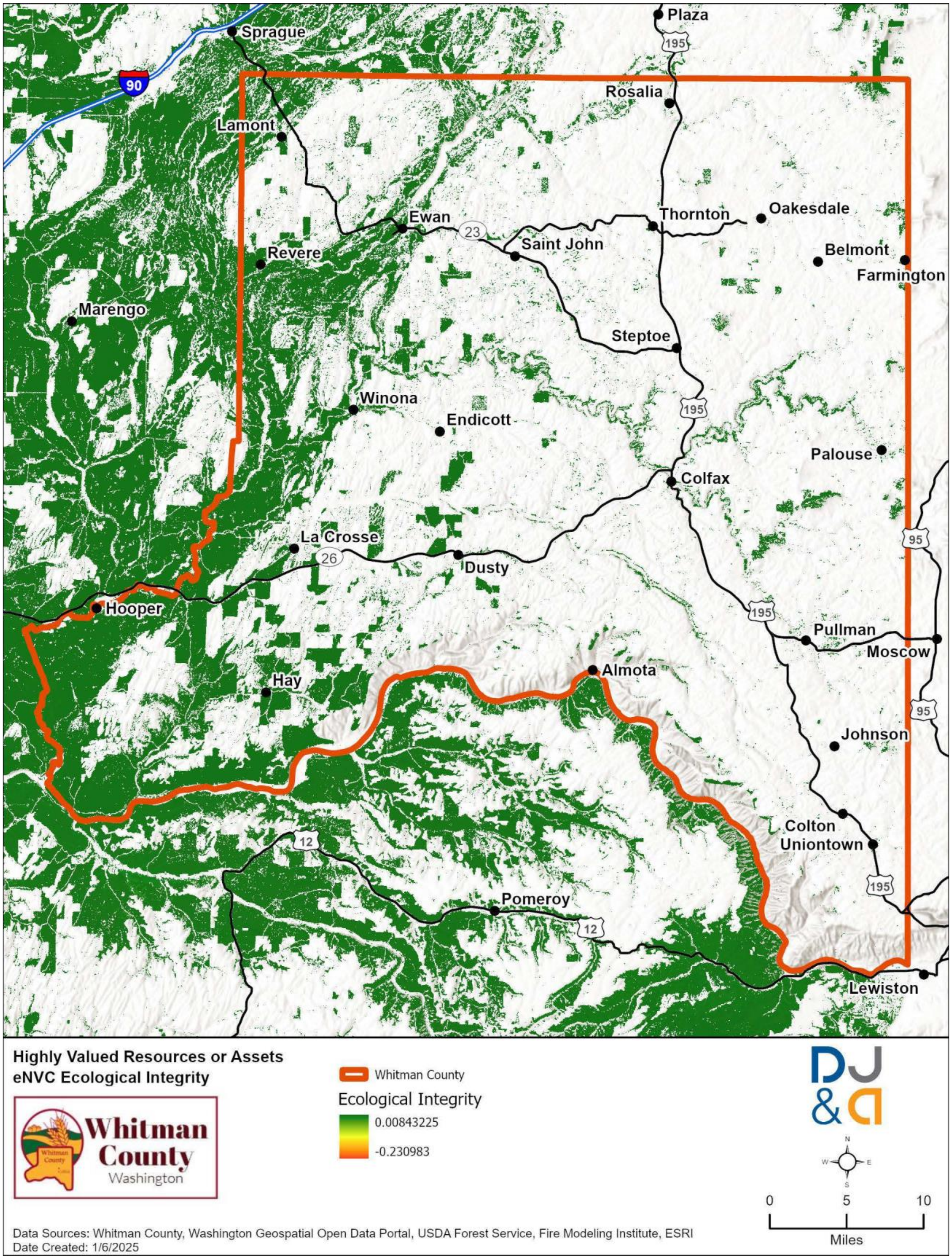
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Highly Valued Resources or Assets
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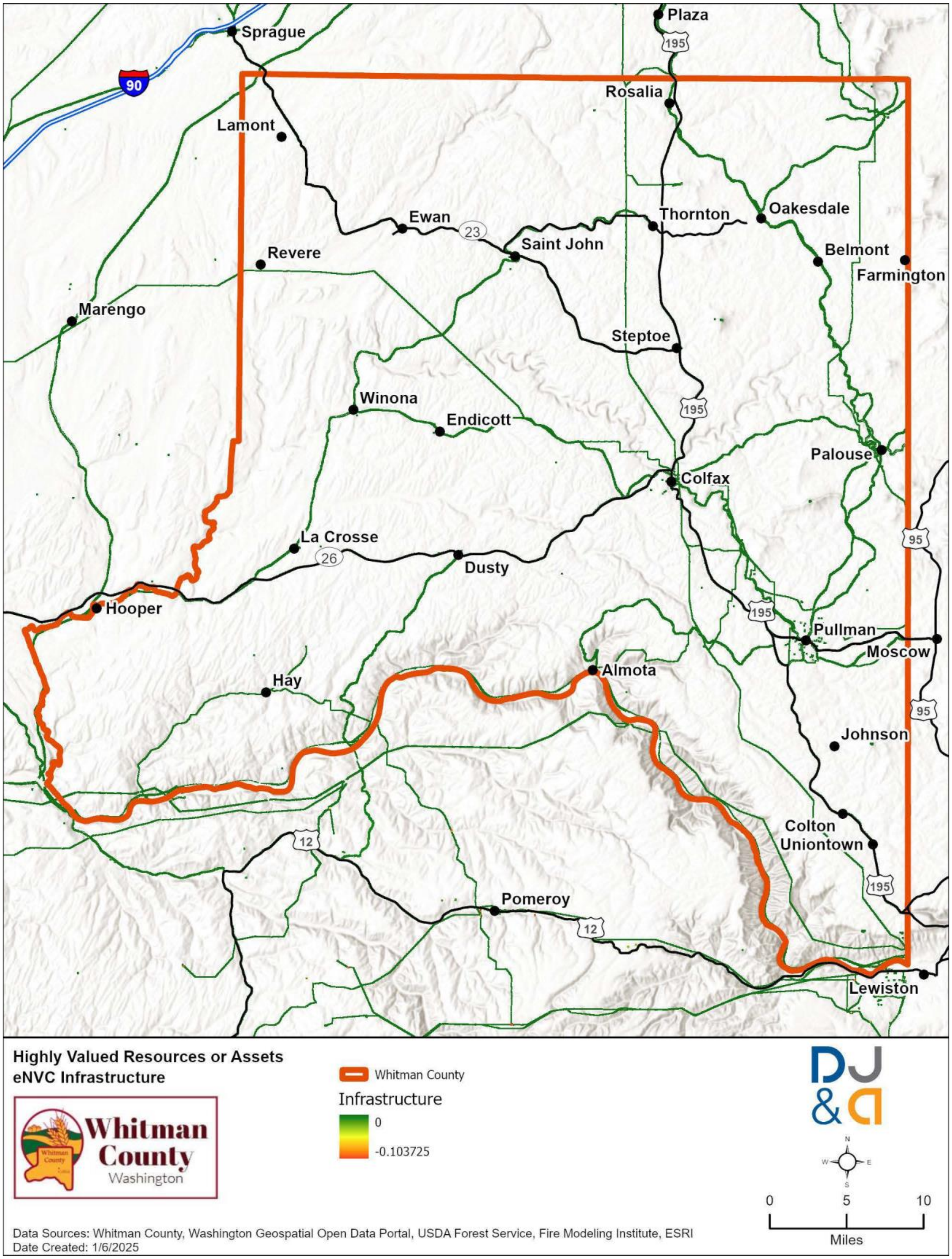
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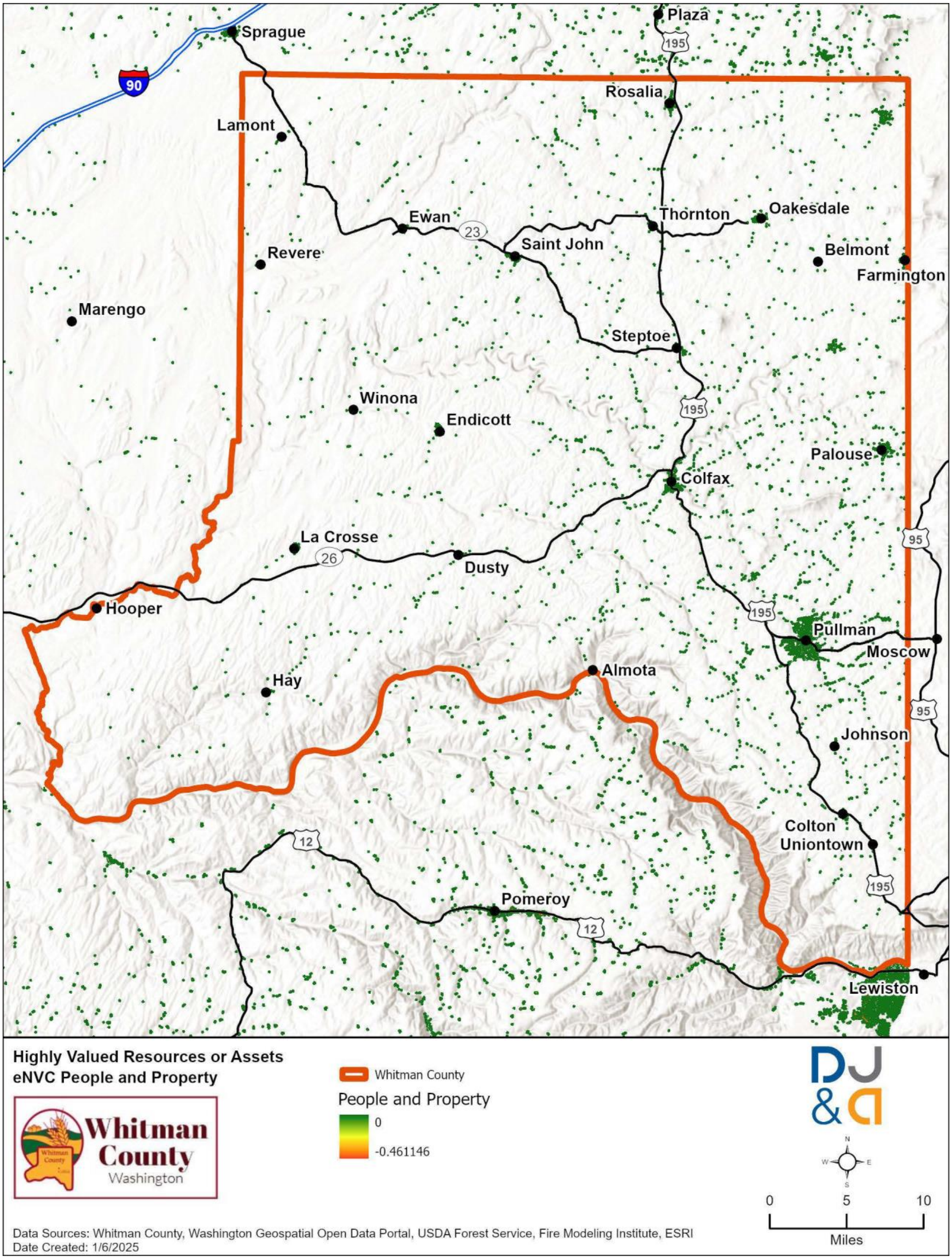
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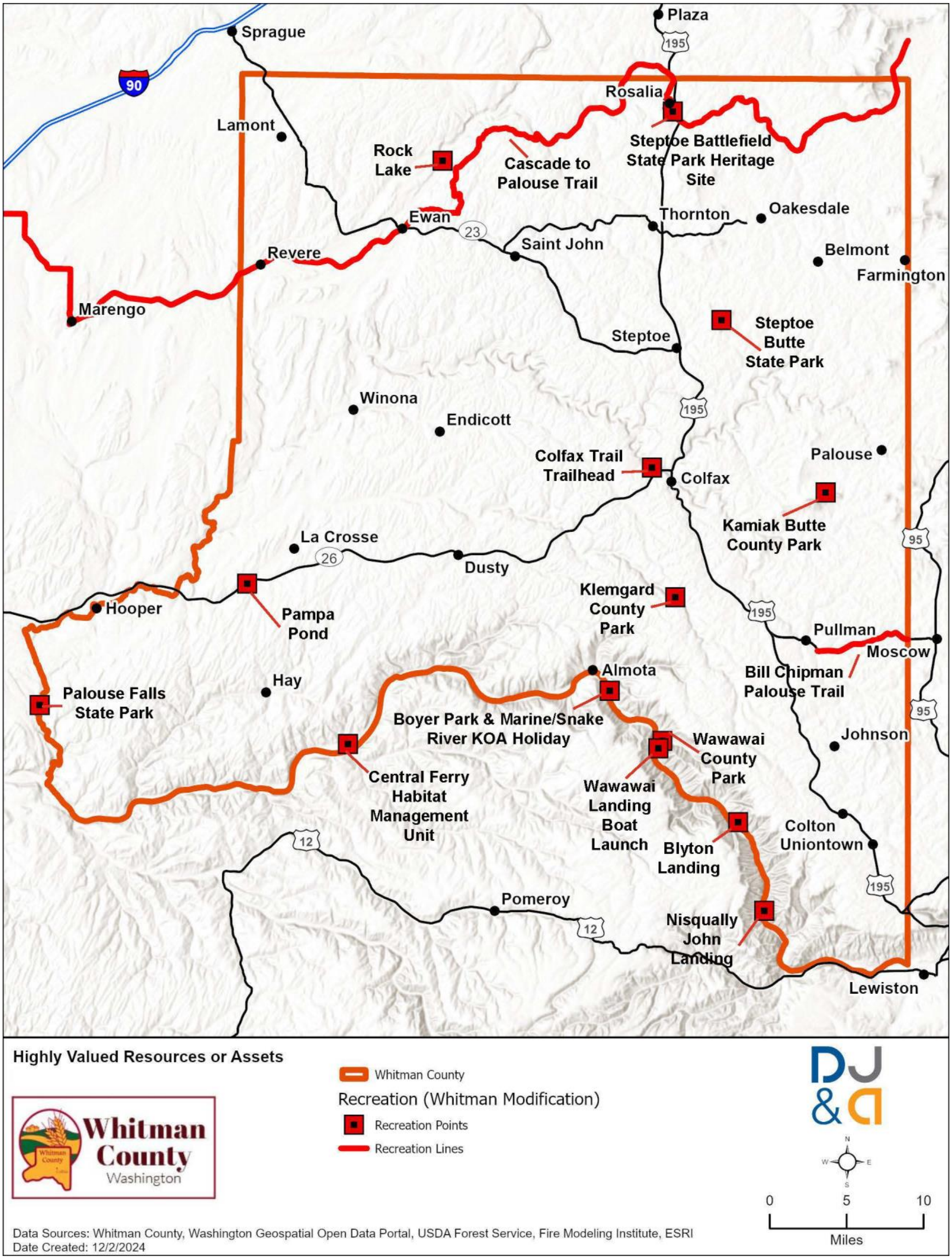
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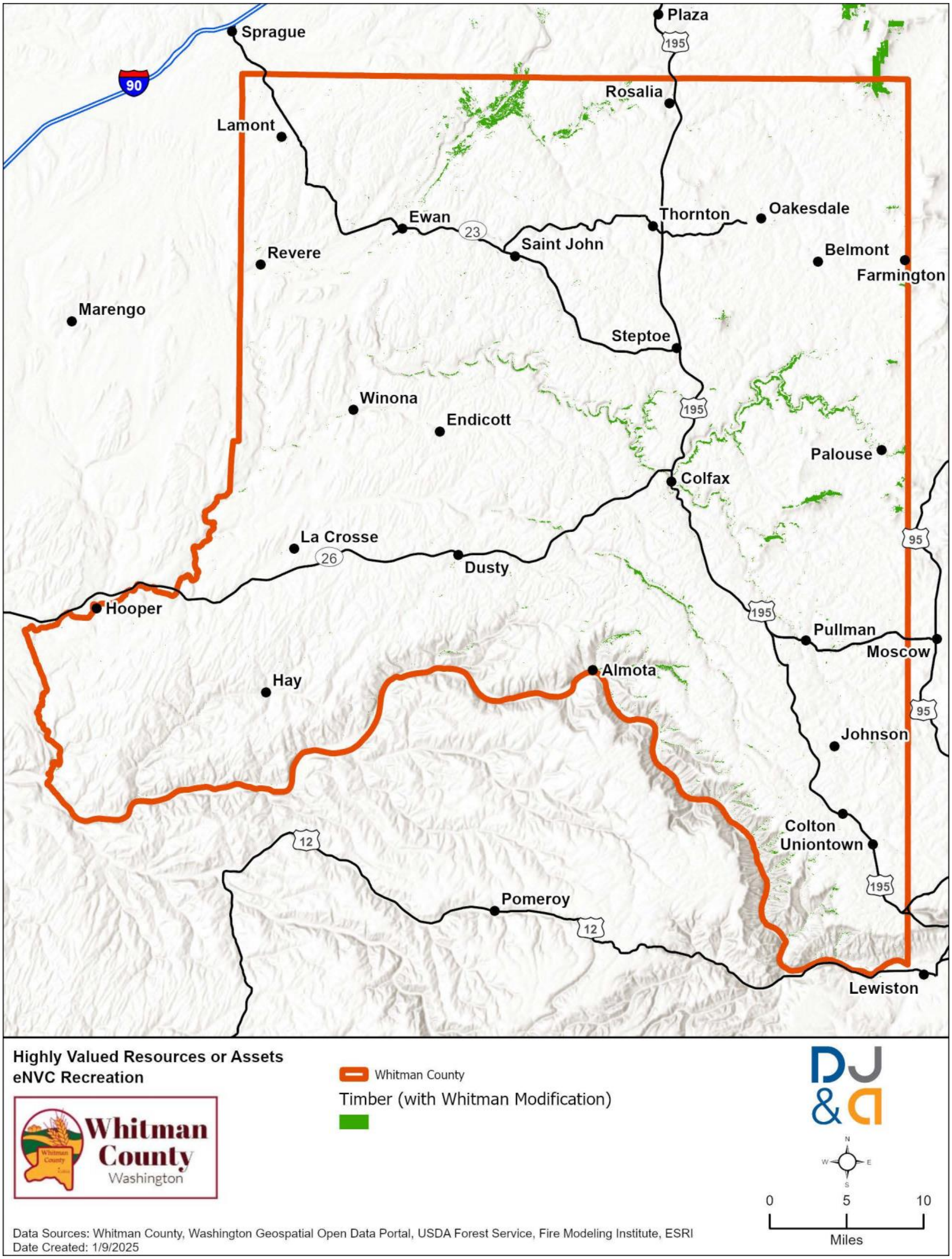
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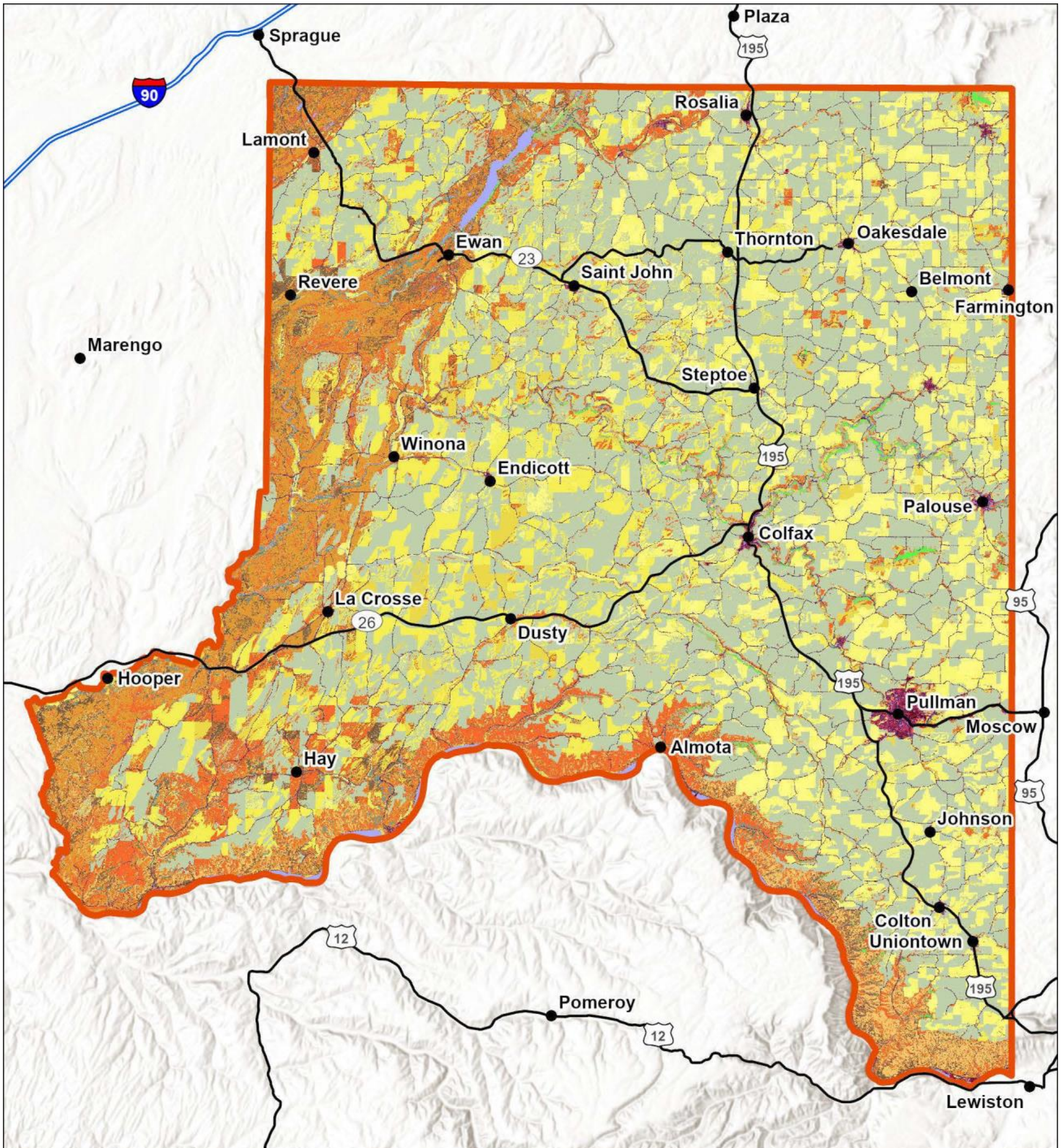

LANDFIRE Existing Vegetation Type (EVT)

Whitman County
EVTs (see legend on additional sheet)

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Data Sources: Whitman County, Washington Geospatial Open Data Portal, USDA Forest Service, Fire Modeling Institute, Landfire, ESRI

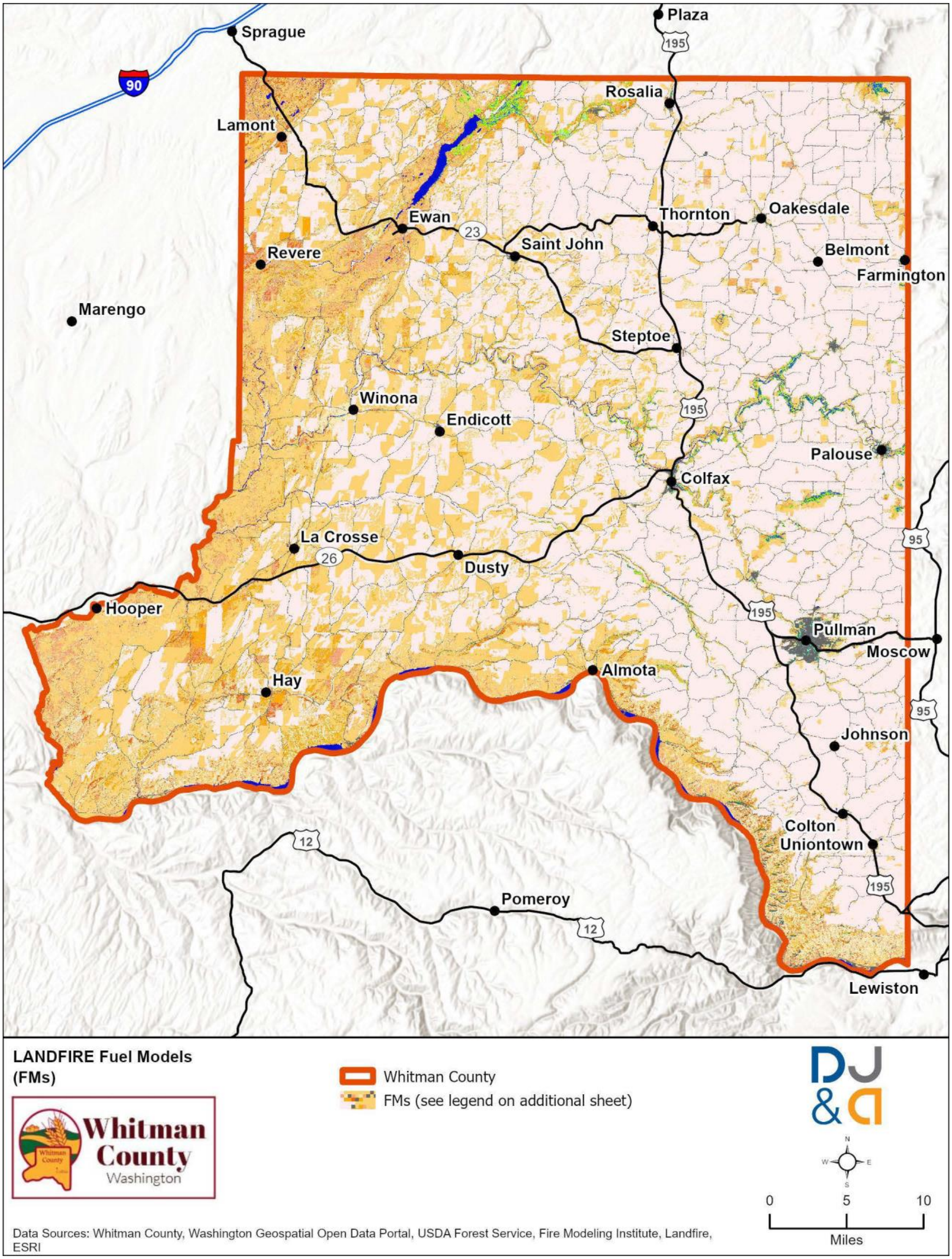
EVT Name

- Columbia Basin Foothill and Canyon Dry Grassland
- Columbia Basin Foothill Riparian Herbaceous
- Columbia Basin Foothill Riparian Shrubland
- Columbia Basin Foothill Riparian Woodland
- Columbia Basin Palouse Prairie
- Columbia Plateau Scabland Shrubland
- Columbia Plateau Steppe and Grassland
- Developed-High Intensity
- Developed-Low Intensity
- Developed-Medium Intensity
- Developed-Roads
- Great Basin & Intermountain Introduced Annual and Biennial Forbland
- Great Basin & Intermountain Introduced Annual Grassland
- Great Basin & Intermountain Introduced Perennial Grassland and Forbland
- Great Basin & Intermountain Ruderal Shrubland
- Interior West Ruderal Riparian Forest
- Interior Western North American Temperate Ruderal Grassland
- Interior Western North American Temperate Ruderal Shrubland
- Inter-Mountain Basins Active and Stabilized Dune
- Inter-Mountain Basins Alkaline Closed Depression
- Inter-Mountain Basins Big Sagebrush Shrubland
- Inter-Mountain Basins Big Sagebrush Steppe
- Inter-Mountain Basins Cliff and Canyon
- Inter-Mountain Basins Semi-Desert Shrub-Steppe
- North American Arid West Emergent Marsh
- Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest
- Northern Rocky Mountain Foothill Conifer Wooded Steppe
- Northern Rocky Mountain Lower Montane Riparian Woodland
- Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland
- Northern Rocky Mountain Mesic Montane Mixed Conifer Forest
- Northern Rocky Mountain Montane-Foothill Deciduous Shrubland
- Northern Rocky Mountain Ponderosa Pine Woodland and Savanna
- Open Water
- Quarries-Strip Mines-Gravel Pits-Well and Wind Pads
- Rocky Mountain Alpine-Montane Wet Meadow
- Rocky Mountain Aspen Forest and Woodland
- Rocky Mountain Cliff Canyon and Massive Bedrock
- Western Cool Temperate Bush fruit and berries
- Western Cool Temperate Close Grown Crop
- Western Cool Temperate Developed Evergreen Forest
- Western Cool Temperate Developed Herbaceous
- Western Cool Temperate Developed Mixed Forest
- Western Cool Temperate Developed Shrubland
- Western Cool Temperate Fallow/ Idle Cropland
- Western Cool Temperate Orchard
- Western Cool Temperate Pasture and Hayland
- Western Cool Temperate Row Crop
- Western Cool Temperate Row Crop - Close Grown Crop
- Western Cool Temperate Urban Deciduous Forest
- Western Cool Temperate Urban Evergreen Forest
- Western Cool Temperate Urban Herbaceous
- Western Cool Temperate Urban Mixed Forest
- Western Cool Temperate Urban Shrubland
- Western Cool Temperate Vineyard
- Western Cool Temperate Wheat
- Western North American Ruderal Wet Meadow & Marsh
- Western North American Ruderal Wet Shrubland

LANDFIRE Existing Vegetation Type (EVT) - Legend

Whitman County Washington

Data Sources: Whitman County, Washington Geospatial Open Data Portal, USDA Forest Service, Fire Modeling Institute, Landfire ESRI
Date Created: 11/7/2024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LANDFIRE Fuel Models (FMs)
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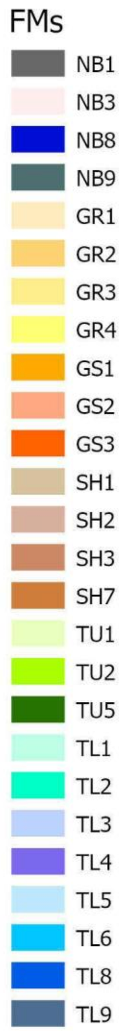

LANDFIRE Fuel Models (FMs)- Legend

Whitman County Washington

Data Sources: Whitman County, Washington Geospatial Open Data Portal, USDA Forest Service, Fire Modeling Institute, Landfire ESRI
Date Created: 11/7/2024

Appendix D: Glossary of Terms

Term	Definition	Source
Asset (Wildfire)	Human-made features, such as commercial structures, critical facilities, housing, etc., that have a specific importance or value	(Gilbertson-Day et al. 2020)
At-risk community	The term "at-risk community" means an area— (A) that is comprised of— (i) an interface community as defined in the notice entitled "Wildland Urban Interface Communities Within the Vicinity of Federal Lands That Are at High Risk From Wildfire" issued by the Secretary of Agriculture and the Secretary of the Interior in accordance with title IV of the Department of the Interior and Related Agencies Appropriations Act, 2001 (114 Stat. 1009) (66 Fed. Reg. 753, January 4, 2001); or (ii) a group of homes and other structures with basic infrastructure and services (such as utilities and collectively maintained transportation routes) within or adjacent to Federal land; (B) in which conditions are conducive to a large-scale wildland fire disturbance event; and (C) for which a significant threat to human life or property exists as a result of a wildland fire disturbance event.	Healthy Forest Restoration Act of 2003 (P.L. 108-148)
Community Wildfire Protection Plan	(3) COMMUNITY WILDFIRE PROTECTION PLAN.—The term "community wildfire protection plan" means a plan for an at risk community that— (A) is developed within the context of the collaborative agreements and the guidance established by the Wildland Fire Leadership Council and agreed to by the applicable local government, local fire department, and State agency responsible for forest management, in consultation with interested parties and the Federal land management agencies managing land in the vicinity of the at-risk community; (B) identifies and prioritizes areas for hazardous fuel reduction treatments and recommends the types and methods of treatment on Federal and non-Federal land that will protect 1 or more at-risk communities and essential infrastructure; and (C) recommends measures to reduce structural ignitability throughout the at-risk community.	Healthy Forest Restoration Act of 2003 (P.L. 108-148)
Community Wildfire Risk Reduction Zones (CWiRRZ)	Areas where different types of mitigation activities can be most effective at reducing risk of structure losses from wildfire. Generally, there are four Risk Reduction Zones: Minimal Exposure Zone, Indirect Exposure Zone, Direct Exposure Zone, and Wildfire Transmission Zone. Wildfire Transmission Zone is also broken out further by major fuel categories such as Tree, Shrub, Grass, Agriculture, and Non-Vegetated.	(USDA Forest Service 2024)

Term	Definition	Source
Condition Class (Vegetation)	Depiction of the degree of departure from historical fire regimes, possibly resulting in alterations of key ecosystem components. These classes categorize and describe vegetation composition and structure conditions that currently exist inside the Fire Regime Groups. Based on the coarse-scale national data, they serve as generalized wildfire rankings. The risk of loss of key ecosystem components from wildfires increases from Condition Class 1 (lowest risk) to Condition Class 3 (highest risk).	(NWCG 2023a)
Exposure (Wildfire)	The placement or coincidental location of an asset or resource within a hazardous environment	(Gilbertson-Day et al. 2020)
Fire Behavior	The manner in which a fire reacts to the influences of fuel, weather, and topography.	(NWCG 2023b)
Fire Intensity	A general term relating to the heat energy released in a fire.	(USDA 2023)
Fire Management	All activities related to the management of wildland fires, including fire prevention, fire suppression, and use of prescribed fire.	(NWCG 2023b)
Fire Regime	Fire regimes describe and categorize patterns of fire ignition, seasonality, frequency, type (crown, surface, or ground fire), severity, intensity, and spatial continuity (pattern and size) that occur in a particular area or ecosystem	(USDA 2023)
Fire Return Interval	Number of years between two successive fires in a specified area. Often used to designate an average of intervals (i.e., mean fire interval).	(USDA 2023)
Fire Severity	Degree to which a site has been altered or disrupted by fire; loosely, a product of fire intensity and residence time.	(NWCG 2024)
Flame Length	The length of flames in a fire front measure along the slant of a flame, from the midpoint of its base to its tip. Flame length is mathematically related to fireline intensity and tree crown scorch height.	(USDA 2023)
Fuel	Any combustible material, especially petroleum-based products and wildland fuels	(NWCG 2024)
Fuel Class	A set of fuels with similar traits. Fuels are categorized as herbaceous or woody and live or dead. Dead fuels are classed as 1-, 10-, 100-, or 1,000-hour timelag fuels, based on the time needed for fuel moisture to come into equilibrium with the environment: • 1-hour timelag fuels: Dead fuels comprised of herbaceous plants or woody plants less than about 0.25 inch (6.4 mm) in diameter and the surface layer of litter on the forest floor. • 10-hour timelag fuels: Dead fuels comprised of wood from 0.25 to 1 inch (0.6–2.5 cm) in diameter and the litter from just beneath the surface to around 0.75 inch (1.9 cm) below ground. • 100-hour timelag fuels: Dead fuels comprised of wood from 1 to 3 inches (2.5–7.6 cm) in diameter and litter from around 0.75 to about 4 inches (1.9–10 cm) below ground. • 1,000-hour timelag fuels: Dead fuels comprised of wood from 3 to 8 inches (7.6–20.3) in diameter and the forest floor layer >4 inches (10 cm) below ground.	(USDA 2023)

Term	Definition	Source
Fuel Continuity	A qualitative description of the distribution of fuels both horizontally and vertically. Continuous fuels readily support fire spread. The larger the fuel discontinuity, the greater the fire intensity required for fire spread.	(USDA 2023)
Fuel Loading	The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available fuel (consumable fuel) or total fuel and is usually dry weight.	(NWCG 2024)
Fuel Model	Simulated fuel complex for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.	(NWCG 2024)
Fuel Moisture	Expressed as a percent or fraction of oven-dry fuel weight. It is the most important fuel property controlling flammability. In living plants, its fluctuations vary considerably by species but are usually above 80% to 100%. As plants mature, moisture content decreases. When herbaceous plants cure, their moisture content responds as dead fuel moisture content, which fluctuates according to changes in temperature, humidity, and precipitation.	(USDA 2023)
Fuel Reduction	Manipulation, including combustion, or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control.	(NWCG 2024)
Prescribed Fire	Any fire intentionally ignited by management in accordance with applicable laws, policies, and regulations to meet specific objectives. Also called a controlled burn or prescribed burn.	(USDA 2023)
Likelihood (Wildfire)	The annual probability of wildfire burning in a specific location.	(USDA Forest Service 2024)
Rate of Spread (ROS	The rate of spread is in chains per hour (ch/h) and is defined as the speed with which the fire is moving away from the site of origin. Wind, moisture, and slope drive the fire. The flaming zone, or fire head, moves away from the origin quickly with great intensity.	(NWCG 2023a)
Resource (Wildfire)	Resources are natural features, such as wildlife habitat, vegetation type, or water, with specific importance or value	(Gilbertson-Day et al. 2020)
Susceptibility (Wildfire)	Propensity of an asset or resource to be damaged if a wildfire occurs	(Gilbertson-Day et al. 2020)
Vulnerability (Wildfire)	A function of exposure and susceptibility	(Gilbertson-Day et al. 2020)
Wildfire Hazard	A physical situation with potential for causing damage to vulnerable resources or assets. Quantitatively, wildfire hazard is measured by two main factors: 1) burn probability (or likelihood of burning), and 2) fire intensity (measured as flame length, fireline intensity, or other similar measure).	(Gilbertson-Day et al. 2020)
Wildfire Risk	A function of wildfire hazard (likelihood and intensity) and vulnerability (exposure and susceptibility) of assets and resources	(USDA Forest Service 2024)

Appendix E: 2023 Pacific Northwest Quantitave Wildfire Risk Assessment

2023 PNW Quantitative Wildfire Risk Assessment Methods

Prepared by:
Andy McEvoy[1], Chris Dunn[1], Ian Rickert[2]

[1] Oregon State University, College of Forestry
[2] U.S. Forest Service, Region 6

Suggested Citation:

McEvoy, Andy; Dunn, Christopher; Rickert, Ian. 2023 PNW Quantitative Wildfire Risk Assessment Methods (2023). [Unpublished Manuscript].

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1 Introduction to the 2023 QWRA

1.1 Purpose of Assessment

Risk management is foundational to decision-making under uncertainty and continues to be used across a specturm of industries, including natural resource management. While risk management is often referred to as a mindset, in practice it typically follows the process depicted in Figure 1. As the pace of change in the fire environment increases, faster decisions must be made even when faced with uncertainty. Decision support tools that address critical stages of the risk management process are increasingly needed to support the wildfire challenges impacting environments and communities globally.

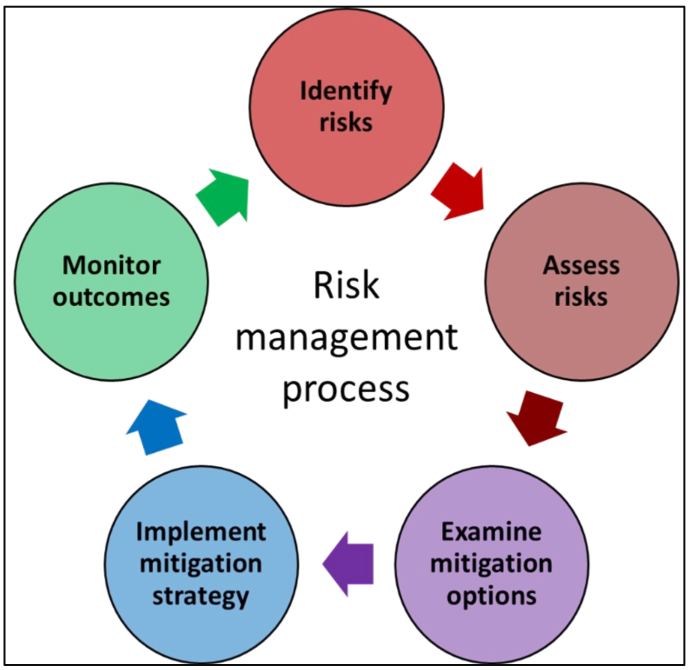

Figure 1. The risk management process

Today we find that risk management is transitioning towards a strategic discussion, blending risk manager's and strategist's expertise. Strategy is about making choices with uncertainty, and one cannot make the right strategic decision without understanding risk. A good strategy relies on the diagnosis of the problem, developing guiding policies, and then a set of coherent actions. As you can see, the components of a good strategy are aligned with the first three steps of the risk management process.

The purpose of the Pacific Northwest Quantitative Wildfire Risk Assessment (PNW QWRA) is to provide objective, science-based risk analytics that can be used to support strategic risk management across Oregon and Washington. Analytics produced as part of the PNW QWRA support community wildfire protection planning, fuels planning, active fire response and myriad other land management needs at regional and sub-regional scales. The PNW QWRA does the following:

1. Updates Oregon and Washington's all-lands wildfire risk assessment to represent current conditions and scientific advances,
2. Fulfills an important step in the risk management process,

3. Provides information symmetry across agencies to support strategic planning and implementation across all-lands,
4. Supports the efficient allocation of finite resources to areas and resources most at risk,
5. Expands the number and distribution of values exposed to wildfire,
6. Helps align land management agencies towards common goals of protecting societal values, and
7. Inform and educate practitioners and the public about wildfire risk.

1.2 2023 Update Process

In 2018, project partners released a PNW QWRA (hereafter PNW QWRA 2018; Gilbertson-Day et al., 2018) which evaluated and represented risk based on the landscape and best available science at that time. Beginning in winter of 2022, project partners began the process of updating PNW QWRA 2018 to evaluate risk on a more contemporary landscape, accounting for changes on the landscape that have occurred since the release of PNW QWRA 2018. The updated risk assessment is hereafter referred to as PNW QWRA 2023. The purpose of the update has been to:

1. Assess wildfire risk on the current landscape that accounts for changes in fuel from wildfires, land management activities, etc.
2. Utilize updated risk assessment tools, technology and data.
3. Consider and incorporate feedback that has been offered since the release of the previous assessment.

The PNW QWRA update process was facilitated and managed by Oregon State University in close collaboration with a leadership team that included representatives from the U.S.D.A. Forest Service, Bureau of Land Management, Washington Department of Natural Resources and Oregon Department of Forestry. Over the course of the year and half long update process, a wide range of partners and stakeholders were engaged.

The PNW QWRA update process was initiated in February of 2022 when work began on updated wildfire hazard modeling. Pyrologix LLC was contracted to conduct the modeling and secondary analyses and produce an array of wildfire hazard analytics for Oregon and Washington, including those that are required for calculating risk in a QWRA framework. Pyrologix and PNW QWRA partners hosted a three-day fuels calibration workshop in February 2022 during which fire and fuel specialists from across Oregon and Washington participated by reviewing available fuel data and recommending changes to it based on their knowledge and experience. Between February 2022 and December 2022, when the hazard modeling was complete, Pyrologix shared multiple different drafts of the hazard modeling landscape and draft hazard results for review. Fire and fuel specialists reviewed draft data and offered feedback.

In November of 2022, PNW QWRA partners, led by OSU, began the process of identifying and characterizing highly-valued resources and assets (HVRAs) for which risk would be assessed in PNW QWRA 2023. Highly-valued Resources and Assets are the values (e.g. timber, infrastructure, habitat, etc.) for which risk is evaluated in the assessment. Selecting HVRAs for the PNW QWRA 2023 began with an ArcGIS storymap illustrating a proposed set of HVRAs based on the PNW QWRA 2018 and feedback from stakeholders. The storymap included descriptions of the data that might be used, and a survey soliciting feedbacks on the proposed HVRAs and suggestions for additional or different HVRAs. We shared the storymap and survey with more than 100 partners and stakeholders.

Based on feedback collected from the survey, OSU formed working groups of relevant subject matter experts to lead development of nine HVRAs. Between December of 2022 and March 1, 2023, the working groups developed strategies for how each HVRA would be characterized, organized the data required, and created draft maps for each HVRA and its constituent sub-HVRAs. More than 30 project partners and subject matter experts reviewed the final list of HVRAs and mapping methods during a hybrid workshop on March 1-3, 2023. Following completion of all HVRA datasets, a group of six individuals representing state and federal agency leadership in Oregon and Washington deliberated on and agreed to a relative importance schema for the PNW QWRA 2023 during a virtual meeting on May 31, 2023.

Oregon State University produced and released preliminary results on June 30, 2023. Project partners and HVRA working group members were given an opportunity to review the preliminary results and offer feedback, including suggested changes. During the course of review, project partners recommend substantial changes to the Ecological Integrity HVRA. The relevant working groups reconvened and responded to the feedback. Using the updated HVRA data, OSU produced and released final PNW QWRA 2023 data to partners in October 2023.

1.3 Using This Report

This report is intended to provide readers with sufficient background, methods and guidance so that they can interpret and apply PNW QWRA 2023 data layers to their specific decision-making context. To that end, the report is divided into the following sections:

- **Section 2, Quantitative Wildfire Risk Assessment Framework**. This section offers an overview of quantitative risk assessment process, generally. This section defines terminology, data layers, and processes which are essential understanding and using the PNW QWRA 2023 outputs.
- **Section 3, Wildfire Hazard Modeling for the Pacific Northwest Quantitative Wildfire Risk Assessment 2023**. This section provides detailed methods regarding the development of wildfire simulation inputs, calibration of wildfire models and a description of burn probability and fire intensity data layers produced for the PNW QWRA 2023.
- **Section 4, Effects Analysis for the Pacific Northwest Quantitative Wildfire Risk Assessment 2023**. This section provides detailed methods regarding HVRA characterization, as well as specific methods describing how we mapped the extent, characterized the susceptibility and assigned relative importance for each sub-HVRA.
- **Section 5, Integrated Risk Results**. This section includes maps for the integrated risk results across all HVRAs as well as HVRA-level maps.
- **Section 6, Suggested Uses and Best Practices**. This section provides readers with guidance on how to choose appropriate QWRA data layers for their project, considerations when symbolizing and classifying QWRA data, and strategies for applying PNW QWRA data to smaller geographies.
- **Appendix A, Summary of PNW QWRA 2023 Sub-HVRAs.** This is a reference summary which includes naming conventions and a brief description of each sub-HVRA.

- **Appendix B, PNW QWRA 2023 Data Description.** This is a summary of the various spatial data layers that are available for download.
- **Appendix C, Additional Hazard Products Available for the Pacific Northwest.** In addition to the hazard data used in development of the PNW QWRA 2023, Pyrologix also produced a large suite of additional hazard information and risk analytics which will be made available upon request. This section is a summary of those additional hazard products.

2 Quantitative Wildfire Risk Assessment Framework

This section provides a summary of the QWRA framework and is intended to help general audiences understand the terminology, methods and outputs common across QWRAs. Specific details about development of the PNW QWRA are in Sections three through seven.

Risk can generally be described as an estimate of the likelihood and consequence of uncertain future events (Yoe, 2016). Wildfire risk is quantified as the spatially coincident estimates of fire likelihood (burn probability), fire intensity (e.g., flame length) and the impacts (susceptibility) of highly-valued resources or assets for which risk is being evaluated (Scott et al., 2013; Figure 2). A quantitative wildfire risk assessment evaluates risk in two parts:

1. Hazard assessment
2. Effects analysis

An in-depth description of the QWRA framework and applications is available in Scott et al. (2013). Here we provide a summary of the framework and general methodology.

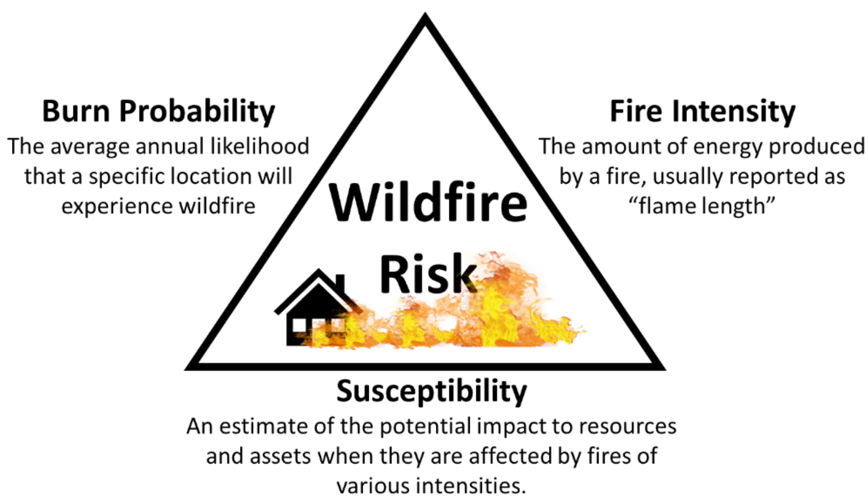

Figure 2. The wildfire risk triangle illustrates the three components that define wildfire risk.

2.1 Hazard Assessment

A hazard is a process, phenomenon, or activity with the potential to cause social, economic, or environmental degradation, including injury or death (UNODRR, 2022). Sometimes wildfire hazard is expressed as the condition of wildland fuel, but this ignores other contributing factors (i.e., weather and topography), and discounts the importance of the likelihood of experiencing a wildfire. Under the QWRA framework, wildfire hazard is comprised of both burn probability and fire intensity.

2.1.1 Burn Probability

Wildfire likelihood (burn probability) is an estimate of the average annual likelihood that a wildfire will occur at any given location. Burn probability is simulated using a model that integrates information about the physical landscape, historical fire occurrence, and historical weather observations. We simulate 10,000 or more plausible fire season scenarios across sub-regions of Oregon and Washington, each driven by a random draw of recent fire weather observations and the physical landscape (Finney et al., 2011). The number of times a point on the landscape is encountered by fire, divided by the number of simulated fire seasons, provides the estimate of average annual likelihood of fire, or burn probability. These burn probability values reflect long-term annual averages and should not be thought of as seasonal forecasts.

2.1.2 Wildfire Intensity

Wildfire intensity is a measure of how much energy is produced at the flaming front of a wildfire (Byram, 1959). Intensity is often measured in terms of flame length for ease of relating to and representing this component of wildfire hazard. Higher flame lengths represent more intense fires. The terms fire intensity and fire severity are often used interchangeably, but, in fact, they are not the same (Keeley, 2009). Fire severity refers to a measure of fire impacts on the resource or asset that has been affected. Common metrics of fire severity include tree mortality, loss of biomass or impacts to soil. Increasing fire intensity often leads to increasing fire severity, but the terms are not interchangeable. We use response functions to crosswalk fire intensity into a measure of severity, which is discussed later in this document.

Similar to burn probability, fire intensity is often quantified from simulation models that integrate information about the physical landscape and historical weather observations, making estimates across a large number of plausible scenarios. Modeled fire intensity level (FIL) outputs are usually binned into six classes:

- **FIL 1**: 0 to 2 ft. flame lengths
- **FIL 2**: 2 to 4 ft. flame lengths
- **FIL 3**: 4 to 6 ft. flame lengths
- **FIL 4**: 6 to 8 ft. flame lengths
- **FIL 5**: 8 to 12 ft. flame lengths
- **FIL 6**: greater than 12 ft. flame lengths

The FIL data layers each quantify the conditional probability that flame lengths will be within the defined range of each class. For example, at a given location FIL 1 might be 0.83, indicating that 83% of the time the location experiences a fire the flame lengths will be less than two feet high. At that same location, FIL 6 might be 0.04, indicating that 4% of the time that location experiences a fire, flame lengths exceed 12 feet. Fire hazard models simulate fires under a wide range of plausible weather conditions across the full length of fire season (e.g., June – October), so any given location will have a distribution of potential fire intensities occurring in multiple FIL classes resulting from variation in fire weather. The FIL values across all six classes will sum to one at any given location.

2.2 Effects Analysis

The effects analysis in the QWRA process addresses the consequences of wildfire to a suite of values exposed to wildfire. Estimating wildfire consequences requires that we: (1) identify highly-valued resources and assets (HVRAs) for which risk will be assessed; (2) characterize and quantify the susceptibility of each HVRA to wildfire; and (3) determine the importance of each HVRA relative to all the other HVRAs. These three steps require subject matter experts from a broad distribution of disciplines. Once complete, we can combine spatial characterizations of HVRAs with the hazard data to calculate risk.

2.2.1 Identifying HVRAs

Highly-valued resources and assets vary from one assessment to the next based on the purpose of the assessment, but generally include infrastructure, natural resources and ecosystem services on which managers base their decisions regarding the allocation of finite resources. The list of HVRAs included in a QWRA should also be specific enough to support a clear mitigation and prioritization schema. Including too many values can result in ineffective prioritization by comparing HVRAs that drive fire and land management decisions (e.g., risk to municipal water sources) to values that do not necessarily drive fire or land management decisions (e.g., risk to deer browse). When selecting HVRAs, it is also important to consider the quality of available data to map and characterize their condition. For this and other reasons, selecting HVRAs is usually a collaborative process.

Highly valued resources and assets are typically classified into sub-HVRAs based on similar characteristics. Often, sub-HVRA designations reflect management priorities and may influence the effects analysis and their relative importance (described below).

2.2.2 Quantifying Susceptibility

Highly-valued resources and assets or sub-HVRAs may have a unique response to fire which, when combined with fire hazard estimates, determines risk values. Within the QWRA framework, the effect of fire on each HVRA or sub-HVRA (susceptibility) is a function of fire intensity. Importantly, fire effects may be beneficial or adverse and, accordingly, the resulting risk may include positive or negative outcomes.

To capture varied fire effects for each HVRA or sub-HVRA at each of the six fire intensity levels, a response function is used (Table 1). Response functions are numeric values ranging from -100 to 100 indicating the magnitude of percent value change for the HVRA at each fire intensity level (FIL). Negative numbers indicate an adverse effect while positive numbers indicate a beneficial effect. To refine estimates of susceptibility, a sub-HVRA may be further characterized by covariates which do not influence relative importance but do influence how the sub-HVRA responds to fire. Covariates are not required. In the example in Table 1, the sub-HVRAs (i.e. species and habitat priority) influence both response functions and relative importance, whereas the covariates (i.e. resilience and resistance scores) only influence response functions.

Fire effects are expressed in terms of percent value change so that risk can be integrated across diverse HVRAs that are not readily comparable through typical financial market estimates. In many cases, scientific information on the susceptibility of all HVRAs to the distribution of simulated fire intensity is not available, requiring subject matter experts (i.e., resource specialists) to capture general trends in how these values respond to increasing fire intensity. Response functions are generally assigned in a collaborative workshop setting with subject matter experts as well as fire and fuels specialists.

2.2.3 Relative Importance

The QWRA framework allows for risk to multiple spatially coincident HVRAs to be integrated in a single value at any given location. From a prioritization standpoint, however, it is necessary that the integrated risk value reflect social values and fire management objectives. To help ensure that is the case, relative importance (RI) values are assigned to each HVRA, quantifying the priority status of each HVRA relative to the other HVRAs. The specific RI schema ought to reflect the priorities and values of the entire planning landscape. Given that QWRAs are decision-support tools for decision makers, it is important that leadership across the collaborative partners are present and contributing to this schema.

Relative importance is assigned in two steps. The first step is to assign RI values to each HVRA (Table 2). Relative importance values reflect mission, policy, and existing strategies which guide or constrain how agencies respond to wildfire risk. In the example in Table 2, Drinking Water is 60% as important as People and Property. The overall share of relative importance is calculated by dividing the relative

Table 1. Example of response function framework for several wildlife species. The sub-HVRA classes represent species and relative habitat priority. In the case of greater sage-grouse, a covariate further explains how the sub-HVRAs respond to fire.

			Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**Covariate**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
(Habitat Importance)		*(Resilience and resistance score)*	*0 - 2'*	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Species #1, *Priority Habitat*	55%	--	20	50	-10	-60	-80	-100
Species #1, *General Habitat*	15%	--	40	20	-10	-60	-80	-100
Species #2, *Priority Habitat*	24%	High RR	30	10	0	-30	-50	-90
		Moderate RR	-10	-20	-30	-60	-100	-100
		Low RR	-10	-30	-70	-100	-100	-100
Species #2, *General Habitat*	6%	High RR	30	10	0	-30	-50	-90
		Moderate RR	-10	-20	-30	-60	-100	-100
		Low RR	-10	-30	-70	-100	-100	-100

importance value by the total amount of relative importance and is provided as a means to more easily compare how relative importance is distributed.

For any HVRA where sub-HVRAs have been defined, the second step is to allocate the HVRA-level RI from step one across its constituent sub-HVRAs. Sub-HVRA level RI can be divided equally across the sub-HVRAs, or may be divided in a way that reflects management (e.g. structure density, conservation status, etc.).

Table 2. Example of how relative importance is allocated across hypothetical HVRAs.

HVRA	Relative Importance	Overall Share of Importance
Infrastructure	60	19%
Timber	40	12%
Vegetation Condition	30	9%
Drinking Water	60	19%
People and Property	100	31%
Wildlife Habitat	31	10%
Total RI	**321**	**100%**

When calculating risk, relative importance for each sub-HVRA is normalized by the relative extent of that sub-HVRA and represented as the relative importance per pixel (RIPP; Equation 1). Normalizing by relative extent is designed to ensure that risk to HVRAs with limited spatial extents (e.g. infrastructure) is not underrepresented despite its importance to fire management compared to the risk to HVRAs with broad spatial extents (e.g. ecological integrity; Scott et al., 2013).

2.2.4 Calculating Risk

Risk is estimated within the QWRA framework by combining wildfire hazard with HVRA susceptibility (Scott et al., 2013). Risk is calculated for each pixel separately based on the fire hazard data for that pixel and based on which sub-HVRAs or HVRAs are present. Given that the susceptibility of HVRAs is expressed in terms of value change, risk outputs are expressed as net value change (NVC). At each pixel, NVC can be calculated for a single sub-HVRA, or integrated across all sub-HVRAs/HVRAs present.

There are two ways of calculating NVC: conditional net value change (cNVC) and expected net value change (eNVC). As illustrated in Equation 1, cNVC is first calculated as the risk to a specific sub-HVRA:

$$cNVC_j = \sum_{i}^{n} FLP_i * RF_{ij} * RIPP_j \qquad \text{Eq. (1)}$$

Where,
$cNVC_j$ = conditional net value change for sub-HVRA j
j = specific sub-HVRA
i = fire intensity level class (i.e. FIL 1 through FIL 6)
n = total number of FIL classes (i.e. 6)
FLP_i = flame length probability for FIL class i
RF_i = response function for sub-HVRA j at FIL i
$RIPP_j$ = relative importance per pixel for sub-HVRA j

Then, cNVC for any specific HVRA is the sum of all constituent sub-HVRA cNVC:

$$cNVC_k = \sum_{j}^{m} cNVC_j \qquad \text{Eq. (2)}$$

Where,
$cNVC_k$ = conditional net value change for HVRA k
j = specific sub-HVRA within HVRA class k
m = total number of sub-HVRAs within HVRA class k

Further, cNVC can further be integrated across all or a subset of HVRAs follows in Equation 3:

$$cNVC = \sum_{k}^{r} cNVC_k \qquad \text{Eq. (3)}$$

Where,
$cNVC$ = conditional net value change for all HVRAs or a specific subset of HVRAs
k = specific HVRA class
r = total number of HVRAs across which cNVC is being integrated

Expected net value change is similarly calculated at the pixel level and can be calculated for a single sub-HVRA or HVRA, or integrated across any combination of HVRAs. To calculate eNVC, cNVC is multiplied by burn probability:

$$eNVC = cNVC * BP \qquad \text{Eq. (4)}$$

Where,
$eNVC$ = expected net value change
$cNVC$= conditional net value change
BP= burn probability

QWRAs produce a suite of decision support tools, or data layers, available to support a decision maker as is, or in conjunction with further analyses. By creating multiple data layers, QWRAs provide a lot of flexibility in how one characterizes wildfire risk to address a question or concern by end users. Integrated eNVC is the most commonly used risk characterization metric, but how one chooses to characterize risk (i.e. conditional or expected, integrated or non-integrated) depends on the intended planning process or specific question at hand. For example, fire responders use conditional risk outputs in strategic decision making or pre-planning response strategies since the wildfire is present or assumed present for their decision making. These estimates are also helpful for understanding where values are concentrated despite their burn probability. Alternatively, eNVC supports the efficient allocation of finite resources for risk reduction activities aimed at maximizing risk reduction by strategically targeting areas with greatest likelihood of negative outcomes in any given year. Integrated risk outputs are essential for creating cohesive, cross-boundary understandings of risk, while non-integrated risk products might be easier to comprehend or target a specific resource of interest when financial resources are directed that way.

3 Wildfire Hazard Modeling for the Pacific Northwest Quantitative Wildfire Risk Assessment (2023)

3.1 Fuelscape Development

To model wildfire hazard for the PNW QWRA 2023, Pyrologix LLC developed a modeling landscape (fuelscape) that represents the best approximation of the spatial arrangement and characteristics of fuel for fire season 2022. The fuelscape consists of geospatial raster datasets representing surface fuel model (FBFM40), canopy cover (CC), canopy height (CH), canopy bulk density (CBD), canopy base height (CBH), and topography characteristics (i.e. slope, aspect, elevation). LANDFIRE (LANDFIRE, 2022))data provided the foundation for characterizing the fuelscape, but Pyrologix and PNW QWRA partners compiled spatial disturbance records to make the fuelscape as contemporary as possible, engaged over 50 subject matter experts to refine the fuelscape based on their knowledge and created custom fuel models to improve representation of hazard in agricultural and developed areas.

The LANDFIRE program assigns FBFMs and canopy characteristics using two primary input layers: Existing Vegetation Type (EVT) and Map Zone (MZ). One challenge inherent with large analysis areas, such as the Pacific Northwest region, are seamlines that result from different rulesets for the same EVT across MZs. To reconcile across MZ boundaries, rules were filtered by Pyrologix LLC to allow only one ruleset per EVT for the entire fuelscape. When several MZs had different rules for a specific EVT, Pyrologix LLC determined which MZ had the greatest share of a given EVT and that ruleset was applied across the landscape.

The LANDFIRE fuel data provided the basis for the fuelscape, but was subsequently edited based on expert opinion and local knowledge. Pyrologix LLC hosted a fuel calibration workshop February 1-3rd, 2022 which included 36 wildland fire professionals from across the PNW representing the USDA Forest Service, Department of Interior agencies, Oregon Department of Forestry, Washington Department of Natural Resources, The Nature Conservancy, Oregon State University, and other partners. During the workshop, participants reviewed and edited LANDFIRE fuel data and mapping rulesets to reflect local experience and expectations with the goal of producing more accurate simulated fire behavior results.

To represent as contemporary a fuelscape as possible, Pyrologix LLC incorporated spatial disturbance data representing wildfires and fuel treatments that occurred up through the end of 2021 and modified LANDFIRE FBFM40 data to reflect post-disturbance conditions. Disturbance modifications took into consideration the type of disturbance, the severity, and the time since the disturbance occurred. Fuel treatment records were available from the Forest Activity Tracking System (FACTS) for the USDA Forest Service and the National Fire Plan Operations and Reporting System (NFPORS) for Department of Interior. Washington Department of Natural Resources and Oregon Division of Forestry also provided historical fuel treatment data.

The PNW QWRA 2023 included two new fire behavior fuel models that were designed to estimate fire spread in agricultural and developed areas (Figure 3). In the PNW QWRA 2018, most agricultural and developed areas were characterized as non-burnable because, at the time, there was not adequate way to represent fire spread in those areas during simulations. As a result, many agricultural and developed areas had no risk information in the PNW QWRA 2018.

Pyrologix LLC used two custom fuel models for the PNW QWRA 2023 The Burnable Ag fuel model allowed fires to spread into identified agricultural pixels. However, to be more reflective of observed outcomes, fires were not allowed to ignite in agricultural pixels. Fire spread in dryland agriculture types was represented with a GR2 FBFM, and GR1 in other agricultural types. Similarly, the Burnable Urban fuel model allowed fires to transmit into developed areas under extreme fire weather conditions. The distance which a simulated fire transmitted into a developed area was a function of the fire weather severity.

The final fuelscape adjustment was an effort to account for the mitigating effects of irrigation on fire spread. OSU identified all pixels estimated to have been irrigated in at least three of the last five years from the most recent IrrMapper data available (2017 - 2021; Figure 3; Ketchum et al., 2020). IrrMapper classifies land cover annually, including irrigated agriculture, using machine learning to evaluate geospatial data and satellite imagery across the West. The selected IrrMapper data served as a mask to modify underlying fire hazard data. In pixels identified as irrigated in three out of the last five years, we set the burn probability to 0.0001, assuming that it is very unlikely for persistently irrigated pixels to burn. Similarly, we set the probability of FIL1 to 0.75 and FIL2 to 0.25 while FIL3 through FIL6 were set to zero. The assumption regarding fire intensity was that in the unlikely event that a fire were to transmit into persistently irrigated land, the fuel moisture would likely be high and therefore fire intensities would be low.

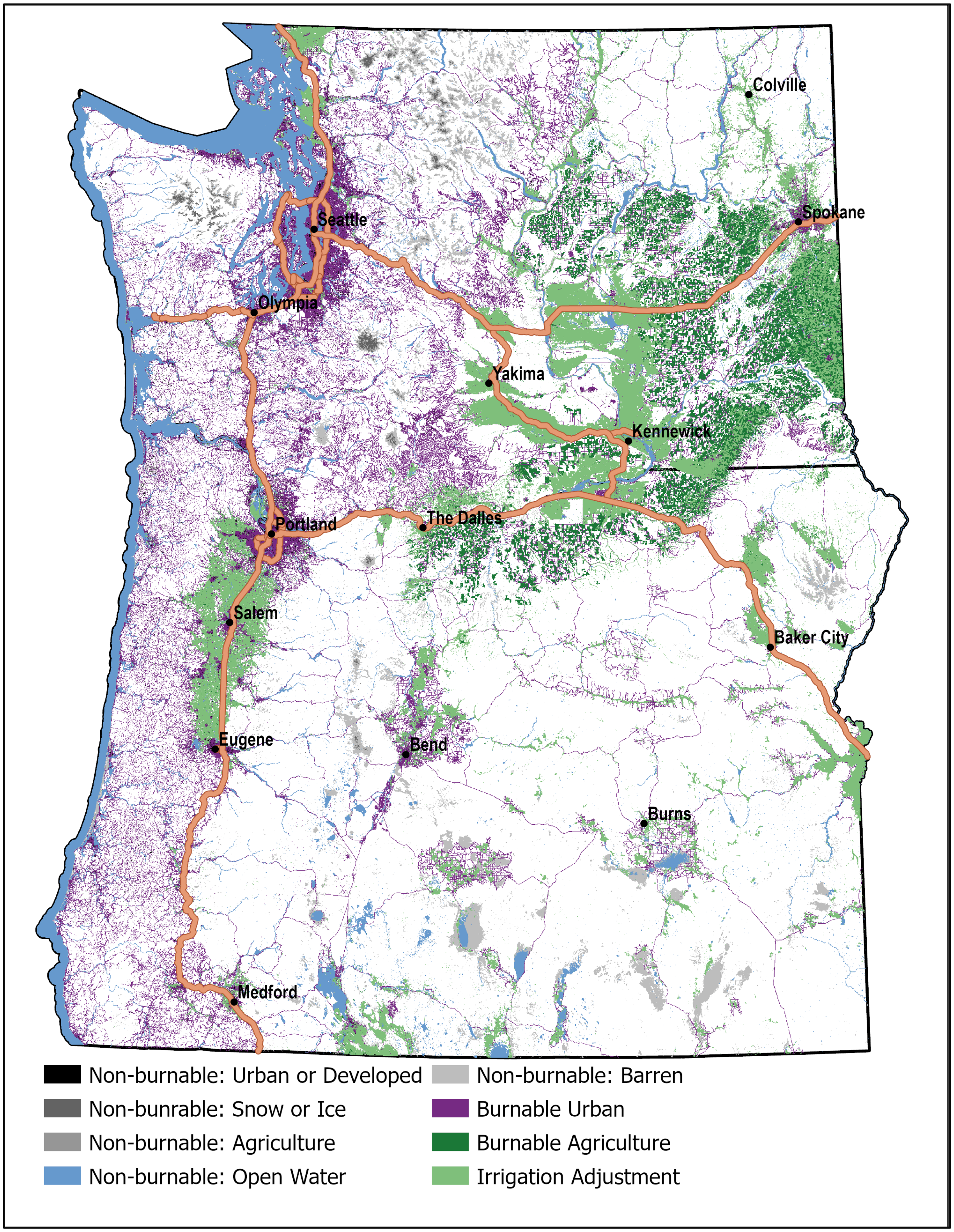

Figure 3. Non-burnable and custom fuel models, and fuelscape adjustments used in wildfire hazard modeling for PNW QWRA 2023. Custom fuel models include burnable agriculture and burnable urban. The irrigation adjustment includes pixels identified as irrigated in at least three of the last five years (Ketchum et al., 2020) and where we adjusted hazard outputs to reflect mitigating effect of irrigation. All raster data is drawn with pyramids to make viewing easier; the actual extent of these fuel models and adjustments is less than shown here.

3.2 Wildfire Hazard Modeling

3.2.1 Burn Probability

Pyrologix LLC estimated burn probability using the large-fire simulator, FSim (Finney et al., 2011). FSim is a Monte Carlo model which simulates a full range of plausible fires and fire seasons based on the variability in factors that influence fire occurrence including, ignition location, seasonality, and fire weather conditions. Fire occurrence probability in FSim is a function of a logistic regression between documented historic large fire ignitions in the study area and the daily Energy Release Component (ERC) at the time of ignition (Cohen and Deeming, 1985). For each day of a simulated fire season, FSim draws from plausible weather scenarios and simulates an ignition if the ERC exceeds the 80th percentile of historic ERC values (Riley et al., 2013). When an ignition is simulated, FSim generates a spatial fire perimeter by computing daily fire spread based on weather and available fuels while estimating the effect of suppression. FSim operates on a daily time step each season and is usually run for at least 10,000 seasons. Burn probability is calculated by adding up the number of instances that a pixel was intersected by simulated fire and dividing the sum by the total number of simulated seasons. Accordingly, burn probability from FSim is an estimate of average annual wildfire likelihood at each pixel.

For the PNW QWRA 2023, Pyrologix LLC calibrated FSim to historic fire occurrence and observed fire weather characteristics and simulated 10,000 fire seasons for each of 23 Fire Occurrence Areas (FOAs, Figure 4). For each FOA, FSim was calibrated to a distribution of fire size and annual number of large fires using spatial fire records from the Fire Occurrence Database (FOD; Short, 2022) which includes fires 1992 – 2020, and records from state and federal agencies for fires that occurred in 2021. For each FOA, the logistic regression between large fire occurrence and ERC was calculated using daily weather records (2007 – 2021) sampled from a representative remote automated weather stations (RAWS) within each FOA. In FOAs 423 and 404, the Labor Day 2020 fires were excluded from the calibration statistics in order to prevent overpredicting the size and likelihood of large wildfires that would lead to overpredictions of rare events. Extensive research on these wildfires has shown the casual wind event to be anomalous. Initial modeling was done at 120-meter pixels and then downscaled to account for unburnable portions of the landscape detected at 30 meters.

The PNW QWRA 2023 burn probability raster was produced by merging the burn probability raster from each FOA (Figure 5).

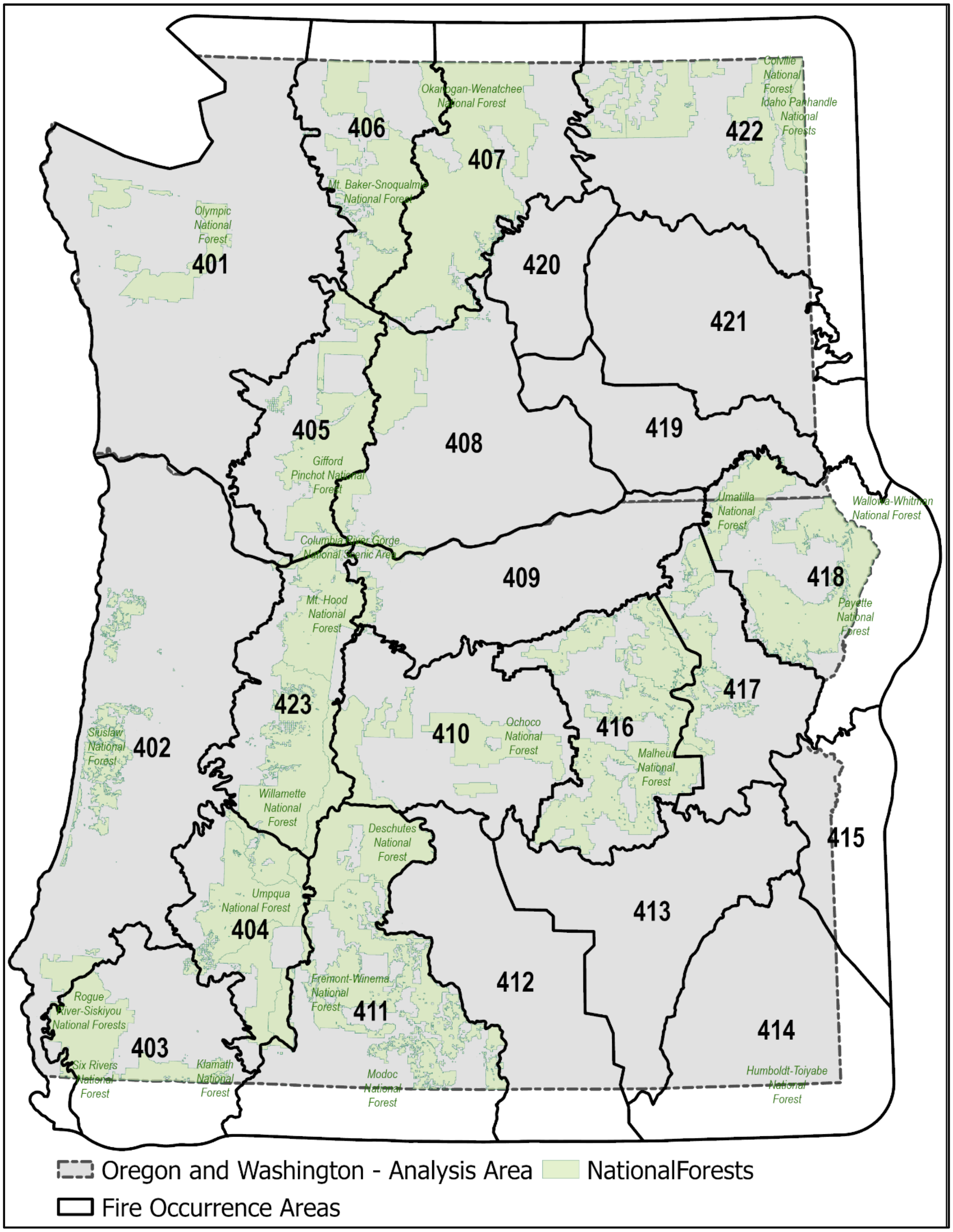

Figure 4. The 23 Fire Occurrence Areas (FOAs) used to calibrate wildfire hazard models and run simulations. Fire Occurrence Areas extend beyond the analysis area (i.e. Oregon and Washington) to allow for fires that ignite outside the analysis area but transmit into it.

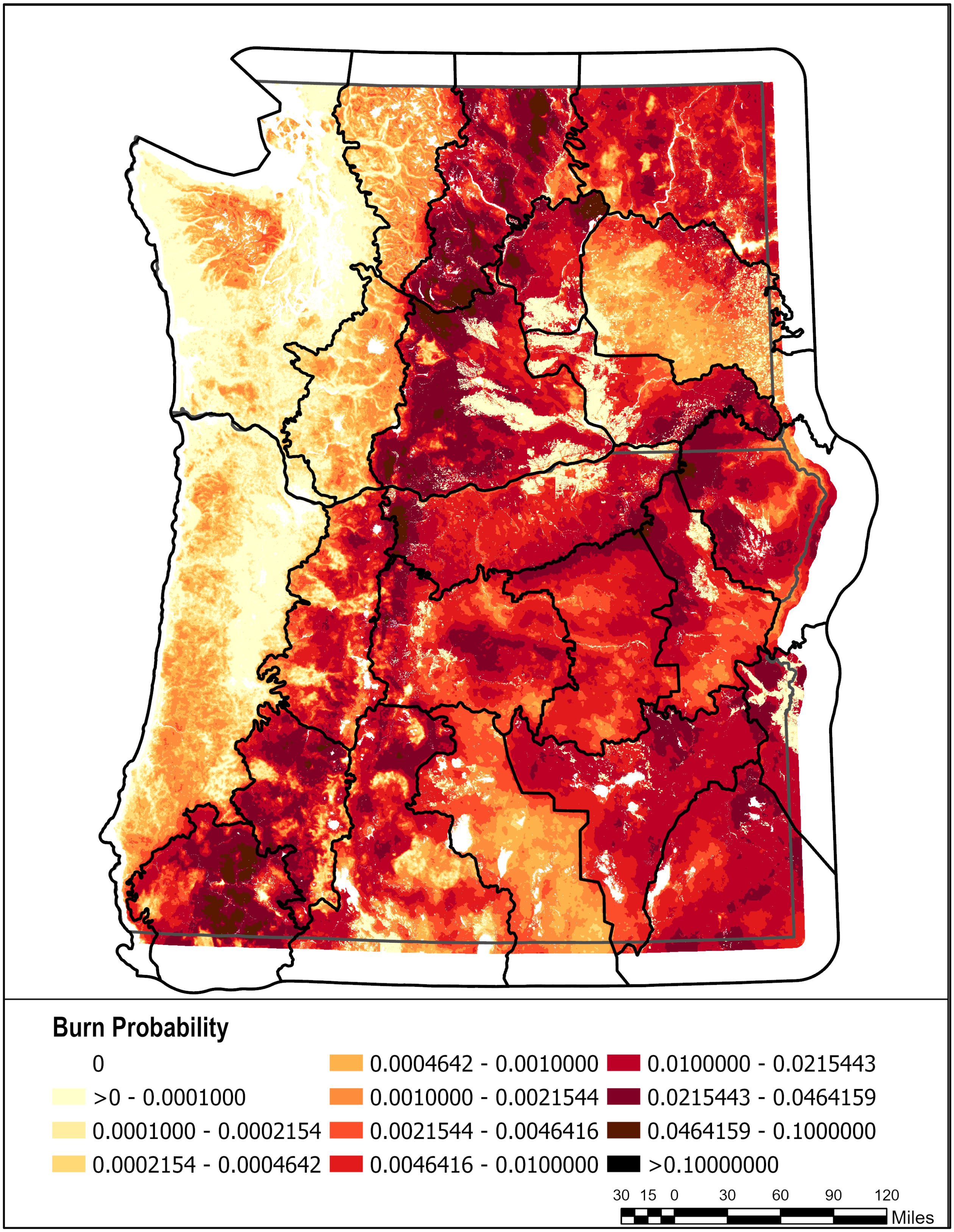

Figure 5. Burn probability across the analysis area, including changes to agricultural lands informed by IrrMapper data.

3.2.2 Wildfire Intensity

Pyrologix LLC generated spatial estimates of wildfire intensity using WildEST (Scott, 2020). WildEST is a deterministic wildfire modeling tool that uses a command-line version of FlamMap (Finney, 2006) to simulate 216 deterministic scenarios based on combinations of wind speed, wind direction and fuel moisture content. The 216 scenarios were weighted according to Weather Type Probabilities (WTPs), where more weight was assigned to scenarios associated with higher spread conditions. Pyrologix LLC used 4-Km gridded weather data to develop the 216 scenarios. WildEST simulations were performed at 30-meter resolution.

WildEST produced spatially explicit flame length probabilities for each of the six fire intensity levels (FIL) required for fire effects analysis in the QWRA framework (Figures 6 - 11). Fire intensity level rasters represent the probability of a fire occurring within the specified flame length range based on heading and non-heading fire types simulated in WildEST.

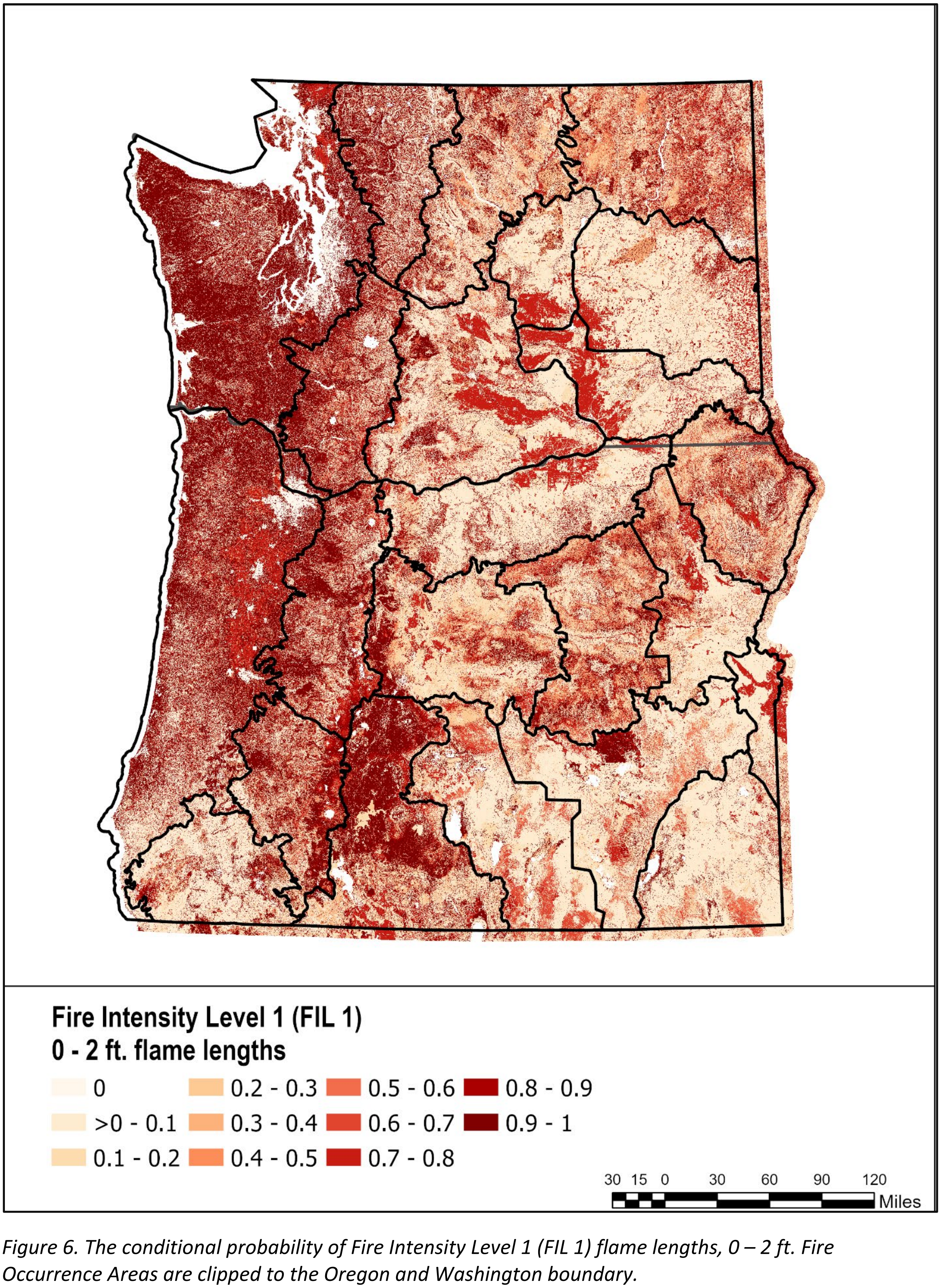

Figure 6. The conditional probability of Fire Intensity Level 1 (FIL 1) flame lengths, 0 – 2 ft. Fire Occurrence Areas are clipped to the Oregon and Washington boundary.

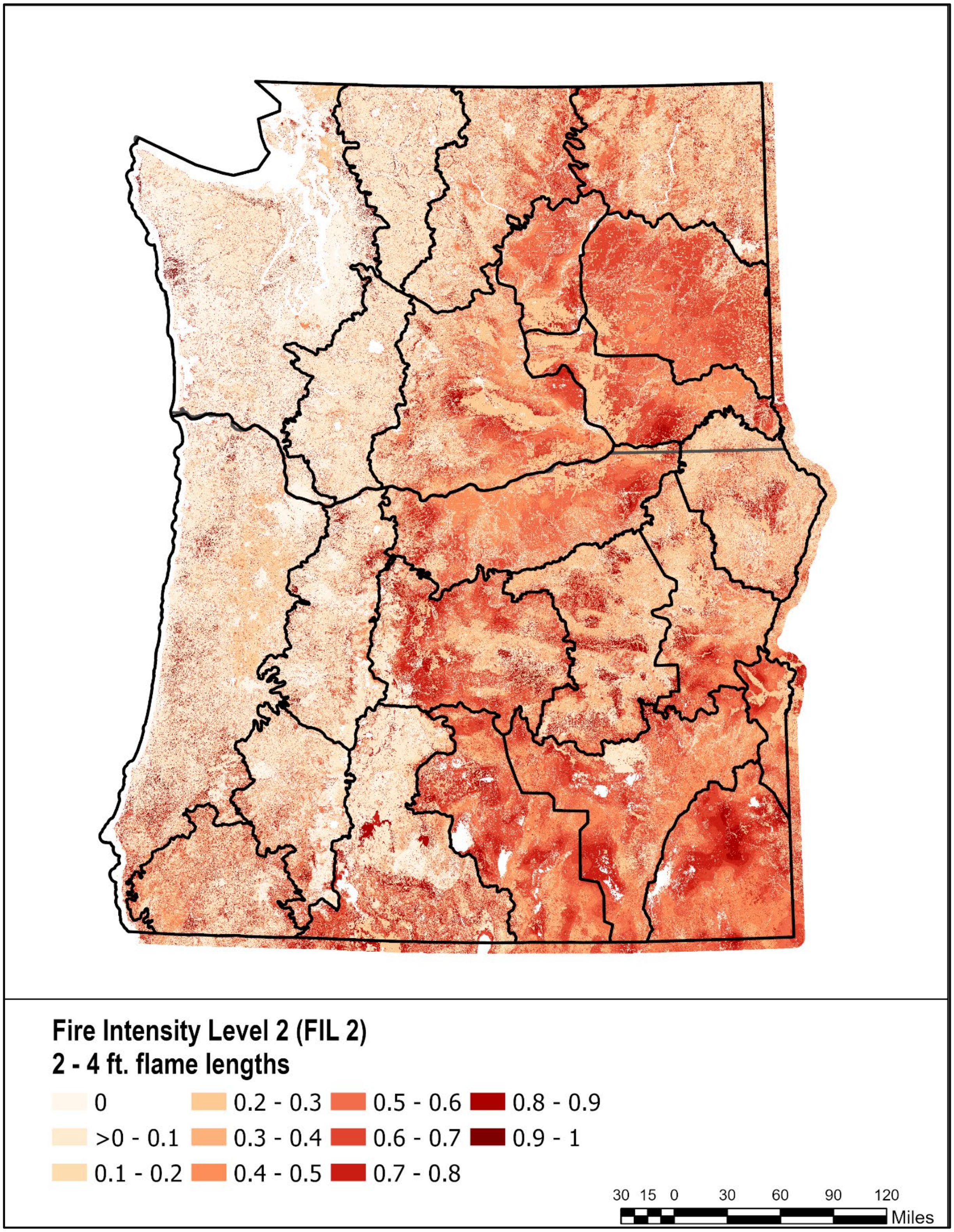

Figure 7. The conditional probability of Fire Intensity Level 2 (FIL 2) flame lengths, 2 - 4 ft. Fire Occurrence Areas are clipped to the Oregon and Washington boundary.

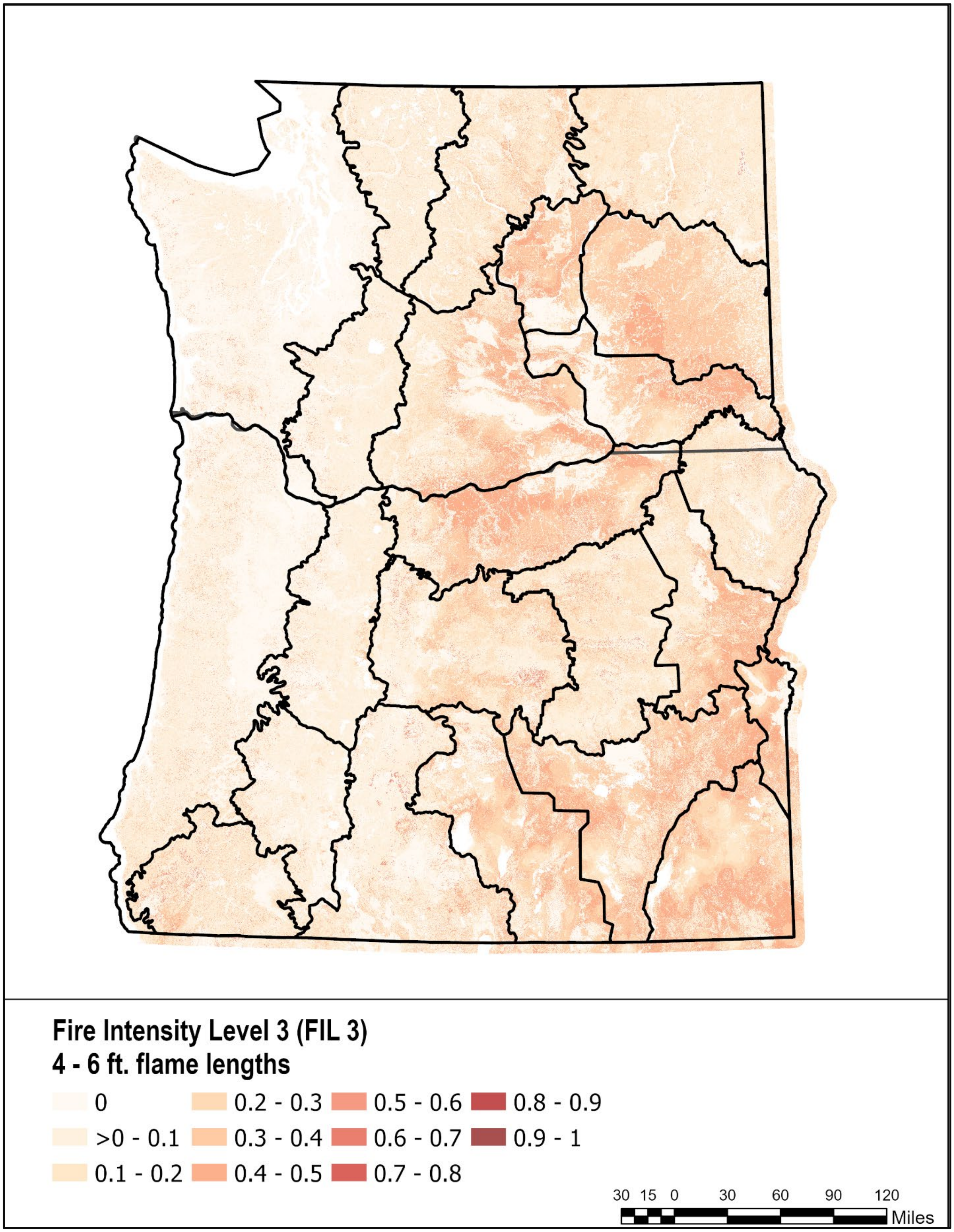

Figure 8. The conditional probability of Fire Intensity Level 3 (FIL 3) flame lengths, 4 - 6 ft. Fire Occurrence Areas are clipped to the Oregon and Washington boundary.

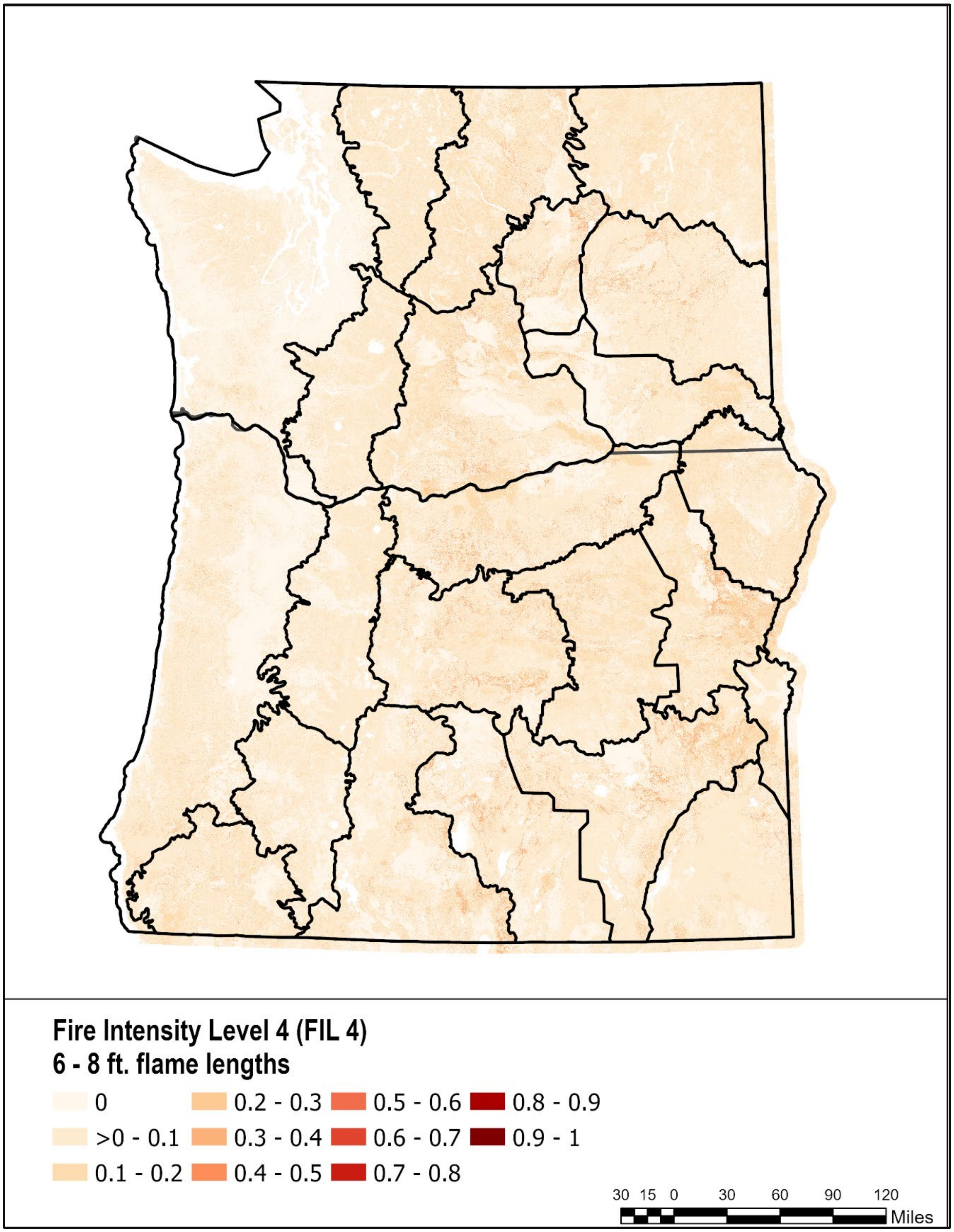

Figure 9. The conditional probability of Fire Intensity Level 4 (FIL 4) flame lengths, 6 - 8 ft. Fire Occurrence Areas are clipped to the Oregon and Washington boundary.

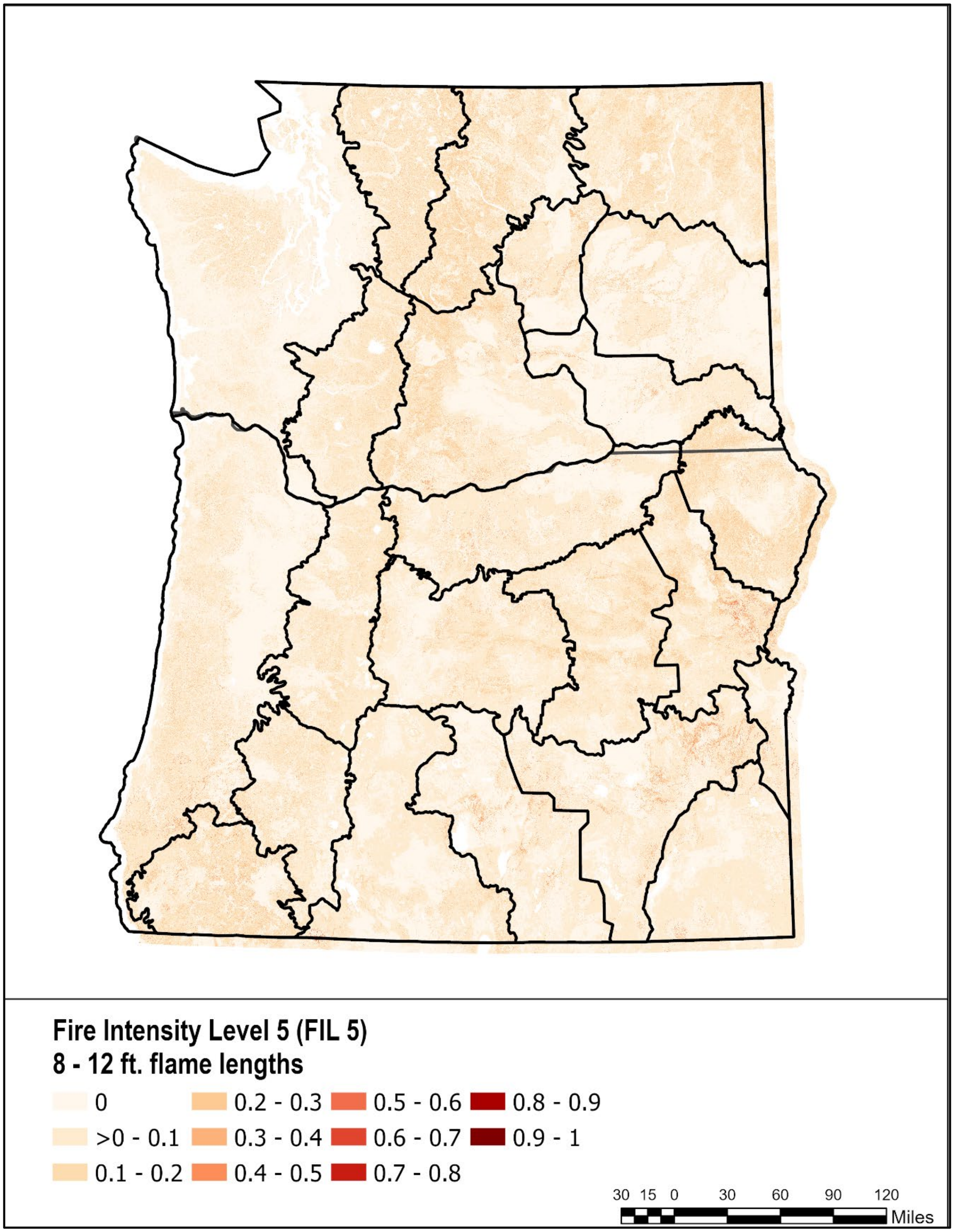

Figure 10. The conditional probability of Fire Intensity Level 5 (FIL 5) flame lengths, 8 - 12 ft. Fire Occurrence Areas are clipped to the Oregon and Washington boundary.

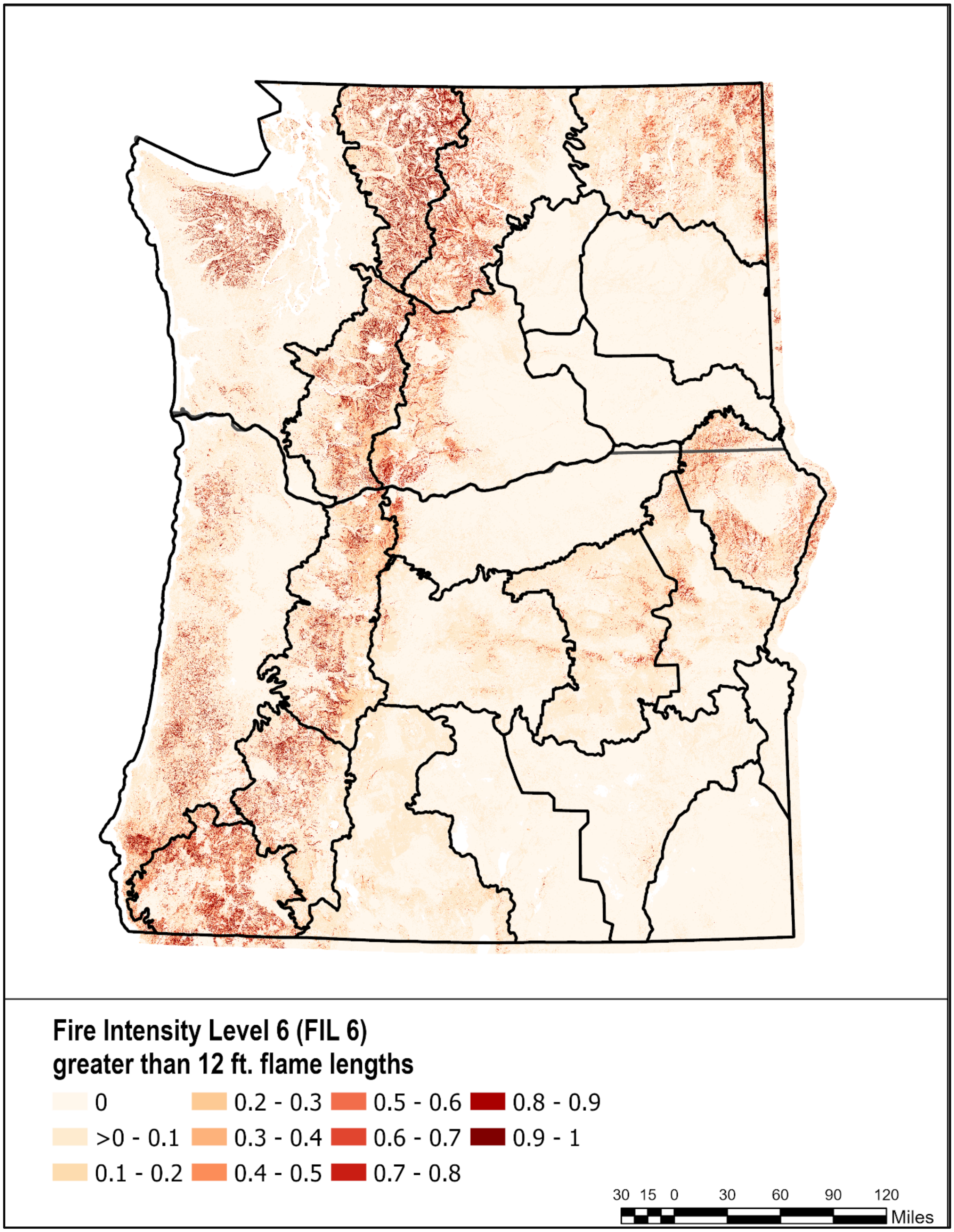

Figure 11. The conditional probability of Fire Intensity Level 6 (FIL 6) flame lengths, greater than 12 ft. Fire Occurrence Areas are clipped to the Oregon and Washington boundary.

4 Effects Analysis for the Pacific Northwest Quantitative Wildfire Risk Assessment (2023)

4.1 Identifying HVRAs for the PNW QWRA 2023

PNW QWRA partners updated the PNW QWRA 2018 HVRAs based on best available science and feedback from PNW QWRA stakeholders. In November 2022, we distributed a digital survey to over 100 stakeholders requesting their feedback on which HVRAs to include in the assessment and how best to represent them. Most of the feedback we received focused on improving the characterization of existing HVRAs, although we did add a few new HVRAs to better represent values across Oregon and Washington.

Table 3. Summary table of HVRAs included in the 2023 QWRA and how they compare to HVRAs in the previous assessment.

HVRA	Included in 2018?	Description of changes
People and Property	Yes	PNW QWRA 2018 used data estimating the distribution of residential structures. We updated to a building footprints data layer that includes residential and non-residential structures.
Infrastructure	Yes	Datasets updated. Some energy production and storage sites were added to list of sub-HVRAs not accounted for in the building footprints dataset. Historical structures, sawmills, and recreation sites are omitted as they are captured in the building footprints dataset.
Drinking Water	Yes	We updated the process for assessing watersheds directly contributing to drinking water. The extent of watersheds changes and reduced significantly across the Columbia Plateau in Washington.
Timber	Yes	We updated the timber volume (i.e., size class) data layers to the most recent estimates. We added private non-industrial ownership as a sub-HVRA.
Agriculture	No	We added this value to the PNW QWRA, accounting for annual and perennial crops.
Ecological Integrity	Yes	We updated the datasets for forest vegetation, but otherwise assessed this value in much the same way. We added new rangeland sub-HVRAs and estimated the effect of wildfire on post-fire annual grass invasion and juniper encroachment.
Wildlife Habitat	Yes	Similar methods with updated datasets. Refined extent and characterization of northern spotted owl. Removed Lahontan cutthroat trout.
Recreation	No	Similar methods but taken out from under the Infrastructure HVRA and placed in its own HVRA.

More than 30 project partners and subject matter experts reviewed the final list of HVRAs and mapping methods for mapping during a three-day workshop March 1-3, 2023. Participants included research scientists, fire and fuels planners, ecologists, wildlife biologists, and resource specialists from across Oregon and Washington. We maintained all HVRAs from the previous risk assessment and added two new HVRAs (Table 3). However, we did adopt updated data layers and methodology for characterizing individual HVRAs that significantly improved their estimates.

During a workshop March 1-3, 2023, relevant subject matter experts from around the PNW, including wildfire fire professionals, assigned response functions to each sub-HVRA. For HVRAs or sub-HVRAs carried over from PNW QWRA 2018, the pre-existing response functions served as a starting point, but, in some cases, changed in the updated QWRA in this update based on new science or gained knowledge. In the case of HVRAs and sub-HVRAs new to the PNW QWRA 2023, we asked working groups of subject matter experts to develop draft response functions which were then reviewed, and when necessary adjusted, by a larger audience during the response function workshop previously mentioned above.

4.2 Relative Importance in the PNW QWRA 2023

Leadership representatives from the Oregon Department of Forestry, Washington Department of Natural Resources, U.S. Forest Service, and the Bureau of Land Management assigned relative importance to each of the eight HVRAs during a meeting on May 31, 2023 (Table 4, Figure 12). Following the assignment of HVRA RI, we allocated each HVRA's RI across its constituent sub-HVRAs. sub-HVRA relative importance was determined based on expert judgement and by referring to policy or management documents. In Section 4.3 we report the overall share of each HVRA's RI allocated to each sub-HVRA. Importantly, the share of RI assigned to each sub-HVRA reflects both the relative importance placed on the sub-HVRA and the spatial extent of the sub-HVRA.

Table 4. Relative importance for HVRAs in the PNW QWRA 2023. Relative importance was assigned by QWRA project partner leaders. The share of relative importance was calculated by dividing a relative importance value by the total amount of importance (i.e. 284).

HVRA	Relative Importance	Share of Relative Importance
People and Property	100	35%
Drinking Water	50	18%
Infrastructure	45	16%
Timber	35	12%
Wildlife Habitat	20	7%
Ecological Integrity	30	11%
Agriculture	3	1%
Recreation	1	0.40%
Total	**284**	**100%**

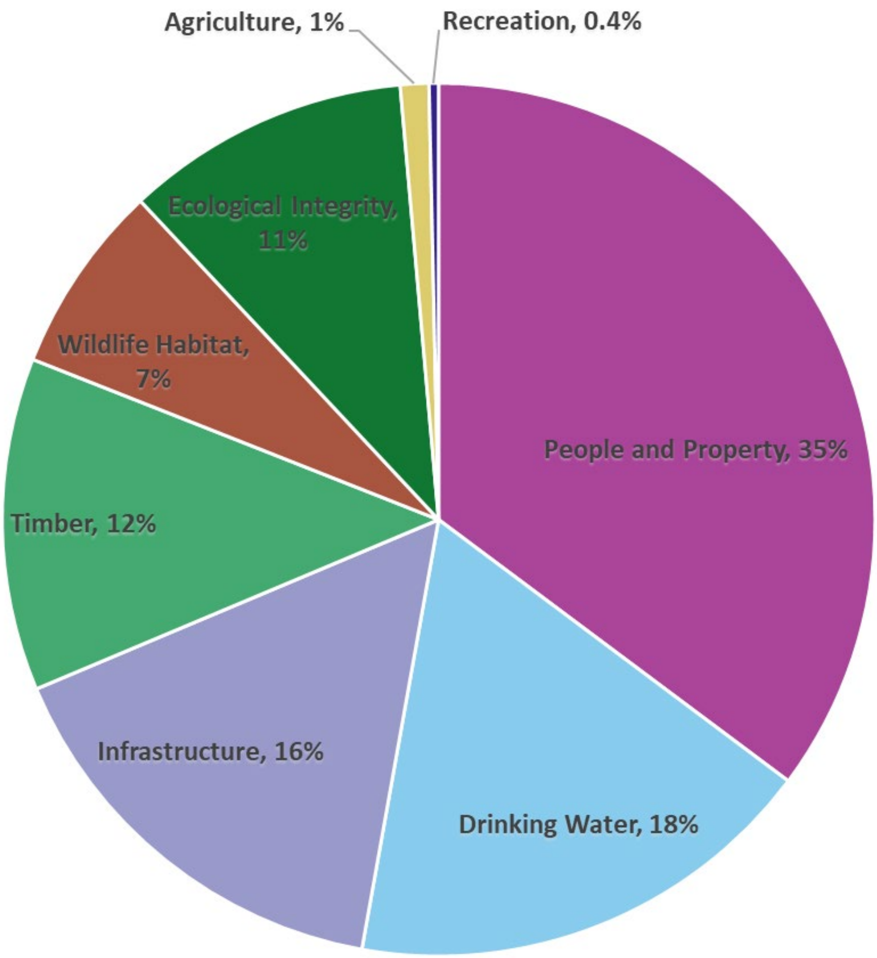

Figure 12. Overall relative importance among HVRAs in PNW QWRA 2023.

4.3 HVRA Summaries

The following sub-sections describe the detailed methods we used to define and map each sub-HVRA, to characterize susceptibility, and to assign relative importance.

4.3.1 People and Property

4.3.1.1 Intent

The People and Property HVRA assesses wildfire risk to residential and non-residential structures and associated property infrastructure.

4.3.1.2 Summary of changes

For this update, we expanded the People and Property HVRA to include non-residential structures and associated property infrastructure. This change is, in part, a result of using building footprint datasets to identify structure locations, as well as the need to account for risk to non-residential structure that in some cases is more important to community resilience than homes (e.g., hospitals, schools). As a result of the changes, the extent of the People and Property HVRA expanded by 1.2 million acres compared to the extent in the PNW QWRA 2018.

4.3.1.3 Methods

We determined the People and Property HVRA extent using a combination of structure location spatial datasets. Microsoft Building Footprints (MBF) served as the foundational dataset-level source of structure location data (Microsoft, 2018), but was updated with local data. The MBF data maps the footprint of individual buildings using a machine learning algorithm applied to aerial imagery. This dataset creates polygons of building footprints that are subsequently converted to points for estimating the number or density of structures.

In Oregon and Washington, we used refined structure point location data which was based on MBF, but amended with additional information from regional, county and local planning sources. In Oregon, the Statewide Building Footprint of Oregon (SBFO) data produced by the Oregon Department of Geology and Mineral Industries (Williams, 2021) used regional, county and local planning data to review and amend MBF data. The SBFO process deleted 18,961 false positive structure locations from the original MBF data, but added 39,188 structures which had previously been unrepresented in the MBF data. In Washington, the Department of Natural Resources similarly modified the MBF data using statewide parcel information to add missing structures and remove false positives. The Washington structure location data is unpublished. To determine structure densities in adjacent states (i.e. California, Nevada, Idaho) to extend out our modeling region beyond the borders of Oregon and Washington (address edge effects), we relied on MBF point locations from each state.

We further classified this HVRA into sub-HVRAs based on the estimated structure density. We calculated density using the kernel density function in ArcPro v3.0 using a 744-foot search radius (approx. 40 acres) and selecting expected structure counts for the output. The kernel density approach concentrates the value on and adjacent to known structure locations, but also assigns some structure density to the surrounding 40-acre area to account for smaller outbuildings potentially missed, additional property amenities, and other property-level improvements or adjacent vegetation that have direct values to the occupants of the primary structures. We then assigned seven density-based sub-HVRAs to account for variation in value from the structures outwards using the following schema:

1. **Very Low Density**: > 0 structures per acre - 1 structure per 40 acres
2. **Low Density**: 1 structure per 40 acres - 1 structure per 20 acres
3. **Moderately Low Density**: 1 structure per 20 acres - 1 structure per 10 acres
4. **Moderate Density**: 1 structure per 10 acres - 1 structure per 5 acres
5. **Moderately-High Density**: 1 structure per 5 acres - 1 structure per 2 acres
6. **High Density**: 1 structure per 2 acres - 3 structures per acre
7. **Very High Density**: > 3 structures per acre

Concurrently, the susceptibility of people and property was stratified by structure density (Table 5). We assumed susceptibility at any given fire intensity level was consistent across the sub-HVRAs until moderately-high structure densities when the response becomes more negative at lower fire intensity levels. The responses are designed to reflect operational limitations in higher density environments as well as the increased potential for structure to structure transmission.

Thirty-five percent of the overall relative importance was allocated to the People and Property HVRA. Within the HVRA, relative importance was allocated proportional to the average number of structures per pixel across the sub-HVRAs. The most importance was allocated to the Very High Density sub-HVRA and the least to the Very Low Density sub-HVRA.

Table 5. Response functions for sub-HVRAs in the People and Property HVRA. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA.

		Fire Intensity Level (flame length)					
		FIL 1	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
Sub-HVRA	Share of HVRA RI	*0 - 2'*	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Very low density; > 0 structures - 1 structure per 40 acres	< 1%	-10	-20	-40	-80	-100	-100
Low density; 1 structure per 40 - 1 structure per 20 acres	1%	-10	-20	-40	-80	-100	-100
Moderately low density; 1 structure per 20 - 1 structure per 10 acres	3%	-10	-20	-40	-80	-100	-100
Moderate density; 1 structure per 10 - 1 structure per 5 acres	7%	-10	-20	-40	-80	-100	-100
Moderately high density; 1 structure per 5 - 1 structure per 2 acres	14%	-10	-30	-50	-80	-100	-100
High density; 1 structure per 2 - 3 structures per acre	47%	-20	-40	-60	-80	-100	-100
Very high density; > 3 structures per acre	28%	-30	-50	-70	-100	-100	-100

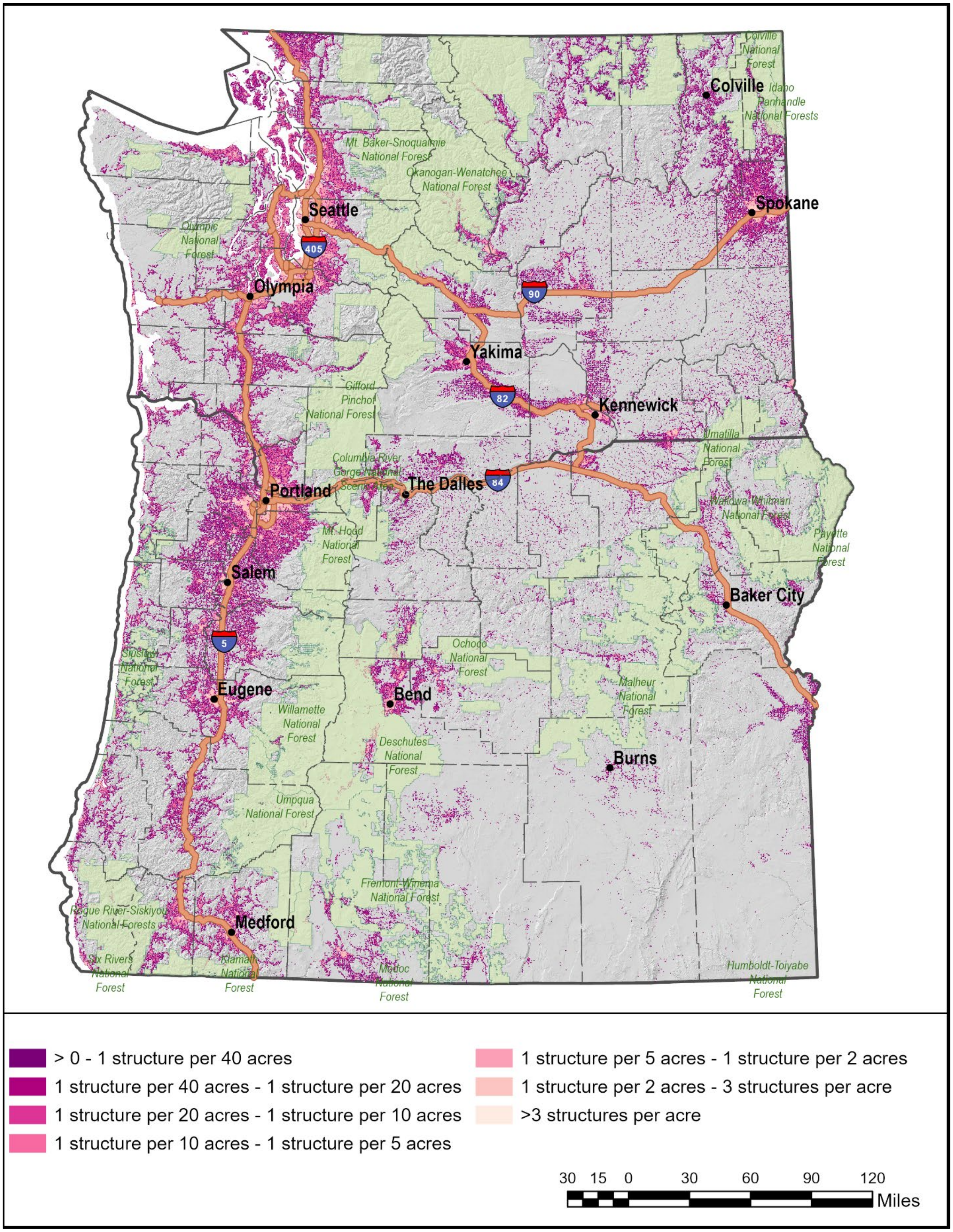

Figure 13. Extent of each sub-HVRA in the People and Property HVRA.

4.3.2 Ecological Integrity

4.3.2.1 Intent

Overall, the Ecological Integrity HVRA is intended to capture the quality and condition of ecosystems and how they respond to wildfires. In the PNW QWRA 2018, this HVRA was called Vegetation Condition.

4.3.2.2 Ecological Integrity, Forested Ecosystems

Summary of changes

We made two notable changes to the ecological integrity data layer within forested ecosystems. First, we excluded the Ecological Integrity HVRA from some privately-owned forested lands based on zoning codes and presumed land management objectives. In total, approximately 5 million forested acres were excluded from the HVRA, largely in western Oregon and Washington or in populated centers throughout the rest of the region.

Secondly, we adjusted response functions in mid- and late-seral forests to account for the relative time required to reestablish them once lost. Generally, we assigned more negative response to transitions from mid- or late-seral structure to early seral structure. In PNW QWRA 2018, response to fire was based only on the relative abundance of the post-fire seral class with respect to historic ranges of variation. The change was first premised on the declining extent of old-growth forests in Oregon and Washington and the amount of time and uncertainty involved in ever re-establishing them once lost. Subsequently, we reasoned that mid-seral structure also takes more time to recover than early-seral structure, and mid-seral structure is essential along the pathway to recovering late-seral structure which is departed from its historical range of variation.

Methods

The Forested Ecological Integrity process evaluated existing structural conditions and assesses whether wildfire moves forest structure towards or away from desired restoration targets. The framework and methods are described in detail in Laughlin et al. (2023), DeMeo et al. (2018), and Haugo et al. (2015).

To begin, we mapped the extent of the HVRA using forest structure data (LEMMA, 2017). However, we constrained the extent further to exclude certain privately-owned and developed landscapes. While ecological integrity is certainly a goal for many private landowners, we assumed that relatively few of them have the capacity or risk tolerance to advance ecological integrity through effects of wildfire. To that end, forested Ecological Integrity was not mapped in the following areas:

- *Within urban growth boundaries and the wildland urban interface (WUI)*. Washington Dept. of Natural Resource and Oregon Dept. of Forestry provided statewide WUI maps. Washington State Dept. of Ecology and Oregon Dept. of Land Conservation and Development provided statewide urban growth boundary datasets.

- *Within tax lots zoned as residential, commercial or industrial.* In Oregon, we referred to the most contemporary statewide zoning spatial data (Oregon Department of Land Conservation and Development, 2023)and zoning code classifications (Oregon Department of Land Conservation and Development, 2014). We mapped forested Ecological Integrity on lands classified as Parks and Open Space, Open Space or Conservation, Federal Forest, Federal Range, Indian Reservation, Tribal Trust, Forest, Prime Forest 80, Secondary Forest 80, Mixed Farm Forest 80 and Mixed Farm Forest 160. Additionally, spatial planning data is not available for all Oregon counties, and, in the absence of zoning data, we elected to map forested Ecological Integrity on all lands. Forested Ecological Integrity was excluded from all other zoning codes.

In Washington, we used spatial land use classification data from the Washington State Forestland Database (Rodgers et al., 2019) and zoning code descriptions (Washington State Legislature, 2023). We mapped forested Ecological Integrity on lands classified as Parks, Designated Forestland, and all Undeveloped Land and Water Areas. Forested Ecological Integrity was excluded from all other zoning codes.

- *Within tax lots managed as private industrial timberland.* We used spatial timberland ownership classifications (Atterbury Consultants Inc., 2023) and excluded lands manage by Real Estate Investment Trusts, Timber Management Investment Organizations, and Industrial Private Forestland Owners.

- *Where forests overlap with the People and Property HVRA.* We excluded forested Ecological Integrity as a mapped HVRA on forested pixels that were also mapped within the extent of the People and Property HVRA.

Within the modified extent, we characterized forest structure (s-class) using canopy cover and tree size thresholds (LEMMA, 2023). The five sub-HVRAs that comprise the forested Ecological Integrity HVRA represent these five s-classes:

1. A: Early seral
2. B: Mid-seral, closed canopy
3. C: Mid-seral, open canopy
4. D: Late-seral, open canopy
5. E: Late-seral, closed canopy

We then calculated the current abundance of each S-Class for individual biophysical settings (BpS; as delineated in Haugo et al. 2015) within ecologically meaningful landscape analysis units (LAUs). LAUs were generally defined by HUC 10 or HUC 8 watersheds. For each S-class within a BpS-LAU combination, we compared the contemporary abundance of the s-class to its historical range of variation (HRV) to estimate if it is currently in excess, deficit, or within HRV (similar) for the LAU.

We estimated fire effects to successional pathways using the s-class transition matrix (Table 7). We also estimated fire effects across fire regime groups (FRG) to account for fire-adaptative traits. We applied the FRG associated with a BpS (Haugo et al., 2015).

Lastly, we defined response functions based on current s-class and its departure status. Most pixels were represented by a standard five-box BpS (Table 8). However, some BpS were associated with non-conventional state and transition models that required tailored response frameworks (Tables 9 – Table 11).

Eleven percent of the overall relative importance was allocated to the Ecological Integrity HVRA (Table 4). Within the HVRA, 50% of the importance was allocated to forested sub-HVRAs and 50% to non-forested sub-HVRAs (Table 6). Each of the five forested sub-HVRAs was assigned 10% of the within HVRA importance.

Table 6.Relative importance for all Ecological Integrity sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA.

Sub-HVRA	Share of HVRA RI
Good and Intermediate Condition Grasslands	12%
Poor Condition Grasslands	2%
Good and Intermediate Condition Shrublands	15%
Poor Condition Shrublands	2%
Encroaching Juniper, >20% cover, Poor Condition	2%
Encroaching Juniper, >20% cover, Good/Intermediate Condition	5%
Encroaching Juniper, 5 - <20% cover, Poor Condition	2%
Encroaching Juniper, 5 - <20% cover, Good/Intermediate Condition	10%
Forests, Early Seral	10%
Forests, Mid-Seral Closed Canopy	10%
Forests, Mid-Seral Open Canopy	10%
Forests, Late-Seral Open Canopy	10%
Forests, Late-Seral Closed Canopy	10%

Table 7. S-class transition matrix for forested Ecological Integrity HVRAs.

	Fire Intensity Level (flame length)					
	FIL 1	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
	0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Beginning s-class	**Transition to s-class**					
Fire Regime Group I, Standard 5-box model						
Early Seral (A)	A	A	A	A	A	A
Mid-Seral Closed (B)	B	B	C	C	A	A
Mid-Seral Open (C)	C	C	C	C	A	A
Late-Seral Open (D)	D	D	D	D	A	A
Late-Seral Closed (E)	E	E	D	D	A	A
Fire Regime Group III, Standard 5-box model						
Early Seral (A)	A	A	A	A	A	A
Mid-Seral Closed (B)	B	B	C	A	A	A
Mid-Seral Open (C)	C	C	C	C	A	A
Late-Seral Open (D)	D	D	D	D	A	A
Late-Seral Closed (E)	E	E	D	D	A	A
Fire Regime Group III, Non-standard 3-box model						
Early Seral (A)	A	A	A	A	A	A
Late Closed (B)	B	B	C	C	A	A
Late Open (C)	C	C	C	C	A	A
Fire Regime Group IV & V, Standard 5-box model						

Early Seral (A)	A	A	A	A	A	A
Mid-Seral Closed (B)	B	C	A	A	A	A
Mid-Seral Open (C)	C	C	A	A	A	A
Late-Seral Open (D)	D	D	D	A	A	A
Late-Seral Closed (E)	E	D	D	A	A	A
Fire Regime Group IV, Non-standard 5-box model						
Early Seral (A)	A	A	A	A	A	A
Mid-Seral Closed (B)	A	A	A	A	A	A
Mid-Seral Open (C)	C	A	A	A	A	A
Late-Seral Open (D)	D	A	A	A	A	A
Late-Seral Closed (E)	E	D	A	A	A	A
Fire Regime Group V, Non-standard 5-box model						
Early Seral (A)	A	A	A	A	A	A
Mid-Seral Closed (B)	D	A	A	A	A	A
Mid-Seral Open (C)	D	A	A	A	A	A
Late-Seral Open (D)	D	A	A	A	A	A
Late-Seral Closed (E)	E	D	A	A	A	A

Table 8. Response functions for standard five-box models in the forested Ecological Integrity HVRA.

Standard Five- Box Model			**TO**														
			A - Early			B - Mid Closed			C - Mid Open			D - Late Open			E - Late Closed		
			Deficit	Similar	Surplus	Deficit	Similar	Surplus	Deficit	Similar	Surplus	Deficit	Similar	Surplus	Deficit	Similar	Surplus
FROM	Early	Deficit	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Similar	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Surplus	NA	NA	-25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mid-Closed	Deficit	0	-50	-100	45	NA	NA	30	15	0	NA	NA	NA	NA	NA	NA
		Similar	20	-10	-50	NA	30	NA	45	50	40	NA	NA	NA	NA	NA	NA
		Surplus	30	10	-30	NA	NA	15	55	50	40	NA	NA	NA	NA	NA	NA
	Mid- Open	Deficit	0	-50	-100	NA	NA	NA	50	NA	NA	NA	NA	NA	NA	NA	NA
		Similar	5	-50	-90	NA	NA	NA	NA	40	NA	NA	NA	NA	NA	NA	NA
		Surplus	25	0	-50	NA	NA	NA	NA	NA	30	NA	NA	NA	NA	NA	NA
	Late-Open	Deficit	*-100*	-100	-100	NA	NA	NA	NA	NA	NA	60	NA	NA	NA	NA	NA
		Similar	*-90*	*-95*	-100	NA	NA	NA	NA	NA	NA	NA	60	NA	NA	NA	NA
		Surplus	*-80*	*-90*	*-100*	NA	NA	NA	NA	NA	NA	NA	NA	50	NA	NA	NA
	Late-Closed	Deficit	*-100*	-100	-100	NA	NA	NA	NA	NA	NA	*30*	10	5	60	NA	NA
		Similar	*-90*	*-95*	-100	NA	NA	NA	NA	NA	NA	45	*45*	15	NA	60	NA
		Surplus	*-80*	*-90*	*-100*	NA	NA	NA	NA	NA	NA	60	60	*60*	NA	NA	50

Table 9. Response functions for non-standard five-box models in fire regime IV in the forested Ecological Integrity HVRA.

Non-Standard Five-Box Model FRG IV			TO														
			Early Open (A)			Early Closed (B)			Mid Closed (C)			Mid Open (D)			Late Closed (E)		
			Deficit	Similar	Surplus	Deficit	Similar	Surplus	Deficit	Similar	Surplus	Deficit	Similar	Surplus	Deficit	Similar	Surplus
FROM	Early Open (A)	Deficit	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Similar	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Surplus	NA	NA	-25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Early Closed (B)	Deficit	30	15	0	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Similar	45	50	40	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Surplus	55	50	40	NA	NA	-25	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mid Closed (C)	Deficit	0	-50	-100	NA	NA	NA	40	NA	NA	NA	NA	NA	NA	NA	NA
		Similar	20	-10	-50	NA	NA	NA	NA	30	NA	NA	NA	NA	NA	NA	NA
		Surplus	30	10	-30	NA	NA	NA	NA	NA	15	NA	NA	NA	NA	NA	NA
	Mid Open (D)	Deficit	0	-50	-100	NA	NA	NA	NA	NA	NA	50	NA	NA	NA	NA	NA
		Similar	5	-50	-90	NA	NA	NA	NA	NA	NA	NA	40	NA	NA	NA	NA
		Surplus	25	0	-50	NA	NA	NA	NA	NA	NA	NA	NA	30	NA	NA	NA
	Late Closed (E)	Deficit	*-100*	-100	-100	NA	NA	NA	NA	NA	NA	30	10	5	60	NA	NA
		Similar	*-90*	*-95*	-100	NA	NA	NA	NA	NA	NA	45	45	15	NA	60	NA
		Surplus	*-80*	*-90*	*-100*	NA	NA	NA	NA	NA	NA	60	60	60	NA	NA	50

Table 10. Response functions for non-standard five-box models in fire regime V in the forested Ecological Integrity HVRA.

Non-Standard Five-Box Model FRG V			TO														
			A - Early			B - Mid1 Closed			C - Mid2 Closed			D - Mid Open			E - Late Closed		
			Deficit	Similar	Surplus	Deficit	Similar	Surplus	Deficit	Similar	Surplus	Deficit	Similar	Surplus	Deficit	Similar	Surplus
FROM	Early (A)	Deficit	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Similar	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Surplus	NA	NA	-25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mid1 Closed (B)	Deficit	0	-50	-100	NA	NA	NA	NA	NA	NA	30	15	0	NA	NA	NA
		Similar	20	-10	-50	NA	NA	NA	NA	NA	NA	45	50	40	NA	NA	NA
		Surplus	30	10	-30	NA	NA	NA	NA	NA	NA	55	50	40	NA	NA	NA
	Mid2 Closed (C)	Deficit	0	-50	-100	NA	NA	NA	NA	NA	NA	30	15	0	NA	NA	NA
		Similar	20	-10	-50	NA	NA	NA	NA	NA	NA	45	50	40	NA	NA	NA
		Surplus	30	10	-30	NA	NA	NA	NA	NA	NA	55	50	40	NA	NA	NA
	Mid Open (D)	Deficit	0	-50	-100	NA	NA	NA	NA	NA	NA	50	NA	NA	NA	NA	NA
		Similar	5	-50	-90	NA	NA	NA	NA	NA	NA	NA	40	NA	NA	NA	NA
		Surplus	25	0	-50	NA	NA	NA	NA	NA	NA	NA	NA	30	NA	NA	NA
	Late Closed (E)	Deficit	*-100*	-100	-100	NA	NA	NA	NA	NA	NA	30	10	5	60	NA	NA
		Similar	*-90*	*-95*	-100	NA	NA	NA	NA	NA	NA	45	45	15	NA	60	NA
		Surplus	*-80*	*-90*	*-100*	NA	NA	NA	NA	NA	NA	60	60	60	NA	NA	50

Table 11. Response functions for non-standard three-box models in the forested Ecological Integrity HVRA.

Three Box Model			TO								
			Early (A)			Late Closed (B)			Late Open (C)		
			Deficit	Similar	Surplus	Deficit	Similar	Surplus	Deficit	Similar	Surplus
FROM	Early (A)	Deficit	30	NA	NA	NA	NA	NA	NA	NA	NA
		Similar	NA	0	NA	NA	NA	NA	NA	NA	NA
		Surplus	NA	NA	-25	NA	NA	NA	NA	NA	NA
	Late-Closed (B)	Deficit	*-100*	-100	-100	45	NA	NA	30	15	0
		Similar	*-90*	*-95*	-100	NA	30	NA	45	50	40
		Surplus	*-80*	*-90*	*-100*	NA	NA	15	55	50	40
	Late-Open (C)	Deficit	*-100*	-100	-100	NA	NA	NA	60	NA	NA
		Similar	*-90*	*-95*	-100	NA	NA	NA	NA	60	NA
		Surplus	*-80*	*-90*	*-100*	NA	NA	NA	NA	NA	50

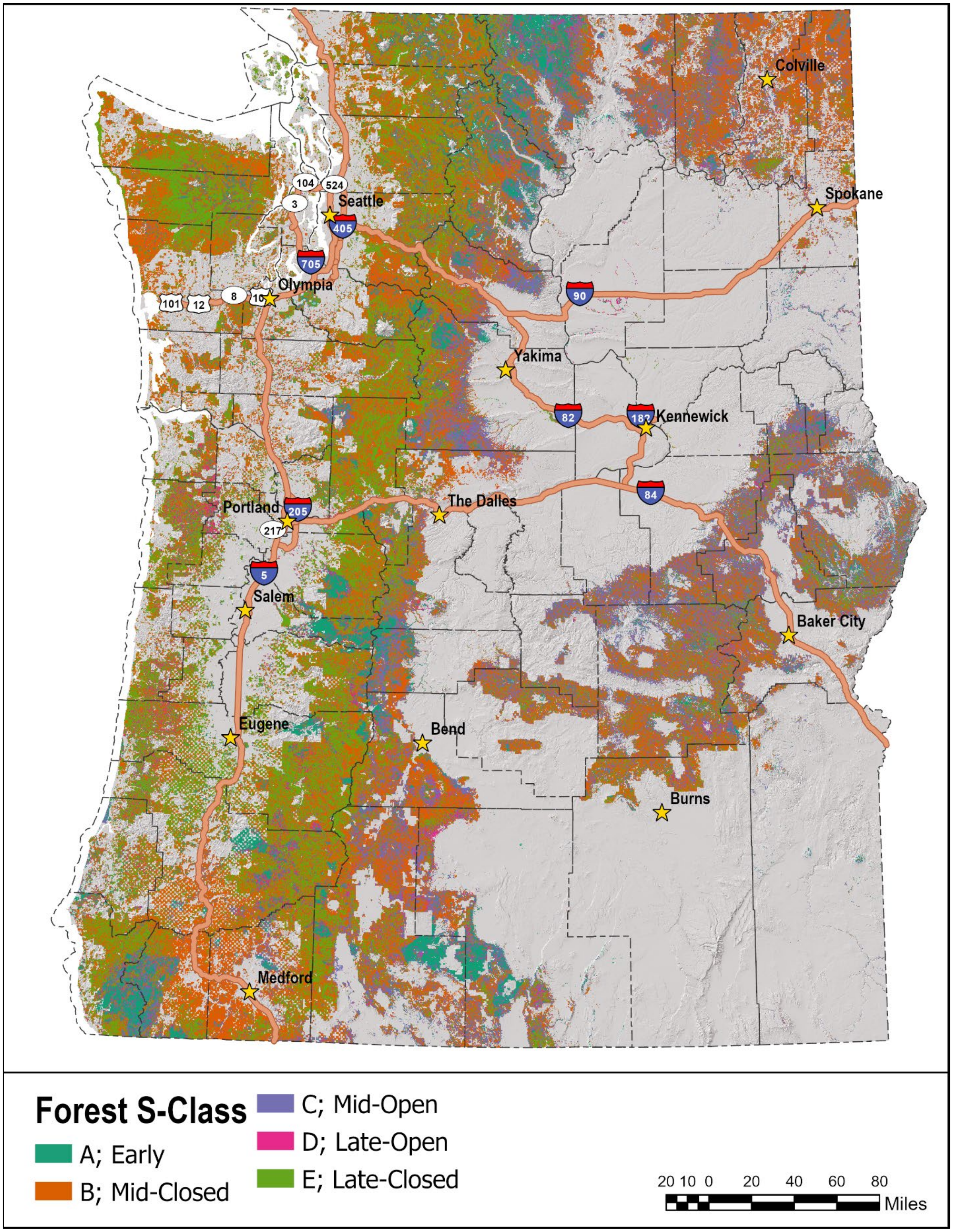

Figure 14. Extent of forested sub-HVRAs in the Ecological Integrity HVRA.

4.3.2.3 Ecological Integrity, Rangeland Ecosystems

Intent

Overall, the Ecological Integrity HVRA is intended to capture the quality and condition of ecosystems and how they respond to wildfires. Our intent within rangeland ecosystems was to assess the likely effect of wildfire on overall condition as measured by threat-based ecostates, with a particular emphasis on post-fire invasion by non-native plant species (i.e., invasive annual grasses).

Summary of changes compared to previous QWRA

Non-forested ecosystems were previously excluded from the Ecological Integrity HVRA in PNW QWRA 2018.

Methods

Assessing wildfire risk to rangeland Ecological Integrity required that we classify existing vegetation into sub-HVRAs based on factors that influence vegetation susceptibility to wildfire. To do so, we used the concepts of threat-based land management (Johnson et al., 2019), as captured in threat-based ecostate maps (Creutzburg, 2022) to characterize existing rangeland condition. The resulting ecostates were classified based on the dominant vegetation (i.e. - shrub, grass, trees) and the relative proportion of percent cover of perennial forbs & grasses to annual forbs & grasses using data from the Rangeland Analysis Platform (U.S. Department of Agriculture, Agricultural Research Service, 2022). The spatial extent of rangeland sub-HVRAs was defined using data from the National Land Cover Database (NLCD; Rigge et al., 2020). The ecostates resulted in our eight rangeland sub-HVRAs:

- **Class A: Good and Intermediate Condition Shrubland** – areas with more than 10% shrubs and the proportion of perennials is greater than annuals in the herbaceous layer
- **Class B: Good and Intermediate Condition Grasslands** – areas with less than 10% shrubs and the proportion of perennials is greater than annuals in the herbaceous layer
- **Class C: Poor Condition Shrubland** – areas with more than 10% shrubs and the proportion of annuals is greater than perennials in the herbaceous layer
- **Class D: Poor Condition Grassland** – areas with less than 10% shrubs and the proportion of annuals is greater than perennials in the herbaceous layer
- **Juniper: early to mid-encroachment, Good and Intermediate Condition Understory** – tree cover (assumed to be encroaching juniper) is 5% - 20% canopy cover and the proportion of perennials is greater than annuals in the herbaceous layer.
- **Juniper: early to mid-encroachment, Poor Condition Understory** – tree cover (assumed to be encroaching juniper) is 5% - 20% canopy cover and the proportion of annuals is greater than perennials in the herbaceous layer.
- **Juniper: late encroachment, Good and Intermediate Condition Understory** – tree cover (assumed to be encroaching juniper) is more than 20% canopy cover and the proportion of perennials is greater than annuals in the herbaceous layer.
- **Juniper: late encroachment, Poor Understory** – tree cover (assumed to be encroaching juniper) is more than 20% canopy cover and the proportion of annuals is greater than perennials in the herbaceous layer.

We used resilience and resistance (R&R) classes as a covariate to help explain the response to fire in conjunctions with the ecostate (Table 12). Resilience and resistance data characterize ecosystem resilience to disturbance and resistance to annual invasive grasses based on abiotic characteristics (Chambers et al., 2017). First, we used the most up to date soil survey data and expert-derived rulesets to classify rangeland ecosystems across Oregon and Washington in one of three R&R classes (Maestas et al., 2016; U.S. Department of Agriculture, Natural Resources Conservation Service, 2023a, 2023b). Next, we replaced some of the original R&R data in eastern Oregon with an updated version of R&R which corrected some known errors in the original STATSGO2 and SSURGO soil data (NRCS West Technology Support Center, 2020).

Across grassland and shrubland ecostates, fire was generally assumed to have negative consequences except at low intensity in some areas with High R&R (Table 12). Negative consequences represent the loss of perennial vegetation as well as increased opportunities for non-native annual vegetation to colonize post-fire areas. Good and intermediate condition ecostates were deemed to have more value at risk, and therefore greater loss compared to poor condition ecostates. In addition, ecostates with High R&R were assumed to be less susceptible than those with Low R&R.

For the encroaching juniper sub-HVRAs, we balanced the benefits of fire-induced juniper mortality with the potential for post-fire invasion by non-native annual grasses with the response functions (Table 12). When fires were high intensity (i.e. FIL 5 and FIL 6), we assumed they would be more likely to kill perennial vegetation and create opportunities for non-native grasses to germinate quickly and invade. That is reflected in all sub-HVRAs as either moderated benefits or significantly enhanced adverse consequences. The early-mid encroachment condition was assumed to have more value at risk of loss.

Eleven percent of the overall relative importance was allocated to the Ecological Integrity HVRA (Table 4). Within the HVRA, 50% of the importance was allocated to forested sub-HVRAs and 50% to rangeland sub-HVRAs (Table 6). Relative importance among the non-forested sub-HVRAs was allocated according to conservation value. The greatest value, and therefore the largest share of relative importance, was placed on good and intermediate condition ecostates.

Table 12. Response functions for sub-HVRAs in the non-forested Ecological Integrity HVRA.

Sub-HVRA	Covariates *(Resistance & Resilience Class)*	Fire Intensity Level (flame length)					
		FIL 1	FIL 2	FIL 3	FIL 4	FIL 5	FIL 6
		0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Good & Intermediate Condition Shrubland *(perennial cover > annual cover)*	High	20	0	0	-50	-60	-60
	Moderate	0	0	-20	-50	-60	-60
	Low	-60	-60	-70	-70	-80	-80
Good & Intermediate Condition Grassland *(perennial cover > annual cover)*	High	20	10	0	0	0	0
	Moderate	10	10	-10	-20	-20	-20
	Low	-40	-40	-40	-40	-40	-40
Poor Condition Shrubland *(annual cover > perennial cover)*	High	-20	-20	-30	-30	-40	-40
	Moderate	-60	-60	-70	-70	-80	-80
	Low	-80	-80	-90	-90	-100	-100
Poor Condition Grassland *(annual cover > perennial cover)*	High	-20	-20	-20	-20	-20	-20
	Moderate	-30	-30	-30	-30	-30	-30
	Low	-40	-40	-40	-40	-40	-40
Juniper, early-mid encroachment, Good & Intermediate Condition Understory *(5-20% tree cover; perennial cover > annual cover)*	High	30	30	40	40	30	30
	Moderate	20	20	30	30	20	20
	Low	10	10	20	20	10	10
Juniper, early-mid encroachment, Poor Condition Understory *(5-20% tree cover; perennial cover < annual cover)*	High	-10	-10	-10	-20	-60	-90
	Moderate	-20	-20	-20	-30	-70	-100
	Low	-30	-30	-30	-40	-80	-100
Juniper, late encroachment, Good & Intermediate Condition Understory *(>20% tree cover; perennial cover > annual cover)*	High	10	10	20	20	10	10
	Moderate	0	0	10	10	0	0
	Low	-10	-10	0	0	-10	-10
Juniper, late encroachment, Poor Condition Understory *(>20% tree cover; perennial cover < annual cover)*	High	-20	-20	-20	-30	-70	-100
	Moderate	-30	-30	-30	-40	-80	-100
	Low	-40	-40	-40	-50	-90	-100

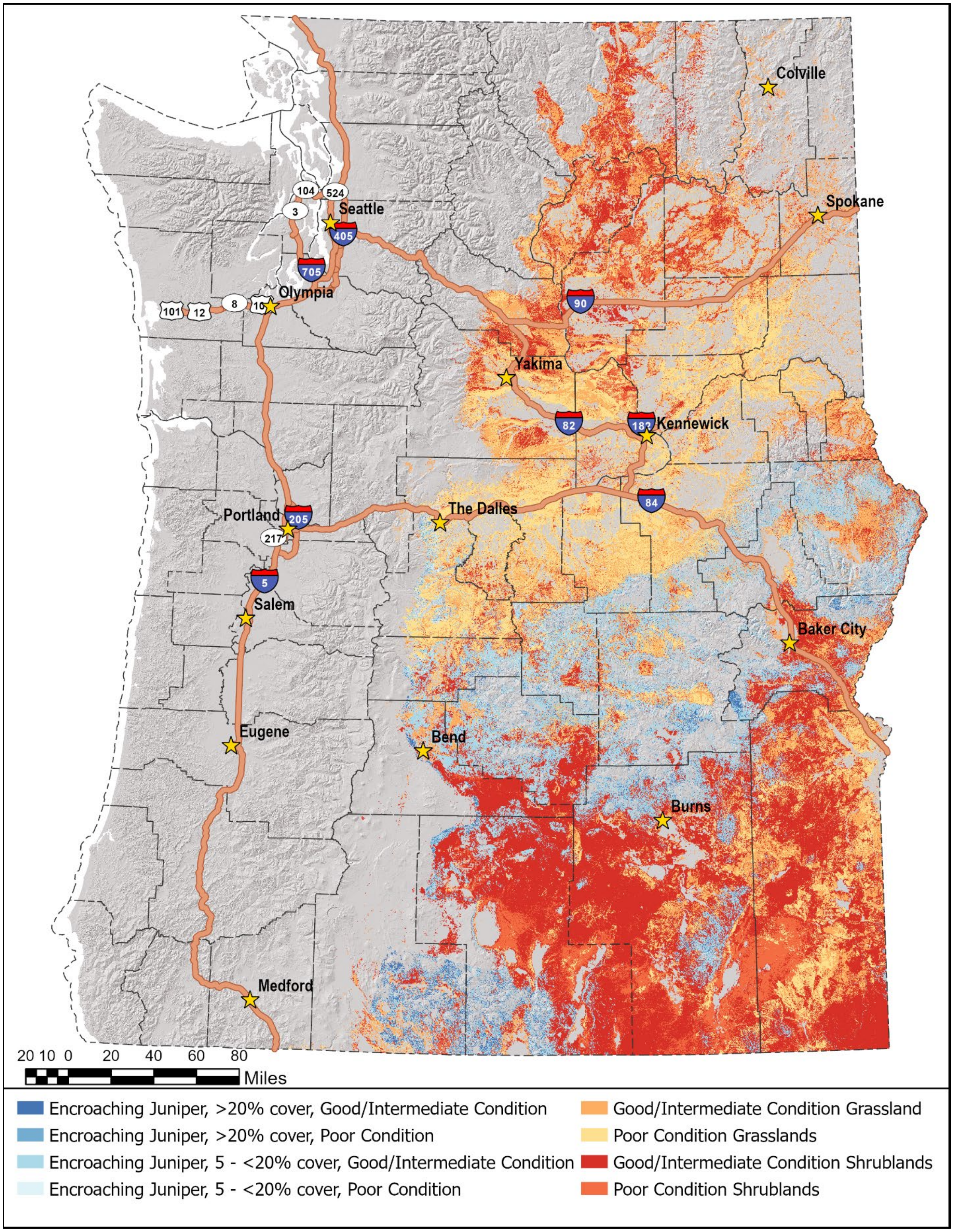

Figure 15. Extent of rangeland sub-HVRAs in the Ecological Integrity HVRA.

4.3.3 Drinking Water

4.3.3.1 Intent

The Drinking Water HVRA is intended to evaluate the risk of post-wildfire sediment delivery to drinking water sources. In the 2018 QWRA this was called the Watershed HVRA. The name change is intended to help communicate the intent.

4.3.3.2 Summary of changes compared to previous QWRA

In response to feedback from QWRA stakeholders, we constrained the extent of this HVRA in central and eastern Washington when compared to the PNW QWRA 2018. The extent of the Watersheds HVRA in the PNW QWRA 2018 included nearly all of central and eastern Washington, reflecting the fact that there are a number of communities who draw their water from the Columbia River. In consultation with the Washington Dept. of Health's Source Water Protection Program intakes and associated source water areas that draw water directly from the Columbia River were omitted from the PNW QWRA 2023.

Response to fire is, in part, based on distance to water body. In the PNW QWRA 2018, the response to fire was based only on the erosion potential. In the PNW QWRA 2023, the response to fire is a function of erosion potential but also a function of how close the pixel is to a drinking source water body.

4.3.3.3 Methods

The Drinking Water HVRA extent was mapped using drinking water intake and source water area data provided by the Oregon Health Authority and the Washington Department of Health. Only surface water intakes were considered. In both states, intakes and source water areas that draw directly from the Columbia were omitted. In Oregon, source water areas were re-delineated using unique intake locations so that source water areas were overlapping and thereby reflecting the entire basin that contributes to an intake.

The population served by each intake was divided evenly across all pixels in the associated source water area. The square root of pixel-level population served was the basis for dividing the HVRA into quantiles which served as the sub-HVRAs:

1. Lowest population served
2. Low population served
3. Moderate population served
4. High population served
5. Highest population served

The response to fire is based on post-fire erosion potential as well as the flow distance from any given pixel to the nearest source water body (Table 13). Post-fire erosion potential was assessed for the PNW QWRA 2018 by the Remote Sensing Applications Center. Flow distance from each pixel in a source water area to the nearest source water was calculated using the Flow Distance tool in ArcPro and using streams, rivers, ponds, lakes and reservoirs identified in the National Hydrography dataset (U.S. Geological Survey (USGS), 2023).

Table 13. Response functions for sub-HVRAs in the Drinking Water HVRA. Response to fire was based on two covariates, erosion potential and distance to water whereas the sub-HVRAs were defined based on the population served.

		Fire Intensity Level (flame length)					
Covariate	**Covariate**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
Erosion Potential	*Distance to Water*	*0 - 2'*	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Slight	0 - 100 meters	0	0	0	-5	-10	-15
	100 - 500 meters	0	0	0	0	-5	-5
	> 500 meters	0	0	0	0	0	0
Moderate	0 - 100 meters	0	0	0	-10	-25	-35
	100 - 500 meters	0	0	0	0	-10	-10
	> 500 meters	0	0	0	0	0	0
High	0 - 100 meters	0	0	0	-30	-40	-50
	100 - 500 meters	0	0	0	-10	-20	-20
	> 500 meters	0	0	0	0	-5	-10
Very High	0 - 100 meters	0	0	-10	-50	-75	-90
	100 - 500 meters	0	0	-5	-20	-30	-40
	> 500 meters	0	0	0	0	-10	-20

Table 14. Relative importance assigned to Drinking Water sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA.

Sub-HVRA	**Share of HVRA RI**
Lowest Population Served	0.2%
Low Population Served	0.8%
Moderate Population Served	4.3%
High Population Served	4.5%
Highest Population Served	90.2%

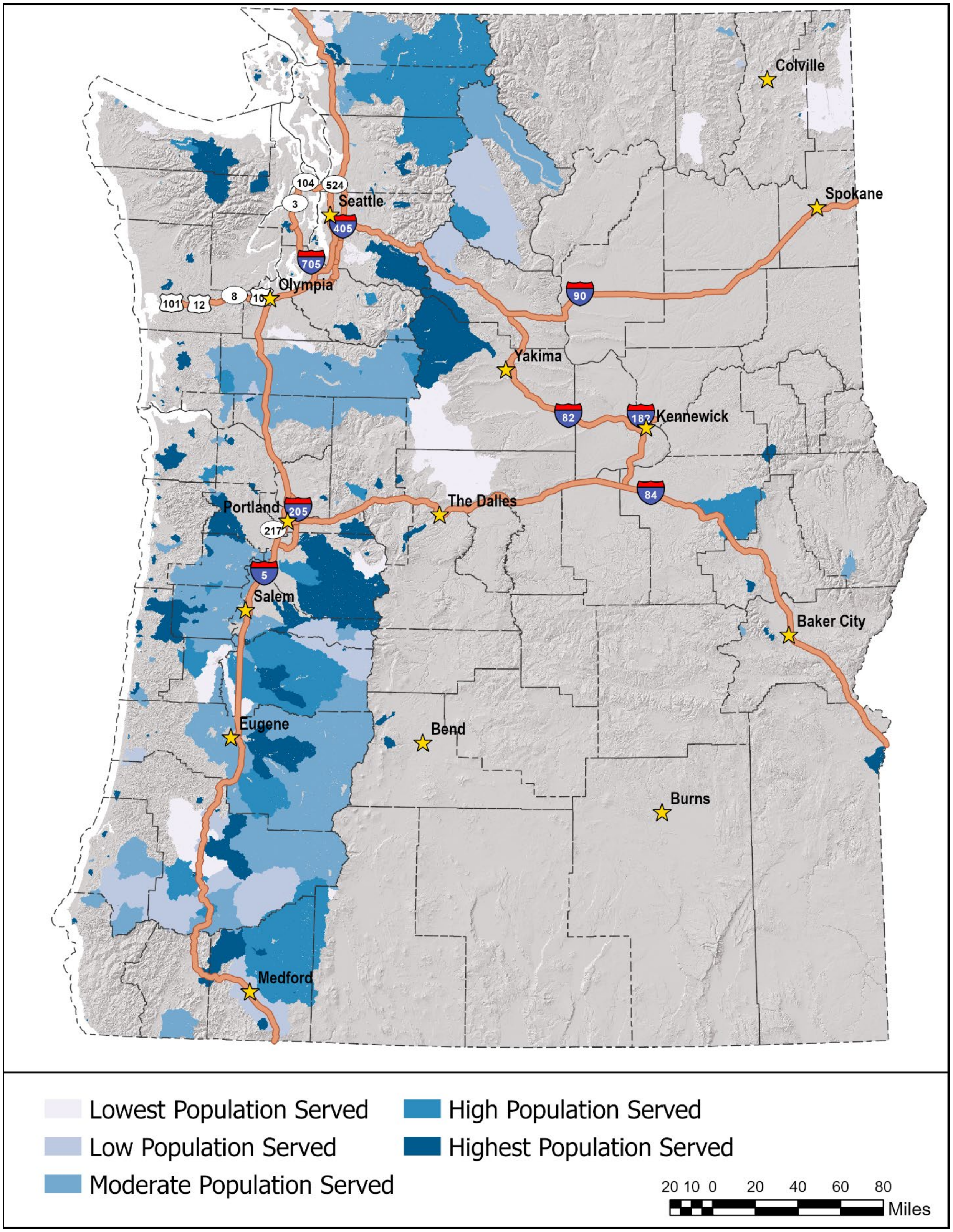

Figure 16. Extent of sub-HVRAs based on per-pixel population served in the Drinking Water HVRA.

4.3.4 Infrastructure

Intent

The Infrastructure HVRA is intended to evaluate wildfire risk to critical infrastructure, namely energy, communication, transportation infrastructure, as well as other essential facilities.

4.3.4.1 Electric Transmission Lines

Summary of changes compared to previous QWRA

The extent of transmission lines in the PNW QWRA 2023 is generally consistent with the PNW QWRA 2018, but we made several changes in how transmission lines were characterized. First, we defined the high voltage transmission lines as those carrying ≥ 100 kV whereas the PNW QWRA 2018 defined them as ≥ 230 kV. This change aligns with industry standards (North American Electric Reliability Corporation, 2018). Secondly, we included vegetation height adjacent to transmission lines as a covariate to further stratify wildfire consequences where taller vegetation poses a greater immediate post-fire hazard and therefore consequence.

Methods

Electric transmission lines were mapped using data from the Homeland infrastructure Foundation-Level Database (HIFLD). High voltage lines were defined as lines with ≥ 100 kV. Low voltage lines were defined as lines with < 100 kV. Lines were converted to 30-meter rasters and expanded by three pixels on each side. We further classified the rasters based on the average adjacent canopy height. Using zonal statistics in ArcPro v3.0 and canopy height(LEMMA, 2023b), we determined the average canopy height within a 60-meter radius. Adjacent canopy height influenced the response to fire, but had no impact on relative importance.

High voltage lines are generally constructed out of steel and therefore relatively resistant to fire effects (Table 15). We also assumed that in most cases, high voltage lines are strung more than 80 feet above the ground. Accordingly, we anticipate low to moderate intensity fire (FIL 1 – FIL4) to have slightly positive to neutral outcomes by reducing fuel loads without adversely impacting transmission infrastructure. Fire effects become increasingly negative as fires exceed FIL5. We assumed low voltage transmission lines were likely constructed out of wood and strung at much lower heights, and therefore more susceptible at all intensities to high voltage lines.

Table 15. Response functions for electric transmission line sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, electric transmission lines were assigned about 36% of all the importance within the Infrastructure HVRA.

Sub-HVRA	Share of HVRA RI	Covariate	Fire Intensity Level (flame length)					
			FIL 1	FIL 2	FIL 3	FIL 4	FIL 5	FIL 6
			0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Electric Transmission Lines - Low Voltage	25%	Canopy height >= 80'	-30	-40	-50	-70	-100	-100
		Canopy height 20 - 80'	-20	-30	-40	-60	-90	-100
		Canopy height < 20'	-10	-20	-30	-50	-70	-90
		Non-forested	-5	-5	-5	-10	-10	-20
Electric Transmission Lines - High Voltage	11%	Canopy height >= 80'	0	0	-20	-30	-50	-60
		Canopy height <80'	0	0	-5	-10	-10	-20
		Non-forested	0	0	0	0	0	0

4.3.4.2 Electric Substations

Summary of changes compared to previous QWRA

The extent and characterization of electric sub-stations is the same as in the PNW QWRA 2018.

Methods

Electric substations were mapped using data from the Homeland Infrastructure Foundation-Level Database (HIFLD). This HVRA captures electric power substations primarily associated with facilities and equipment that switch, transform, or regulate electric power at voltages equal to, or greater than, 69 kV. Points were converted to 30-meter rasters and expanded by three pixels on each side to represent the likely spatial extent of these facilities.

Electric substations were assumed to be relatively resistant to fire overall, reflecting the assumptions that they are generally constructed from non-combustible materials and sites are often maintained with minimal vegetation (Table 16). As fire intensity increases, fire effects are more negative to capture potential impact to the infrastructure as well as the likelihood that operations staff might be forced to evacuate and shut down operations.

Table 16. Response functions for the electric substation sub-HVRA. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, electric substations were assigned about 0.25% of all the importance within the Infrastructure HVRA.

		Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
		0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Electric Substations	0.25%	0	0	-10	-20	-30	-40

4.3.4.3 Oil and Gas Wells

Summary of changes compared to previous QWRA

Oil and gas wells were not previously mapped in the PNW QWRA 2018. This is a new sub-HVRA.

Methods

We mapped oil and gas wells using data from the Homeland Infrastructure Foundation-Level Database (HIFLD). The data represents oil and natural gas wells which is a hole drilled in the earth for the purpose of finding or producing crude oil or natural gas; or producing services related to the production of crude oil or natural gas. Points were converted to 30-meter rasters and expanded by three pixels on each side.

Oil and gas wells were assumed to be relatively resistant to fire overall, reflecting assumptions that they are generally constructed from non-combustible materials and sites are often maintained with minimal vegetation. As fire intensity increases, fire effects are more negative to capture potential impact to the infrastructure as well as the likelihood that operations staff might be forced to evacuate and shut down operations.

Table 17. Response functions for the Oil and Gas Wells sub-HVRA. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, Oil and Gas Wells were assigned about 3% of all the importance within the Infrastructure HVRA.

		Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
		0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Oil and Gas Wells	3%	0	0	0	-10	-10	-20

4.3.4.4 Powerplants

Summary of changes compared to previous QWRA

The extent and characterization of powerplants is the same as in the PNW QWRA 2018.

Methods

Powerplants were mapped using data from the Homeland Infrastructure Foundation-Level Database (HIFLD). The dataset represents electric power plants of multiple types including hydroelectric dams, fossil fuel, nuclear, solar, wind geothermal and biomass. We converted point locations to 30-meter raster pixels and expanded them by three pixels on each side to reflect the spatial distribution of built infrastructure.

Powerplants were assumed to be relatively resistant to fire overall, reflecting the assumptions that they are generally constructed from non-combustible materials and sites are often maintained with minimal vegetation. As fire intensity increases, fire effects are more negative reflecting potential impact to the infrastructure as well as the likelihood that operations staff might be forced to evacuate and shut down operations.

Table 18. Response functions for Powerplants sub-HVRA. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, Powerplants were assigned about 0.15% of all the importance within the Infrastructure HVRA.

		Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
		0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Powerplants	0.15%	0	0	0	-10	-20	-30

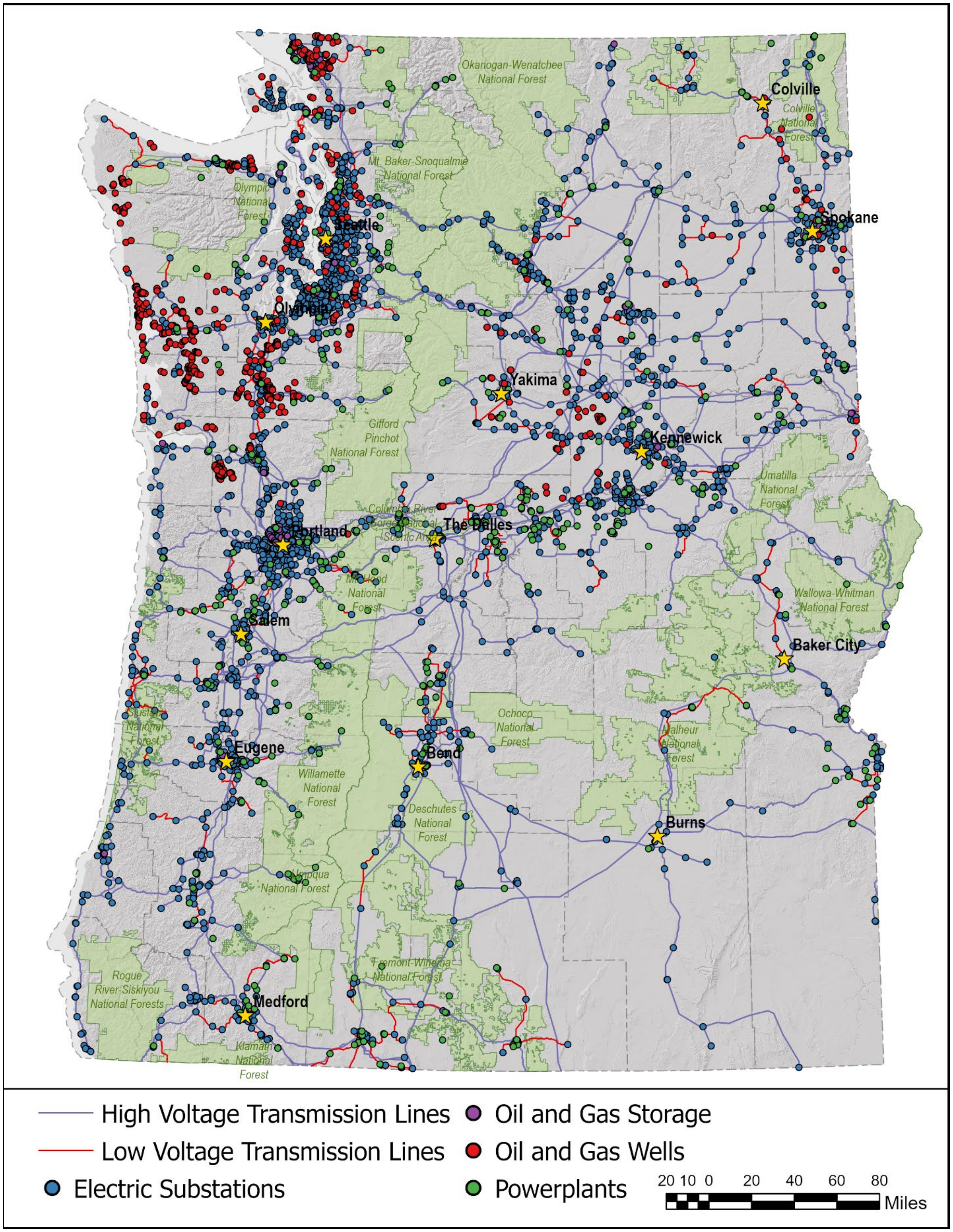

Figure 17. Extent of energy-related sub-HVRAs in the Infrastructure HVRA.

4.3.4.5 Interstates and Highways

Summary of changes compared to previous QWRA

The extent and characterization of interstates and highways is similar to the PNW QWRA 2018. Adjacent canopy cover added as covariate to help explain the response to fire.

Methods

Interstates and highways were mapped using data from the Homeland Infrastructure Foundation-Level Database (HIFLD). Lines were converted to 30-meter rasters and expanded by three pixels on each side. The expanded raster data was then further classified based on the average adjacent canopy height. Using zonal statistics in ArcPro v3.0 and canopy height (LEMMA, 2023b), we determined the average canopy height within a 60-meter radius. Adjacent canopy height influenced the response to fire, but had no impact on relative importance.

Interstates and highways where the adjacent canopy was less than 20 feet high were assumed to be mostly resistant to fires of all intensities. Where the adjacent canopy was greater than 20 feet tall, fire effects become increasingly negative, reflecting the increasing possibility that trees will fall across the road and make it impassable.

Table 19. Response functions for Interstate and State Highway sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, Interstates and Highways were cumulatively assigned about 34% of all the importance within the Infrastructure HVRA.

			Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**Covariate**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
			0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Interstates	8%	Canopy height >= 80'	-20	-50	-80	-90	-100	-100
		Canopy height 20 - 80'	-20	-30	-60	-80	-90	-100
		Canopy height < 20'	-20	-20	-20	-20	-20	-20
State Highways	26%	Canopy height >= 80'	-40	-70	-80	-100	-100	-100
		Canopy height 20 - 80'	-40	-50	-70	-90	-100	-100
		Canopy height < 20'	-20	-20	-20	-20	-20	-20

4.3.4.6 Railroads

Summary of changes compared to previous QWRA

The extent and characterization of railroads is similar to the PNW QWRA 2018. Adjacent canopy cover was added as covariate to help explain the response to fire.

Methods

Railroads were mapped using data from the Homeland Infrastructure Foundation-Level Database (HIFLD). Lines were converted to 30-meter rasters and expanded by three pixels on each side. The expanded raster data was then further classified based on the average adjacent canopy height. Using zonal statistics in ArcPro v3.0 and canopy height (LEMMA, 2023b) we determined the average canopy height within a 90-meter radius. Adjacent canopy height influenced the response to fire, but had no impact on relative importance.

Railroad lines where the adjacent canopy was less than 20 feet high were assumed to be mostly resistant to fires of all intensities. Where the adjacent canopy was greater than 20 feet tall, fire effects become increasingly negative, reflecting the increasing possibility that trees will fall across the railroad and make it impassable.

Table 20. Response functions for the Railroad sub-HVRA. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, Railroads were assigned about 14% of all the importance within the Infrastructure HVRA.

			Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**Covariate**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
			0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Railroads	14%	Canopy height >= 80'	-20	-50	-80	-90	-100	-100
		Canopy height 20 - 80'	-20	-30	-60	-80	-90	-100
		Canopy height < 20'	-5	-5	-5	-5	-5	-5

4.3.4.7 Essential Facilities

Summary of changes compared to previous QWRA

Essential facilities were not previously mapped in the PNW QWRA 2018. This is a new sub-HVRA.

Methods

Essential facilities were mapped using data from the Homeland Infrastructure Foundation-Level Database (HIFLD). Essential facilities are meant to represent structures that might be essential to community function during and immediately following a wildfire, including: hospitals, EMS stations, fire stations, colleges and universities, local law enforcement, schools, childcare centers, solid waste facilities, nursing homes, public health departments, urgent care facilities, wastewater treatment sites, EPA emergency response facilities, public transit centers, and state government buildings.

Essential facilities were assumed to be mildly resistant to low intensity fires, but increasingly susceptible as fire intensities increase. The increasingly negative outcomes were meant to convey not only impacts to the infrastructure but also reduced or canceled operations in many cases (e.g. schools) if staff are forced to evacuate.

Table 21. Response functions for Essential Facilities sub-HVRA. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, Essential Facilities were assigned about 13% of all the importance within the Infrastructure HVRA.

		Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
		0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Essential Facilities	13%	-15	-25	-40	-60	-80	-95

4.3.4.8 Communication Sites

Summary of changes compared to previous QWRA

The extent and characterization of Communication Sites is the same as the PNW QWRA.

Methods

Communication sites were mapped using data from the Homeland Infrastructure Foundation-Level Database (HIFLD). Specifically, we included FM transmission towers, AM transmission towers, broadband radio transmitters, cellular towers, microwave service towers, paging transmission towers, land mobile commercial transmission towers, land mobile broadcast towers, antenna structure, TV broadcast contours, TV digital station transmitters, TV analog station transmitters, and TV digital station transmitters. Points were converted to 30-meter rasters and expanded by three pixels on each side.

Communication sites were assumed to be relatively resistant to fire at low intensities (i.e. FIL1 – 3), but increasingly susceptible as fire intensity increases. The decision to characterize communication sites as relatively resistant to fire overall was intended to reflect the assumption that the infrastructure is often made of steel and also that, in many cases, when damaged the infrastructure can be repaired or replaced relatively quickly.

Table 22. Response functions for the Communication Sites sub-HVRA. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, Communication Sites were assigned about 8% of all the importance within the Infrastructure HVRA.

		Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
		0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Communication Sites	2%	0	-5	-15	-20	-40	-50

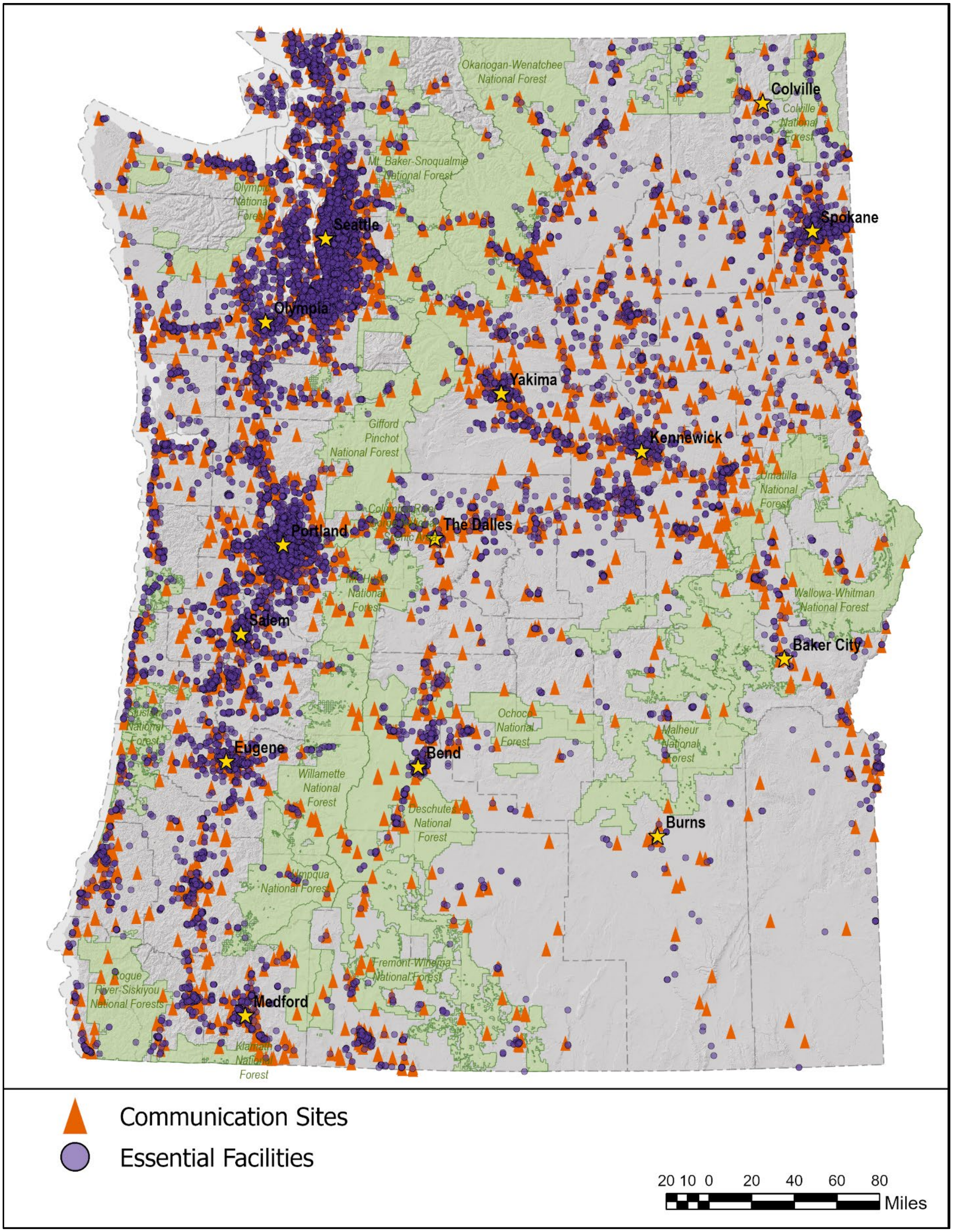

Figure 18. Extent of communication sites and essential facilities.

4.3.5 Timber

Intent

The Timber HVRA is intended to evaluate wildfire risk to commercial timber resources.

General Methods

We grouped sub-HVRAs based on three criteria: land manager, assumed management priority, and timber size class. Land managers included private, state, U.S. Forest Service, Bureau of Land Management and Tribal entities. Methods for mapping the extent of each land manager's timberlands are described in detail in the following sections. We used assumed management priority criteria to distinguish between lands where commercial timber management is the primary objective from those lands where commercial timber management is part of a multiple use strategy. Tribal Active Management, U.S. Forest Service Active Management, BLM Active Management and Private Industrial sub-HVRAs all represent timberlands where commercial timber management is assumed to be the primary management objective. Within all other Timber sub-HVRAs, commercial timber management is presumed to be one of several equally important management objectives. State and federal agencies made these designations on public land, and used available data for tribally-managed lands (Section 4.3.5.3.2 below). We mapped timber size class data using Quadratic Mean Diameter (QMD) from the most recent forest structure data available which approximates forest structure in 2021 (LEMMA, 2023a).

We included fire regime group (FRG), along with timber size class, as a covariate to explain the response to fire. We gave all land managers equal relative importance, but within a land manger type about twice as much importance was placed on active management timberlands compared to timberlands with multiple, equally important management objectives. Additionally, within any sub-HVRA the most relative importance was assigned to the largest size class and the least was assigned to the smallest size class.

4.3.5.1 Private Timberlands

Summary of changes compared to previous QWRA

We included private non-industrial timberlands in this update, which were not included in the last QWRA.

Methods

Industrial ownership was identified using the most recent version of the Atterbury Consultants Forest Ownership data (Atterbury Consultants Inc., 2023), regarded as the most definitive source of this spatial data. Specifically, we selected parcels in Oregon and Washington that were classified as Industrial Forest Private Company (IFPC), Real Estate Investment Trust (REIT) or Timber Investment Management Organizations (TIMO).

We mapped the extent of Private Non-Industrial timber resources using different data and methods in each state. In Oregon, the best available method was to use comprehensive land use rules to identify parcels where active timber management is an allowable land use, and to then further refine the extent based on tree cover. Using statewide planning data, we selected all parcels in Oregon classified as either Farm-Forest, Primary Forest or Secondary Forest (Oregon Department of Land Conservation and Development, 2023), and then further refined the extent by selecting pixels that were greater than 20% tree canopy cover. Private industrial ownerships were excluded using the data previously described.

In Washington, we used the Washington State Forestland Database and selected only parcels identified as small forest landowners (Rodgers et al., 2019) and then further refined the extent by selecting pixels that were greater than 20% tree canopy cover.

Table 23. Response functions for Private Non-Industrial and Private Industrial sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, Private Industrial and Private Non-Industrial sub-HVRAs cumulatively were assigned about 44% of all the importance within the Timber HVRA.

			Fire Intensity Level (flame length)					
Sub-HVRA	Share of HVRA RI	Covariate	FIL 1	FIL 2	FIL 3	FIL 4	FIL 5	FIL 6
			0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Private Non-Industrial, QMD < 10"	3%	FRG I	10	-20	-50	-100	-100	-100
Private Non-Industrial, QMD < 10"		FRG III	0	-30	-60	-100	-75	-100
Private Non-Industrial, QMD < 10"		FRG IV/V	-20	-40	-80	-100	-50	-100
Private Non-Industrial, QMD 10" - 20"	5%	FRG I	50	30	0	-30	-100	-100
Private Non-Industrial, QMD 10" - 20"		FRG III	20	0	-40	-80	-80	-100
Private Non-Industrial, QMD 10" - 20"		FRG IV/ V	-20	-40	-60	-80	-80	-100
Private Non-Industrial, QMD > 20"	1%	FRG I	50	30	0	-10	-100	-100
Private Non-Industrial, QMD > 20"		FRG III	30	10	-20	-80	-100	-100
Private Non-Industrial, QMD > 20"		FRG IV/V	-20	-40	-60	-80	-100	-100
Private Industrial, QMD < 10"	13%	FRG I	10	-20	-50	-100	-100	-100
Private Industrial, QMD < 10"		FRG III	0	-30	-60	-30	-75	-100
Private Industrial, QMD < 10"		FRG IV/V	-20	-40	-80	-10	-50	-100
Private Industrial, QMD 10" - 20"	18%	FRG I	50	30	0	-100	-100	-100
Private Industrial, QMD 10" - 20"		FRG III	20	0	-40	-80	-80	-100
Private Industrial, QMD 10" - 20"		FRG IV/ V	-20	-40	-60	-80	-80	-100
Private Industrial, QMD > 20"	4%	FRG I	50	30	0	-100	-100	-100

Private Industrial, QMD > 20"		FRG III	30	10	-20	-80	-100	-100
Private Industrial, QMD > 20"		FRG IV/V	-20	-40	-60	-80	-100	-100

4.3.5.2 Tribal Timberlands

Summary of changes compared to previous QWRA

The extent and characterization of tribal timberlands is similar to PNW QWRA 2018, although updated timber size class data was used.

Methods

Specific spatial data for tribal owned timber resources was not readily available for most tribes. However, during the development of the PNW QWRA 2018, the Colville reservation provided an extent for commercial timber. The Tribal Owned, Active Management sub-HVRA represents the commercial timber resources on the Colville Reservation using the same spatial extent provided in 2018. The extent of the Tribal Owned, Other sub-HVRA includes all forestland on tribally owned and managed lands.

Table 24. Response functions for the two Tribal timberland sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, Tribal sub-HVRAs cumulatively were assigned about 9% of all the importance within the Timber HVRA.

			Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**Covariate**	**FIL 1** *0 - 2'*	**FIL 2** *2 - 4'*	**FIL 3** *4 - 6'*	**FIL 4** *6 - 8`*	**FIL 5** *8 - 12'*	**FIL 6** *>12'*
Tribal Active Management, QMD < 10"	< 1%	FRG I	10	-20	-50	-100	-100	-100
Tribal Active Management, QMD < 10"		FRG III	0	-30	-60	-100	-100	-100
Tribal Active Management, QMD < 10"		FRG IV/V	-20	-40	-80	-100	-100	-100
Tribal Active Management, QMD 10" - 20"	1%	FRG I	50	30	0	-30	-75	-100
Tribal Active Management, QMD 10" - 20"		FRG III	20	0	-40	-80	-80	-100
Tribal Active Management, QMD 10" - 20"		FRG IV/V	-20	-40	-60	-80	-100	-100
Tribal Active Management, QMD > 20"	< 1%	FRG I	50	30	0	-10	-50	-100
Tribal Active Management, QMD > 20"		FRG III	30	10	-20	-80	-80	-100
Tribal Active Management, QMD > 20"		FRG IV/V	-20	-40	-60	-80	-100	-100
Tribal Other Management, QMD < 10"	2%	FRG I	10	-20	-50	-100	-100	-100
Tribal Other Management, QMD < 10"		FRG III	0	-30	-60	-100	-100	-100
Tribal Other Management, QMD < 10"		FRG IV/V	-20	-40	-80	-100	-100	-100
Tribal Other Management, QMD 10" - 20"	4%	FRG I	50	30	0	-30	-75	-100

Tribal Other Management, QMD 10" - 20"		FRG III	20	0	-40	-80	-80	-100
Tribal Other Management, QMD 10" - 20"		FRG IV/V	-20	-40	-60	-80	-100	-100
Tribal Other Management, QMD > 20"	1%	FRG I	50	30	0	-10	-50	-100
Tribal Other Management, QMD > 20"		FRG III	30	10	-20	-80	-80	-100
Tribal Other Management, QMD > 20"		FRG IV/V	-20	-40	-60	-80	-100	-100

4.3.5.3 U.S. Forest Service

Summary of changes compared to previous QWRA

The extent and characterization of timberlands managed by the U.S. Forest Service is similar to the PNW QWRA, although we updated the timber size class data to modernize estimates.

Methods

The extent of the U.S. Forest Service, Active Management sub-HVRA was mapped based on national forest land management plans and by selecting areas where the land classification is "active management" (Ringo et al., 2016). Active management land classifications represent areas where mechanical treatments are allowable to meet wood production targets.

The extent of the U.S. Forest Service, Multiple Objectives sub-HVRA was mapped based on national forest land management plans and by selecting areas where the land classification is described as having "multiple objectives" (Ringo et al., 2016). Multiple objectives land classifications represent areas where mechanical treatments are restricted and can only be implemented if there is no conflict with other forest plan objectives.

Table 25. Response functions for the two U.S. Forest Service timberland sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, USFS-managed sub-HVRAs cumulatively were assigned about 36% of all the importance within the Timber HVRA.

			Fire Intensity Level (flame length)					
Sub-HVRA	Share of HVRA RI	Covariate	FIL 1	FIL 2	FIL 3	FIL 4	FIL 5	FIL 6
			0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
U.S. Forest Service Active Management, QMD < 10"	5%	FRG I	10	-20	-50	-100	-100	-100
U.S. Forest Service Active Management, QMD < 10"		FRG III	0	-30	-60	-100	-100	-100
U.S. Forest Service Active Management, QMD < 10"		FRG IV/V	-20	-40	-80	-100	-100	-100
U.S. Forest Service Active Management, QMD 10" - 20"	16%	FRG I	50	30	0	-30	-75	-100
U.S. Forest Service Active Management, QMD 10" - 20"		FRG III	20	0	-40	-80	-80	-100
U.S. Forest Service Active Management, QMD 10" - 20"		FRG IV/ V	-20	-40	-60	-80	-100	-100
U.S. Forest Service Active Management, QMD > 20"	3%	FRG I	50	30	0	-10	-50	-100
U.S. Forest Service Active Management, QMD > 20"		FRG III	30	10	-20	-80	-80	-100
U.S. Forest Service Active Management, QMD > 20"		FRG IV/V	-20	-40	-60	-80	-100	-100
U.S. Forest Service Multiple Use Management, QMD < 10"	2%	FRG I	10	-20	-50	-100	-100	-100
U.S. Forest Service Multiple Use Management, QMD < 10"		FRG III	0	-30	-60	-100	-100	-100

U.S. Forest Service Multiple Use Management, QMD < 10"		FRG IV/V	-20	-40	-80	-100	-100	-100
U.S. Forest Service Multiple Use Management, QMD 10" - 20"	7%	FRG I	50	30	0	-30	-75	-100
U.S. Forest Service Multiple Use Management, QMD 10" - 20"		FRG III	20	0	-40	-80	-80	-100
U.S. Forest Service Multiple Use Management, QMD 10" - 20"		FRG IV/ V	-20	-40	-60	-80	-100	-100
U.S. Forest Service Multiple Use Management, QMD > 20"	3%	FRG I	50	30	0	-10	-50	-100
U.S. Forest Service Multiple Use Management, QMD > 20"		FRG III	30	10	-20	-80	-80	-100
U.S. Forest Service Multiple Use Management, QMD > 20"		FRG IV/V	-20	-40	-60	-80	-100	-100

4.3.5.4 U.S. Bureau of Land Management

Summary of changes compared to previous QWRA

The extent and characterization of timberlands managed by the U.S. Bureau of Land Management is similar to the previous QWRA, although updated timber size class data was used.

Methods

The Bureau of Land Management, Active Management sub-HVRA extent was provided by the Bureau of Land Management and is based on the Resource Management Plan and current Land Use Allocation. Specifically, active management class includes all forested Harvest Land Base, Oregon and California Re-vested Railroad Lands and Coos Bay Wagon Road that are not otherwise designated as Congressionally Reserved or wilderness lands.

The Bureau of Land Management, Other Management sub-HVRA extent was provided by the Bureau of Land Management and is based on the Resource Management Plan and current Land Use Allocation. The Other Management sub-HVRA includes all remaining forest land managed by the Bureau of Land Management which is neither included in the Active Management sub-HVRA nor designated as Congressionally Reserved or wilderness.

Table 26. Response functions for the two BLM timberland sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, BLM-managed sub-HVRAs cumulatively were assigned about 10% of all the importance within the Timber HVRA.

			Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**Covariate**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
			0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
BLM Active Management, QMD < 10"	1%	FRG I	10	-20	-50	-100	-100	-100
BLM Active Management, QMD < 10"		FRG III	0	-30	-60	-100	-100	-100
BLM Active Management, QMD < 10"		FRG IV/V	-20	-40	-80	-100	-100	-100
BLM Active Management, QMD 10" - 20"	4%	FRG I	50	30	0	-30	-75	-100
BLM Active Management, QMD 10" - 20"		FRG III	20	0	-40	-80	-80	-100
BLM Active Management, QMD 10" - 20"		FRG IV/V	-20	-40	-60	-80	-100	-100
BLM Active Management, QMD > 20"	4%	FRG I	50	30	0	-10	-50	-100
BLM Active Management, QMD > 20"		FRG III	30	10	-20	-80	-80	-100
BLM Active Management, QMD > 20"		FRG IV/V	-20	-40	-60	-80	-100	-100
BLM Other Management, QMD < 10"	< 1%	FRG I	10	-20	-50	-100	-100	-100

BLM Other Management, QMD < 10"		FRG III	0	-30	-60	-100	-100	-100
BLM Other Management, QMD < 10"		FRG IV/V	-20	-40	-80	-100	-100	-100
BLM Other Management, QMD 10" - 20"	< 1%	FRG I	50	30	0	-30	-75	-100
BLM Other Management, QMD 10" - 20"		FRG III	20	0	-40	-80	-80	-100
BLM Other Management, QMD 10" - 20"		FRG IV/V	-20	-40	-60	-80	-100	-100
BLM Other Management, QMD > 20"	< 1%	FRG I	50	30	0	-10	-50	-100
BLM Other Management, QMD > 20"		FRG III	30	10	-20	-80	-80	-100
BLM Other Management, QMD > 20"		FRG IV/V	-20	-40	-60	-80	-100	-100

4.3.5.5 State Owned or Managed Timberlands

Summary of changes compared to previous QWRA

The extent and characterization of timberlands managed by the Oregon Department of Forestry is similar to the previous QWRA, although updated timber size class data was used. In Washington, new data was used to map the extent of timberland managed by the Washington Department of Natural Resources.

Methods

State owned or managed timberland in Oregon included all state forests managed by the Oregon Department of Forestry (Oregon Department of Forestry, 2022). In Washington, data defining state owned or managed timberland was provided directly by Washington Department of Natural Resources. Using the data provided by DNR, we refined the extent based on the deferral status and any operational restrictions. On some parcels, commercial timber activities are deferred; we selected on parcels or portions of parcels where there was no deferral or the deferral is less than ten years. Likewise, we selected forested state managed timberland where there are no or minimal restrictions on mechanical harvest activities.

Table 27. Response functions for the State Owned or Managed sub-HVRA. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, State-managed sub-HVRAs cumulatively were assigned about 4% of all the importance within the Timber HVRA.

			Fire Intensity Level (flame length)					
Sub-HVRA	Share of HVRA RI	Covariate	FIL 1	FIL 2	FIL 3	FIL 4	FIL 5	FIL 6
			0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
State Owned/Managed, QMD < 10"	1%	FRG I	10	-20	-50	-100	-100	-100
State Owned/Managed, QMD < 10"		FRG III	0	-30	-60	-100	-100	-100
State Owned/Managed, QMD < 10"		FRG IV/V	-20	-40	-80	-100	-100	-100
State Owned/Managed, QMD 10" - 20"	2%	FRG I	50	30	0	-30	-75	-100
State Owned/Managed, QMD 10" - 20"		FRG III	20	0	-40	-80	-80	-100
State Owned/Managed, QMD 10" - 20"		FRG IV/V	-20	-40	-60	-80	-100	-100
State Owned/Managed, QMD > 20"	1%	FRG I	50	30	0	-10	-50	-100
State Owned/Managed, QMD > 20"		FRG III	30	10	-20	-80	-80	-100
State Owned/Managed, QMD > 20"		FRG IV/V	-20	-40	-60	-80	-100	-100

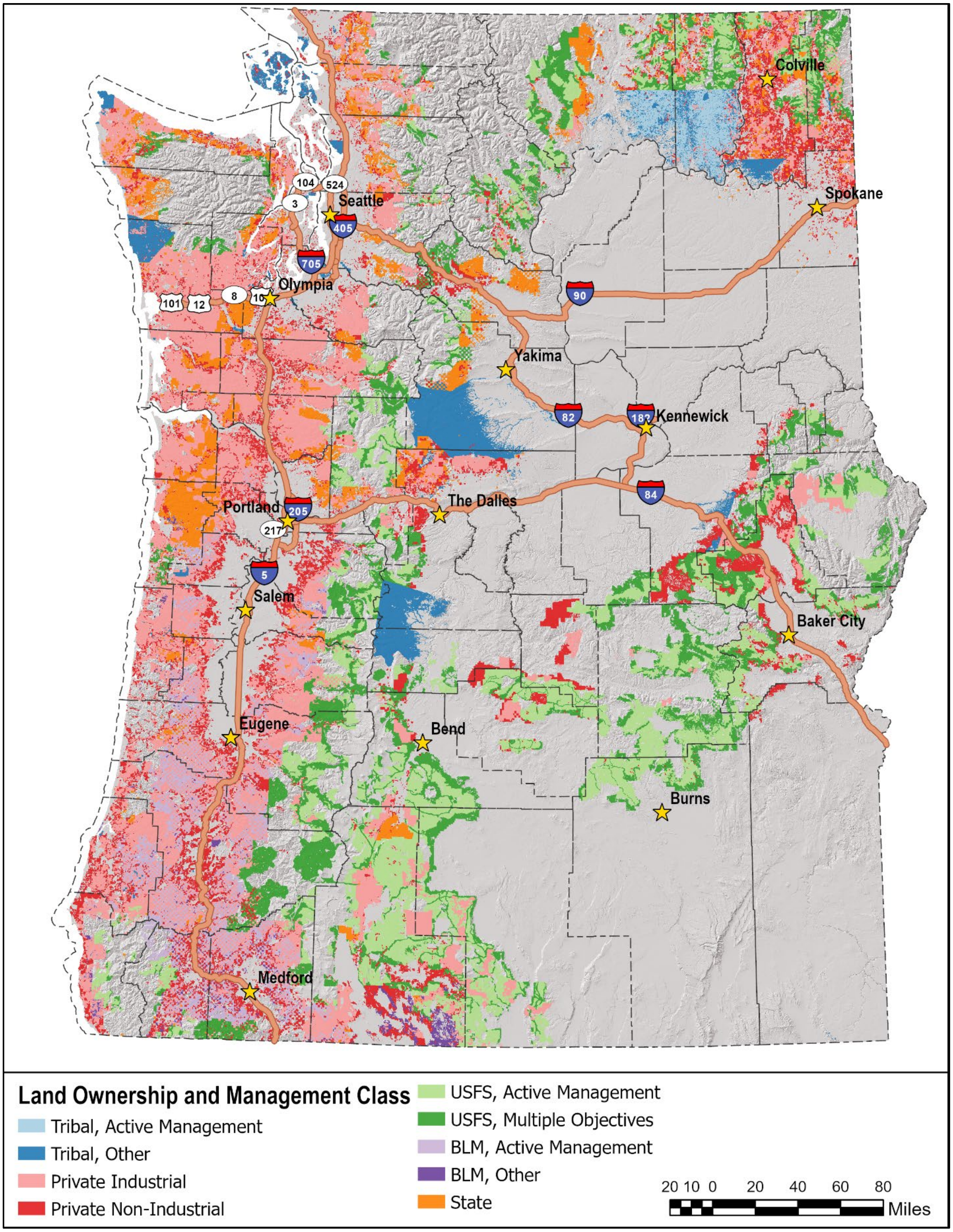

Figure 19. Extent of land management-based sub-HVRAs in the Timber HVRA.

4.3.6 Wildlife Habitat

Intent

The Wildlife HVRA is intended to evaluate wildfire risk to wildlife habitat.

4.3.6.1 Northern Spotted Owl

Summary of changes compared to previous QWRA

In the PNW QWRA 2018 there was a single sub-HVRA for northern spotted owl. In the PNW QWRA 2023, we used updated data, including maps of fire refugia produced by the U.S. Forest Service, to further classify into two sub-HVRAs.

Methods

Northern spotted owl (NSO) habitat extent is based primarily on modeled suitable habitat data developed by the U.S. Forest Service (Davis et al., 2022). Suitable habitat represents areas where the biotic and abiotic characteristics are suitable for nesting, breeding, hunting and dispersal. For the purposes of assigning relative importance, we further classified suitable habitat into two sub-HVRAs based on the likelihood of high severity fire using unpublished data developed by the U.S. Forest Service (Meigs et al., 2020). The data characterizes areas with comparatively low likelihood of high severity fire as “fire refugia.” When suitable habitat was co-located within fire refugia it was given a larger share of the relative importance as a way of recognizing habitat with the highest conservation priority. Conversely, habitat outside the refugia has a greater likelihood of being converted to non-suitable habitat by high severity fire and is therefore still important but of lesser conservation value.

Response to fire was similar across the two sub-HVRAs but assumed to be slightly more positive at FIL 2 for the non-refugia sub-HVRA as a way on conveying the benefits of removing understory fuels in areas with comparably higher likelihood of high severity fire.

Table 28. Response functions for the two northern spotted owl sub-HVRAs. Share of HVRA RI is the amount of the HVRA’s relative importance assigned to each sub-HVRA. In this case, northern spotted owl sub-HVRAs cumulatively were assigned about 21% of all the importance within the Wildlife Habitat HVRA.

		Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
		0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Northern Spotted Owl, outside refugia	3%	20	50	-10	-60	-80	-100
Northern Spotted Owl, inside refugia	18%	40	20	-10	-60	-80	-100

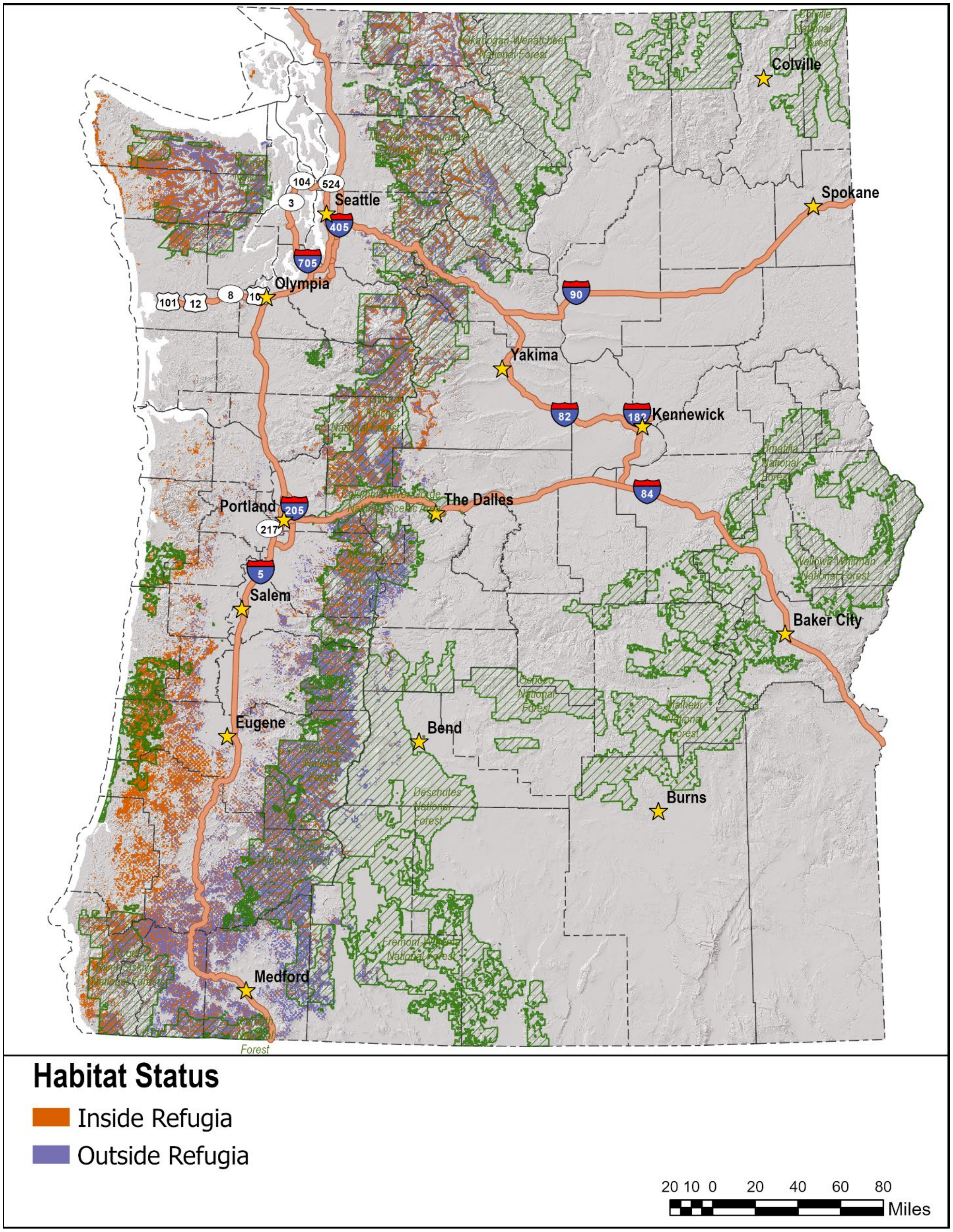

Figure 20. Distribution of the northern spotted owl sub-HVRA in the Wildlife HVRA.

4.3.6.2 Greater Sage-Grouse

Summary of changes compared to previous QWRA

The extent and characterization of greater sage-grouse sub-HVRAs is the same as in the PNW QWRA 2023.

Methods

Greater sage-grouse extent was mapped primarily based on the 2015 Resource Management Plans developed by the U.S. Bureau of Land Management (e.g. U.S. Department of Interior, Bureau of Land Management, 2015). The plans designate greater sage-grouse habitat as focal, priority, and general habitat. Focal areas are particular subsets of the priority habitat which are identified by U.S. Fish and Wildlife as essential strongholds for sage-grouse and of the highest conservation priority. Priority habitat includes areas essential to breeding, late brood-rearing, winter concentration areas, and migration or connectivity corridors. General habitat is of the least conservation priority and includes areas where special management might need to occur in order to sustain greater sage-grouse populations. These habitat management areas defined the sub-HVRAs and influenced allocation of relative importance.

The response to fire was a function of the habitat's resistance to invasive annual plants and resilience to wildfire effects as represented in regional resilience and resistance (R&R) data (NRCS West Technology Support Center, 2020). For all sub-HVRAs and all R&R classes, the impact of fire became increasingly negative as fire intensity increased (Table 29). Habitat with high R&R were assumed to be less susceptible to fires of all intensity levels, and even capable of benefiting from low intensity fire.

Table 29. Response functions for the greater sage-grouse sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, greater sage-grouse sub-HVRAs cumulatively were assigned about 28% of all the importance within the Wildlife Habitat HVRA.

			Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**Covariate**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
			0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Greater sage-grouse, focal habitat	17%	High R&R	30	10	0	-30	-50	-90
		Moderate R&R	-10	-20	-30	-60	-100	-100
		Low R&R	-10	-30	-70	-100	-100	-100
Greater sage-grouse, priority habitat	8%	High R&R	30	10	0	-30	-50	-90
		Moderate R&R	-10	-20	-30	-60	-100	-100
		Low R&R	-10	-30	-70	-100	-100	-100
Greater sage-grouse, general habitat	3%	High R&R	30	10	0	-30	-50	-90
		Moderate R&R	0	-10	-30	-60	-100	-100
		Low R&R	-10	-30	-70	-100	-100	-100

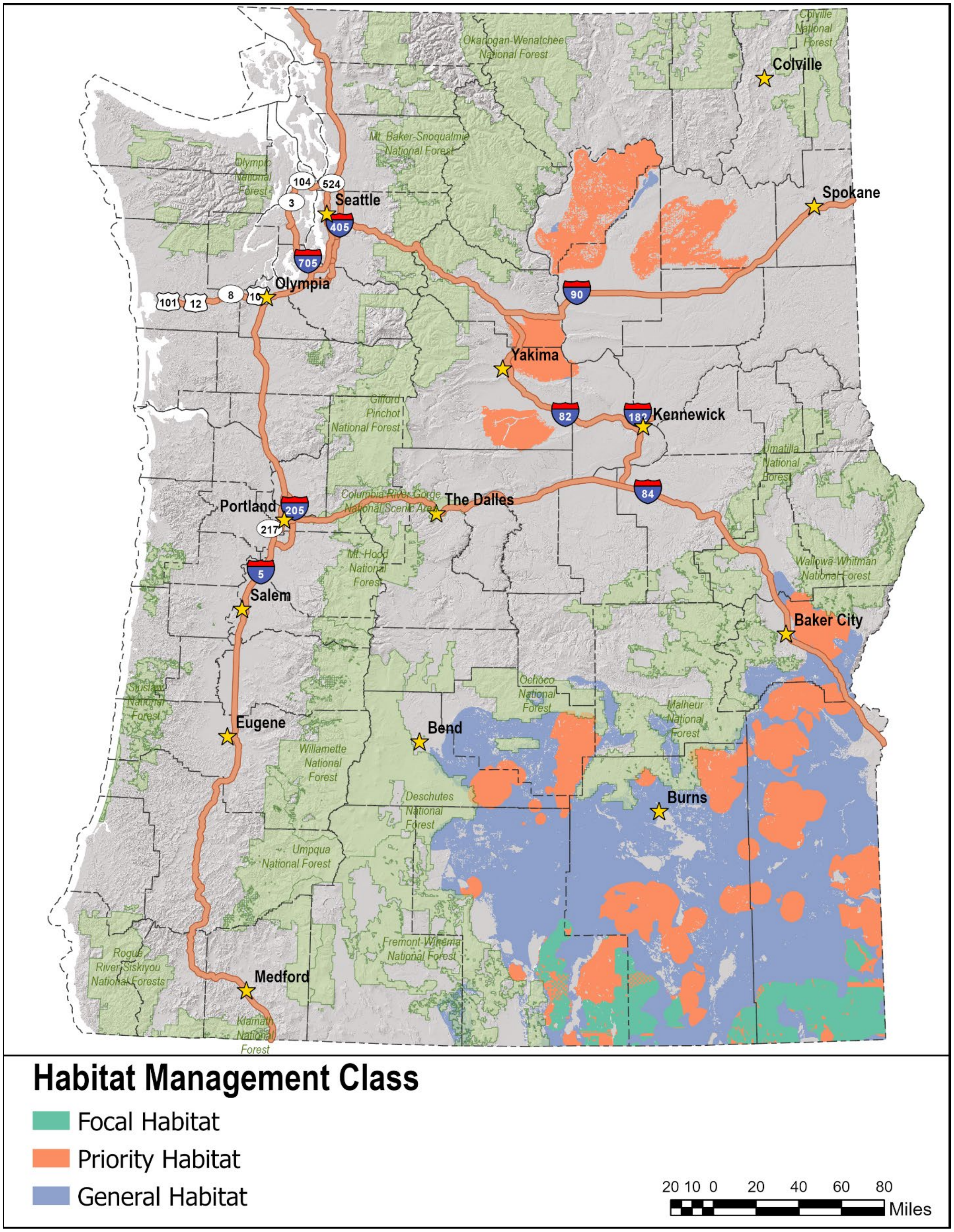

Figure 21.Extent of greater sage-grouse sub-HVRAs in the Wildlife HVRA.

4.3.6.3 Marbled Murrelet

Summary of changes compared to previous QWRA

The extent and characterization of marbled murrelet is the same as in the previous QWRA.

Methods

The extent of Marbled Murrelet habitat was mapped using critical habitat was obtained from U.S. Fish and Wildlife, Endangered Species Program. The response to fire indicates some benefits of fire at lower intensities, reflecting conditions under which fuel loads might be reduced, thereby diminishing future opportunities for high severity fire without threatening habitat quality. As fire intensity increases however, it is increasingly likely that marbled murrelet habitat would be degraded or destroyed.

Table 30. Response functions for the Marbled Murrelet sub-HVRA. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, marbled Murrelet sub-HVRAs cumulatively were assigned about 21% of all the importance within the Wildlife Habitat HVRA.

		Fire Intensity Level (flame length)					
Sub-HVRA	Share of HVRA RI	FIL 1	FIL 2	FIL 3	FIL 4	FIL 5	FIL 6
		0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Marbled Murrelet	21%	40	20	-10	-60	-100	-100

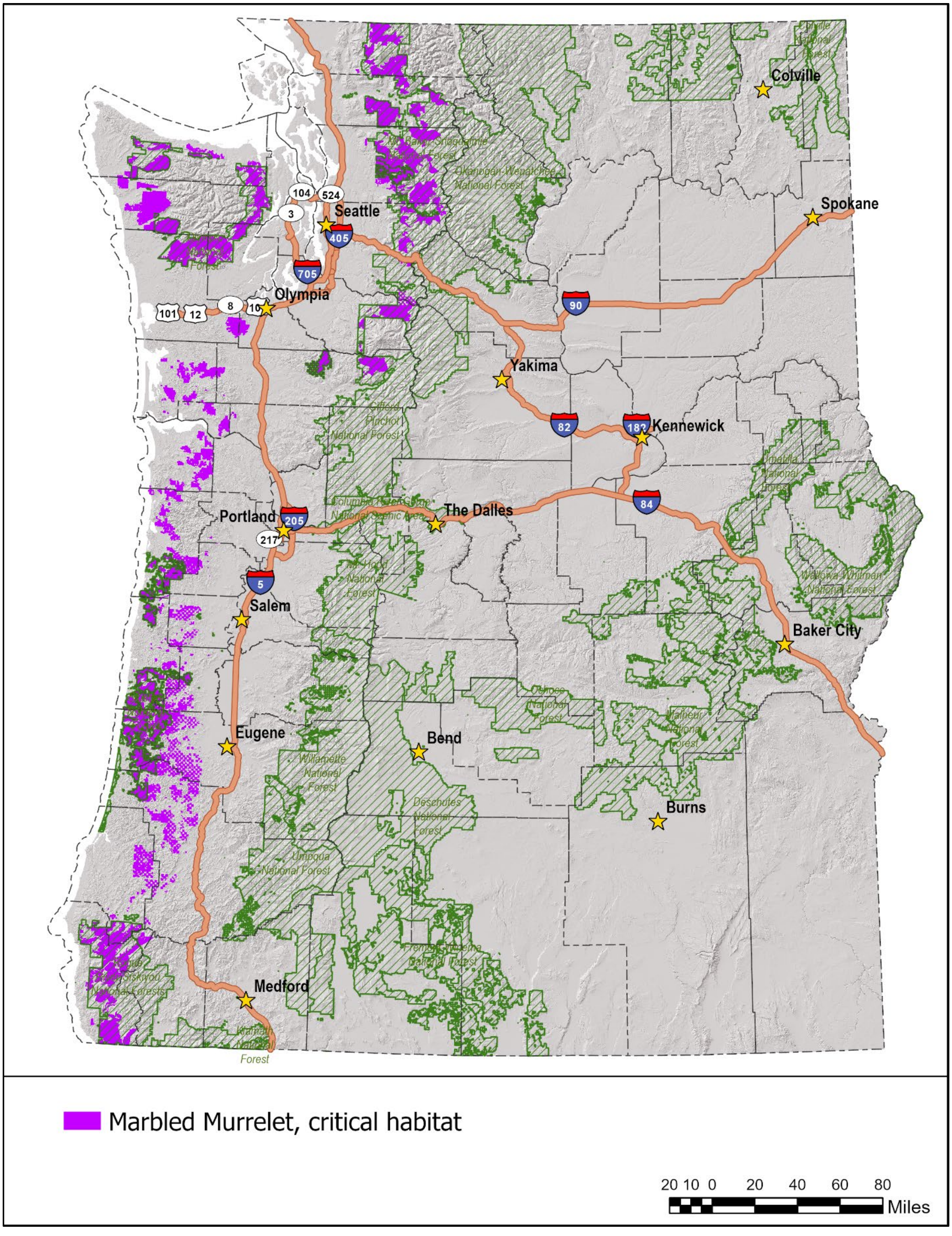

Figure 22. The extent of the marbled murrelet sub-HVRA in the Wildlife HVRA.

4.3.6.4 Aquatic Species

Summary of changes compared to previous QWRA

The extent and characterization of aquatic species sub-HVRAs are similar to the PNW QWRA 2023.

Methods

The extent of the bull trout sub-HVRA was mapped using StreamNet Generalized Fish Distribution layer. Line data was converted to a 30-meter raster and expanded by three pixels on either side to account for the area which might be affected by wildfire and which might impact habitat that includes the riparian area.

We mapped the extent of the steelhead trout sub-HVRA using U.S. Fish and Wildlife Critical Habitat data (NOAA Marine Fisheries Services, 1994). We converted line data to a 30-meter raster and expanded by three pixels on either side to account for the area which might be affected by wildfire and which might impact habitat.

We mapped the extent of the chinook salmon sub-HVRA using U.S. Fish and Wildlife Critical Habitat data (NOAA Marine Fisheries Services, 1994). Line data was converted to a 30-meter raster and expanded by three pixels on either side to account for the area which might be affected by wildfire and which might impact habitat.

The majority of the extent of the Coho salmon sub-HVRA using U.S. Fish and Wildlife Critical Habitat data (NOAA Marine Fisheries Services, 1994). However, the Southern Oregon Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU) was not represented in that layer. To map the SONCC ESU, we compiled spatial population data from multiple sources (Bureau of Land Management; Oregon Department of Fish and Wildlife, 2012) and then clipped streams to the polygons of the SONCC ESU(NOAA Marine Fisheries Services, 2018). Finally, we identified permanent barriers to fish passage and eliminated upstream reaches (Bureau of Land Management). Line data was converted to a 30-meter raster and expanded by three pixels on either side to account for the area which might be affected by wildfire and which might impact habitat.

The response to fire indicates that fire is largely beneficial at low and moderate intensities, but increasingly negative beyond FIL 3 (Table 31).

Table 31. Response functions for the aquatic wildlife sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA. In this case, fish species sub-HVRAs cumulatively were assigned cumulatively about 24% of all the importance within the Wildlife Habitat HVRA.

		Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**FIL 1** *0 - 2'*	**FIL 2** *2 - 4'*	**FIL 3** *4 - 6'*	**FIL 4** *6 - 8`*	**FIL 5** *8 - 12'*	**FIL 6** *>12'*
Bull Trout	8%	20	20	10	-10	-20	-50
Steelhead Trout	8%	20	20	10	-10	-20	-50
Coho Salmon	8%	20	20	10	-10	-20	-50
Chinook Salmon	8%	20	20	10	-10	-20	-50

Figure 23.Extent of bull trout sub-HVRA in the Wildlife HVRA.

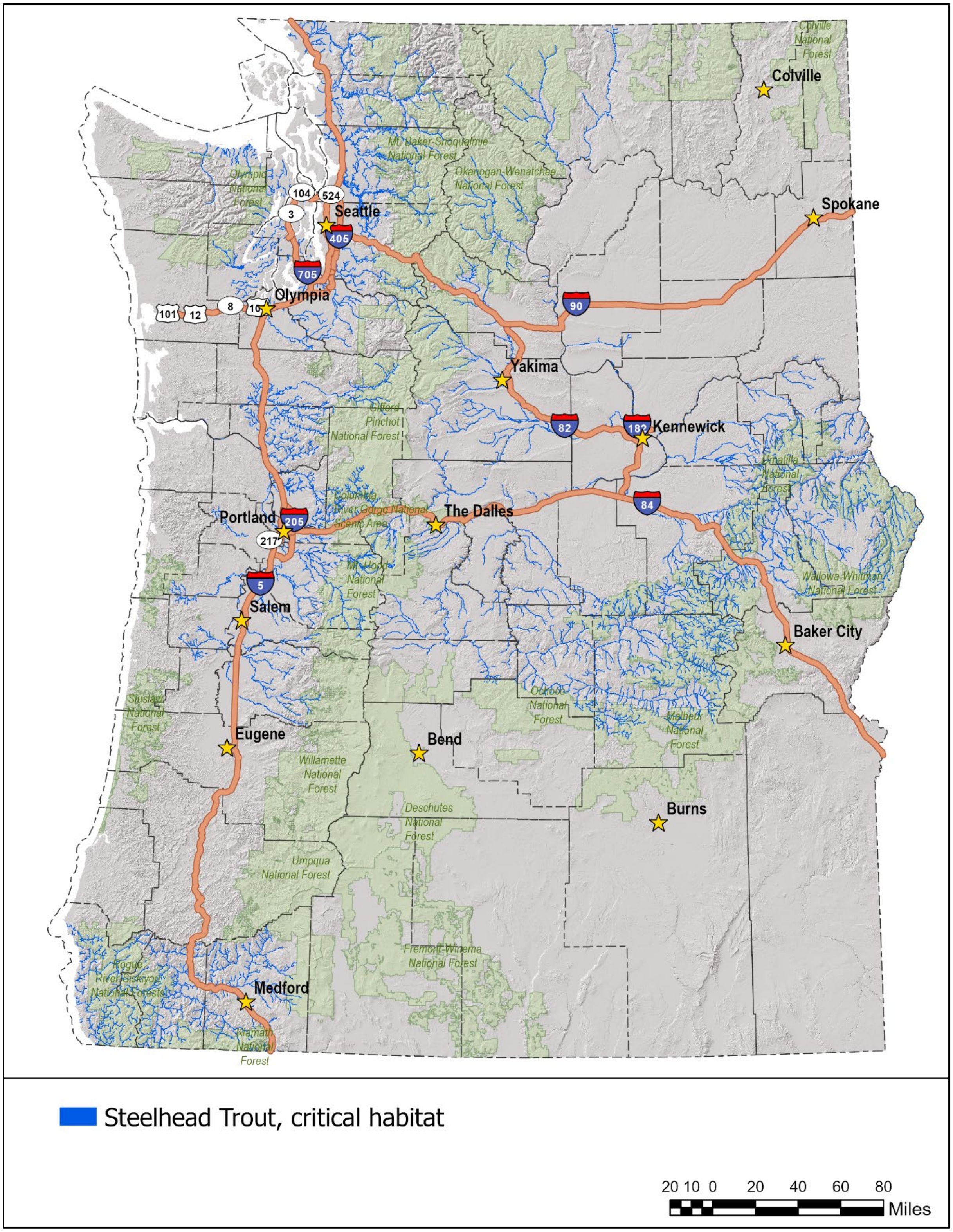

Figure 24 Extent of steelhead trout sub-HVRA in the Wildlife HVRA.

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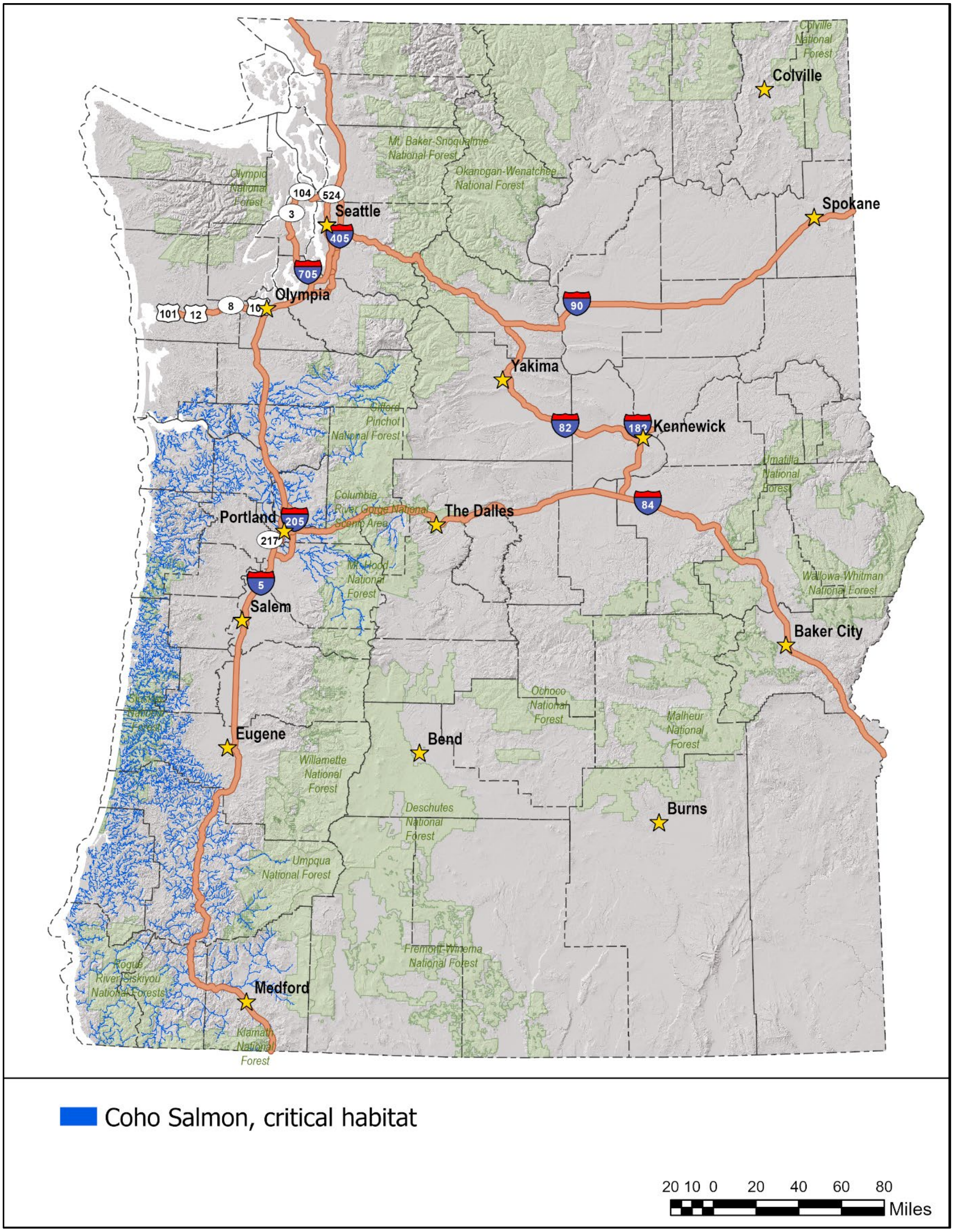

Figure 25. Extent of coho salmon sub-HVRA in the Wildlife HVRA.

Figure 26. Extent of chinook salmon sub-HVRA in the Wildlife HVRA.

4.3.7 Agriculture

4.3.7.1 Intent

The Agriculture HVRA is intended to evaluate wildfire risk to cropland and associated infrastructure.

4.3.7.2 Summary of changes compared to previous QWRA

Agriculture was not mapped as an HVRA in the PNW QWRA.

4.3.7.3 Methods

We mapped the extent of croplands using the last five years of Cropscape data from the U.S. Department of Agriculture (USDA-NASS, 2022). All pixels that were considered cultivated between 2018 and 2022 were included in the HVRA extent and the most common crop type associated with each cultivated pixel was used to classify the sub-HVRA as either perennial or annual.

The response to fire was uniformly adverse across all sub-HVRAs at all intensities (Table 32).

Nine percent of the overall relative importance was allocated to the Agriculture HVRA. Of that, perennials were deemed to be ten times more important than annuals, reflecting the reality that annuals can often be recovered in the following years while perennials may take decades to recover.

Table 32. Response functions for the Agriculture sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA.

		Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**FIL 1**	**FIL 2**	**FIL 3**	**FIL 4**	**FIL 5**	**FIL 6**
		0 - 2'	*2 - 4'*	*4 - 6'*	*6 - 8`*	*8 - 12'*	*>12'*
Perennial	17%	-100	-100	-100	-100	-100	-100
Annual	83%	-100	-100	-100	-100	-100	-100

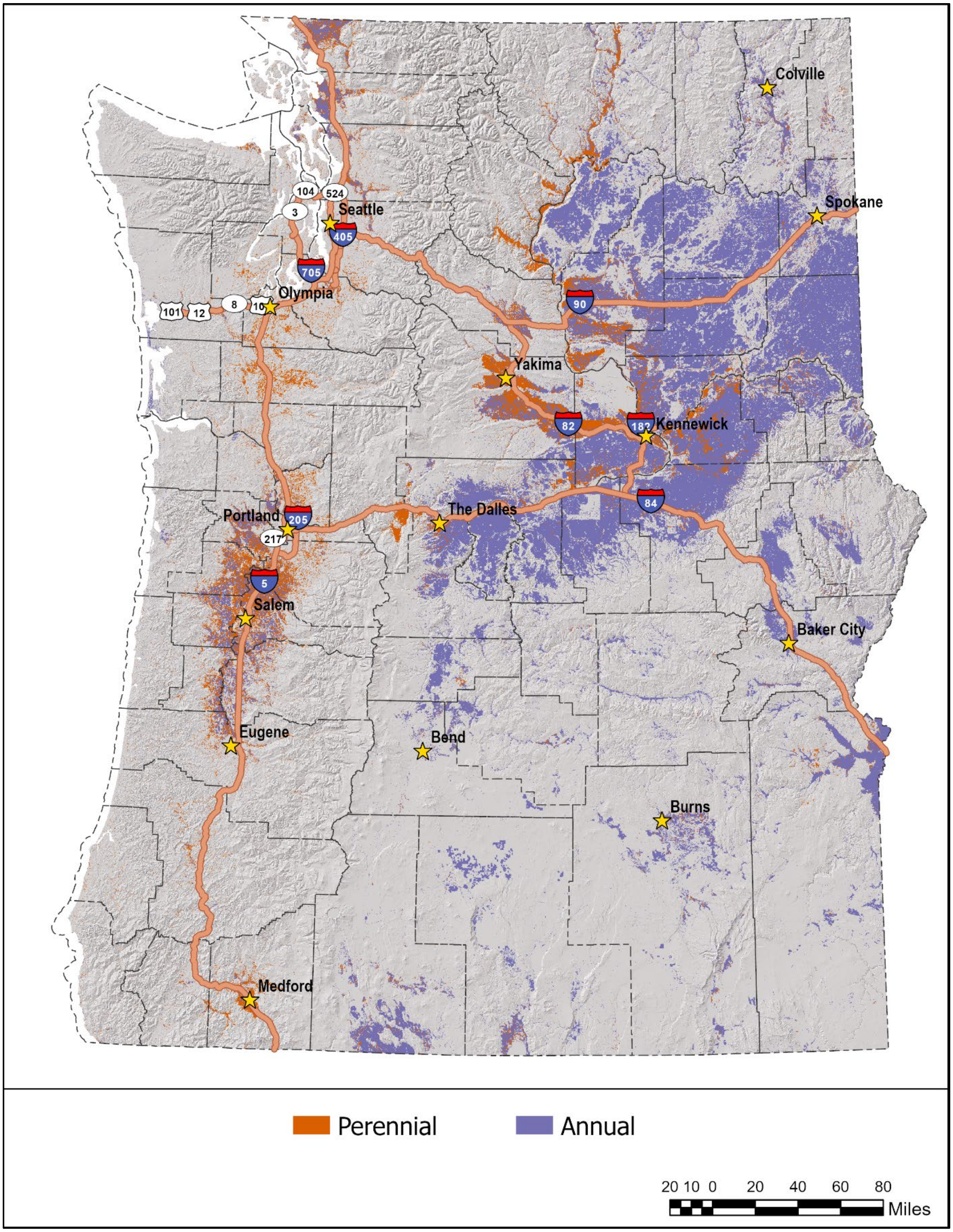

Figure 27. Extent of the Agriculture sub-HVRAs.

4.3.8 Recreation Infrastructure

4.3.8.1 Intent

The Recreation HVRA is intended to evaluate wildfire risk to outdoor recreation infrastructure.

4.3.8.2 Summary of changes compared to previous QWRA

In the PNW QWRA 2018, wildfire risk to recreation infrastructure was captured within the Infrastructure HVRA. In this update, we used the same methods and similar data to map and characterize recreation infrastructure, but created a new Recreation HVRA so that the updated Infrastructure HVRA remains focused on energy, communications, and transportation.

4.3.8.3 Methods

Mapping the extent of recreation infrastructure required a wide range of data sets and methods according to what was available from each landowner or agency.

Non-Federal Recreation Infrastructure in Oregon. We combined multiple spatial datasets from various state agencies. First, we used the Oregon Parkland Dataset which was developed by Oregon State Parks and which maps publicly accessible parks in Oregon (Oregon State Parks, 2019). We filtered the types of parks to include Special Use Park, Nature Park, Regional Park, Regional Sports Park, Destination Park and Community Park. The result was 2,847 parks.

The Oregon Parkland Dataset represents parks as polygons and does not identify specific infrastructure. To estimate the location of recreation infrastructure we intersected the park polygons with known structure locations from the Statewide Building Footprints of Oregon data (Williams, 2021). Any structure mapped in this fashion was assumed to be in the High Development sub-HVRA.

Finally, the Oregon Department of forestry provided a point dataset of recreation infrastructure within State Forests (Oregon Department of Forestry, 2020). Using the Layer_Name attribute, I classified them into appropriate sub-HVRA categories. If the point was attributed as Camping, Visitor Center, Camping, Day-use area, or Day-use area then it was classified as High Development recreation. All other attribute values – e.g. trailhead – were classified as Low Development recreation.

Non-Federal Recreation Infrastructure in Washington. We combined multiple spatial datasets from various state agencies. Washington State Parks and Recreation Commission provided a point dataset of recreation infrastructure locations and descriptions on state lands(Washington State Parks and Recreation, 2018a). Using the Name attribute, we classified all features as either High or Low Development sub-HVRAs. Features described as toilet, pump house, vault, storage, picnic, shed, or shelter were classified as Low Development and everything else as High Development recreation infrastructure.

Next, we used the Washington Major Public Lands polygons to identify likely recreation infrastructure (Washington State Department of Natural Resources, 2017). The Washington Major Public Lands dataset includes ownership parcels for Federal, State, County and City lands within Washington, excluding any lands owned by the Washington Department of Natural Resources. Identifying likely recreation infrastructure required two steps. First, we filtered the dataset so that only parcels described as recreation or park were maintained. Second, we intersected the remaining polygons with Washington's structure point location data. All points were classified as High Development because they represent structures.

Finally, we added developed campgrounds using data from the Washington State Parks and Recreation Commission (Washington State Parks and Recreation, 2018b).

Recreation Infrastructure on Federal land. Federal recreation infrastructure was identified using a national dataset of recreation infrastructure on lands managed by the U.S. Department of the Interior and the U.S. Forest Service (Esri U.S. Federal Datasets, 2021). The dataset includes campgrounds, trailheads, cabins, shelters, picnic areas, headquarters, visitor information centers and ranger stations. We classified all infrastructure as High Development except trailheads.

One percent of the overall relative importance was allocated to the Recreation Infrastructure HVRA. Within this HVRA, significantly more importance was placed on High Development infrastructure compared to Low Development infrastructure.

Table 33. Response functions for the Recreation sub-HVRAs. Share of HVRA RI is the amount of the HVRA's relative importance assigned to each sub-HVRA.

		Fire Intensity Level (flame length)					
Sub-HVRA	**Share of HVRA RI**	**FIL 1** *0 - 2'*	**FIL 2** *2 - 4'*	**FIL 3** *4 - 6'*	**FIL 4** *6 - 8`*	**FIL 5** *8 - 12'*	**FIL 6** *>12'*
High Development	97%	-10	-30	-70	-90	-100	-100
Low Development	3%	-10	-30	-70	-90	-100	-100

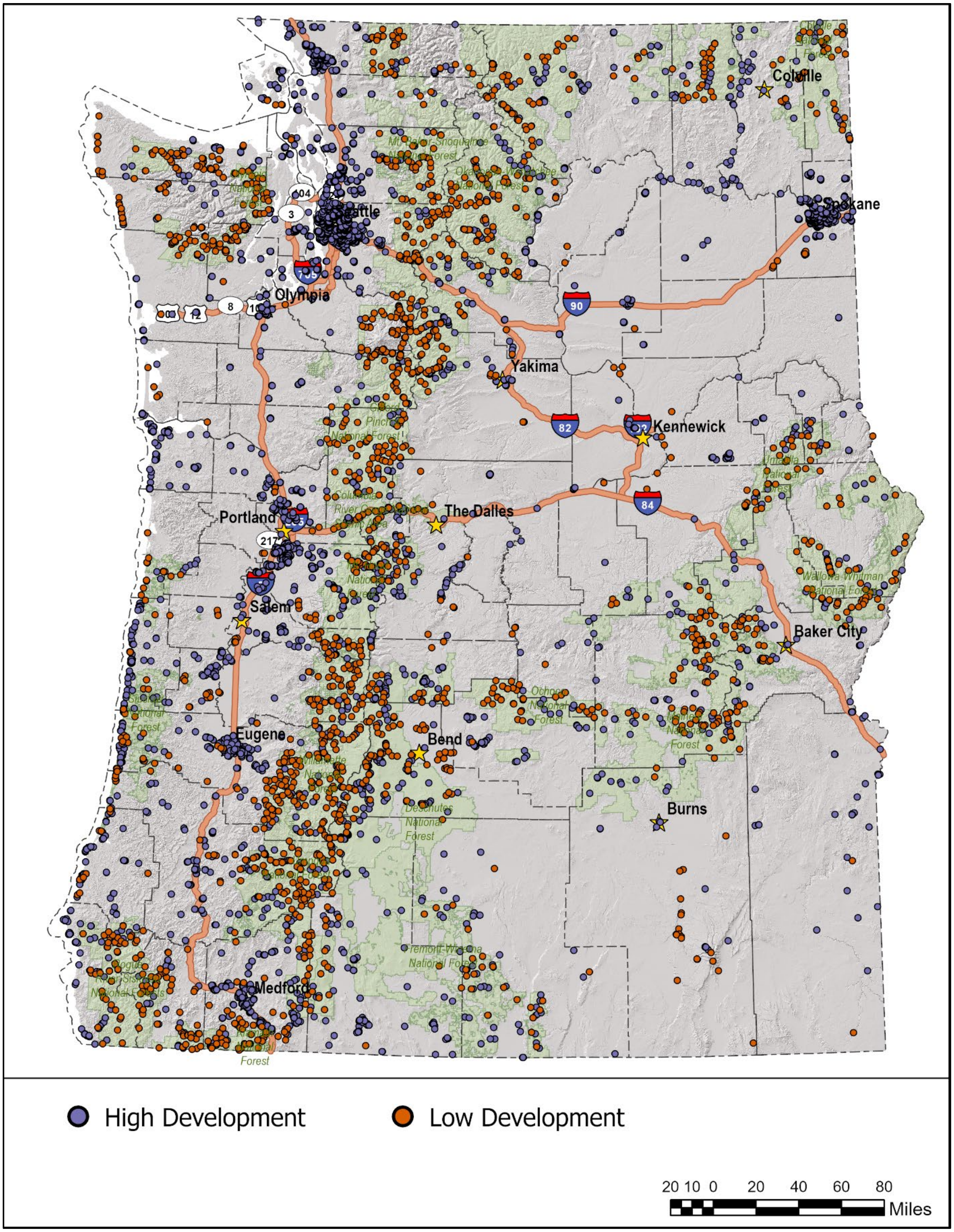

Figure 28. Extent of the Recreation sub-HVRAs.

5 Integrated Risk Results

Integrated risk results (i.e. eNVC and cNVC) are useful ways to look at net risk across multiple HVRAs simultaneously. Users can integrate any combination of HVRAs and sub-HVRAs that might be relevant to their planning objectives. The following figures illustrate the most common integrate risk products which includes integrating HVRAs (Figures 29 and 30), and HVRA-level integrated products which integrate risk across all the sub-HVRAs within an HVRA category (Figures 31 through Figures 38).

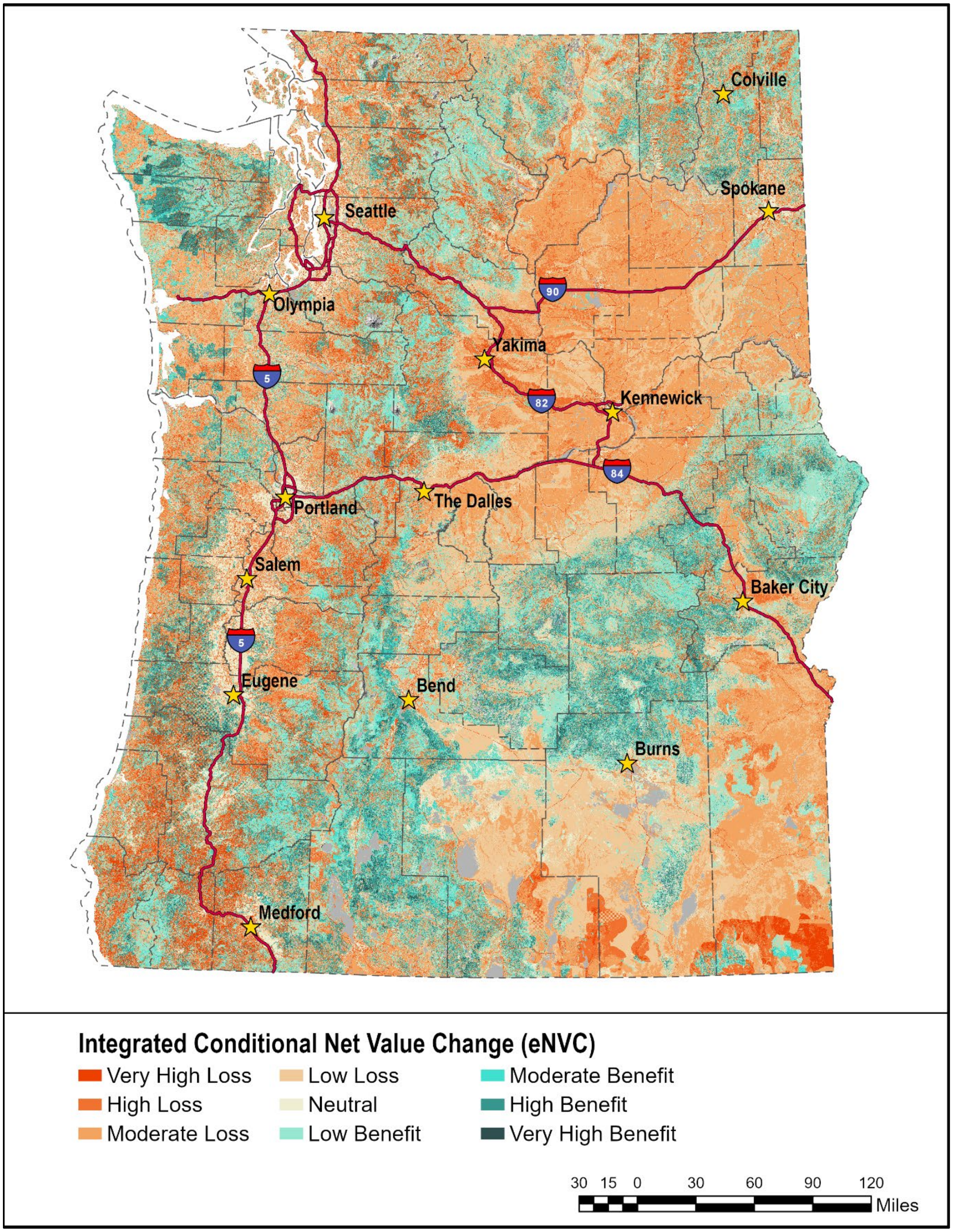

Figure 29. Final expected net value change (eNVC) integrated across all eight HVRAS.

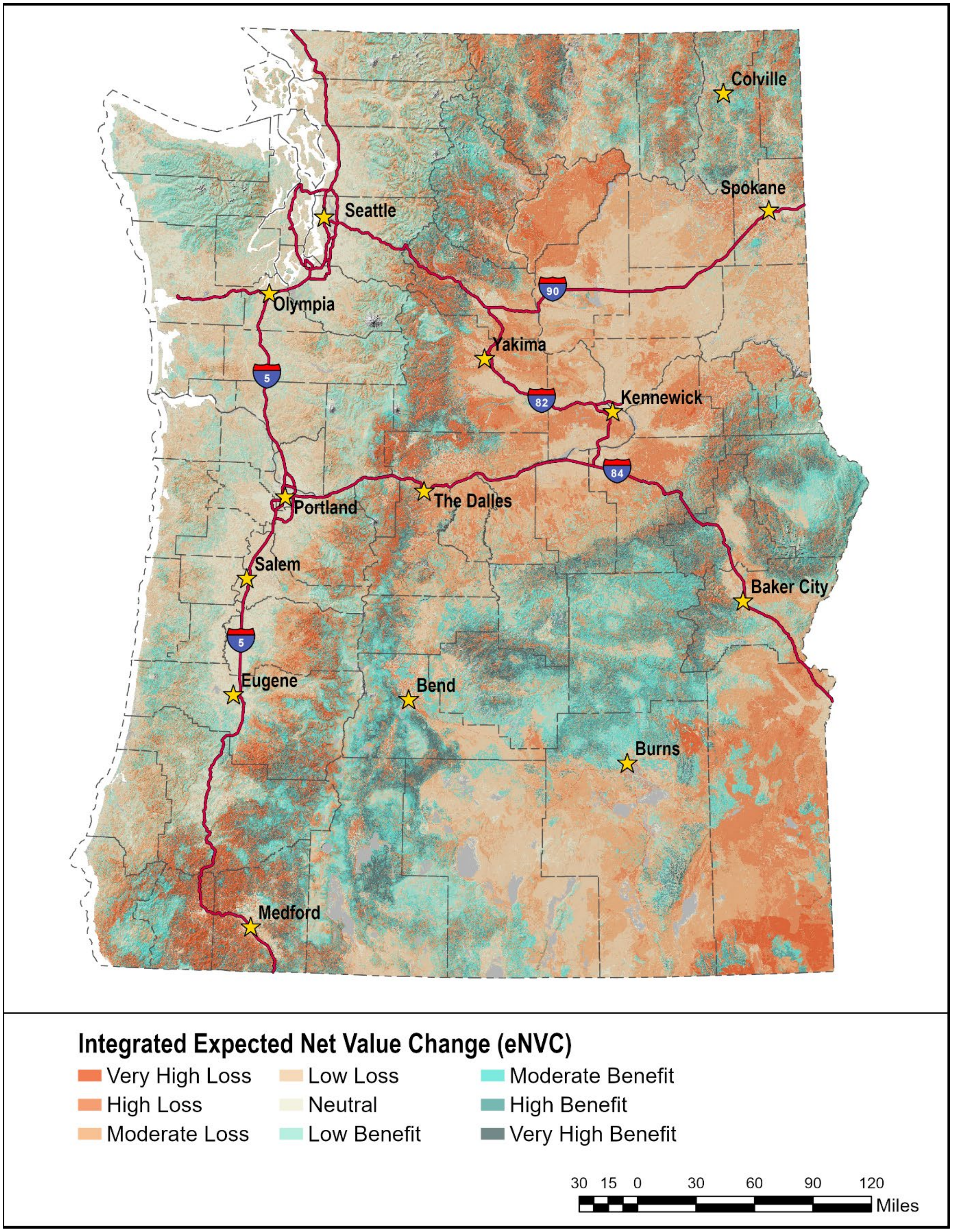

Figure 30. Final conditional net value change (cNVC) integrated across all eight HVRAS.

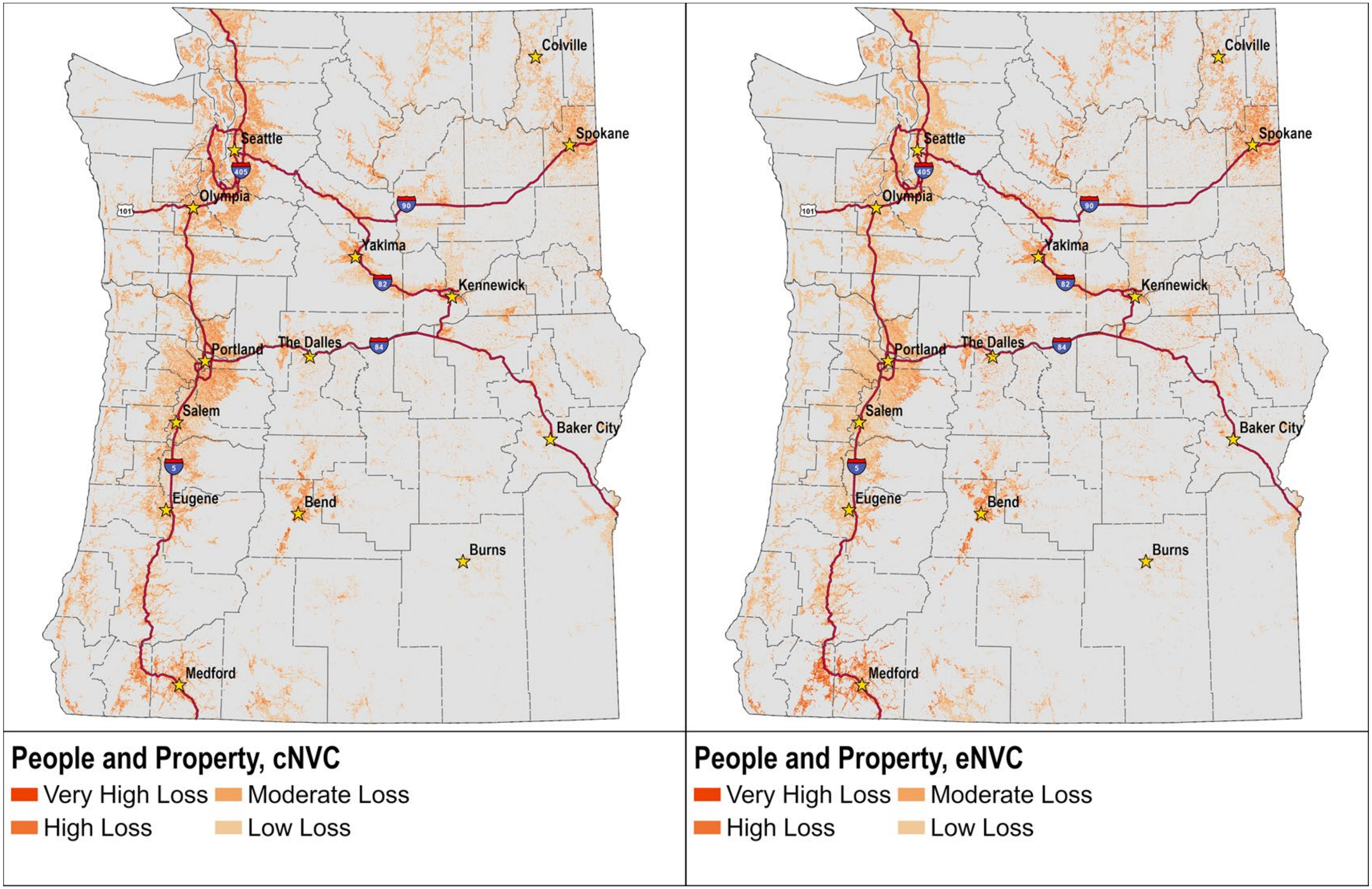

Figure 31. Conditional net value change (cNVC, left) and expected net value change (eNVC, right) for the People and Property HVRA in the PNW QWRA 2023.

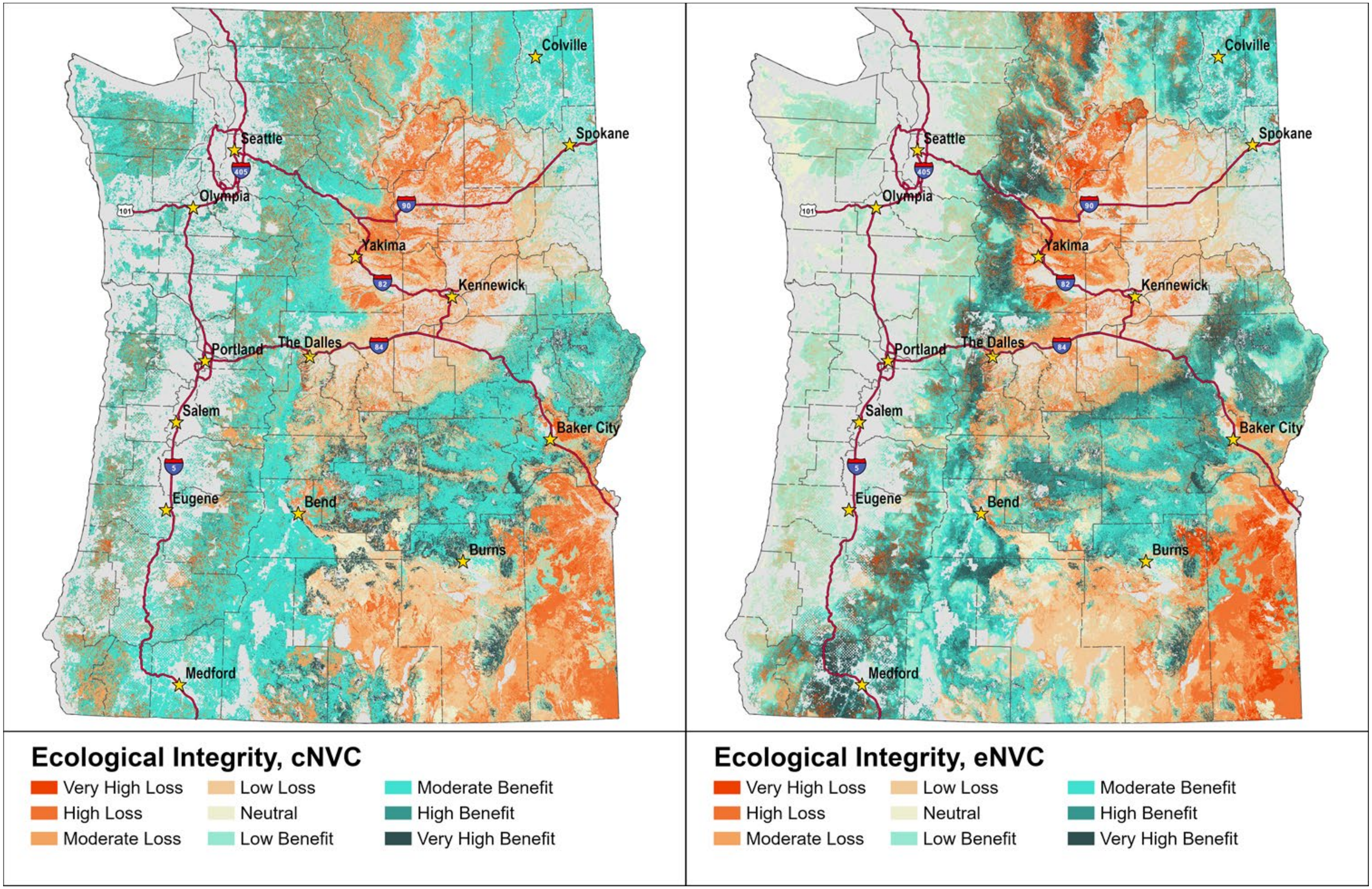

Figure 32. Conditional net value change (cNVC, left) and expected net value change (eNVC, right) for the Ecological Integrity HVRA in the PNW QWRA 2023.

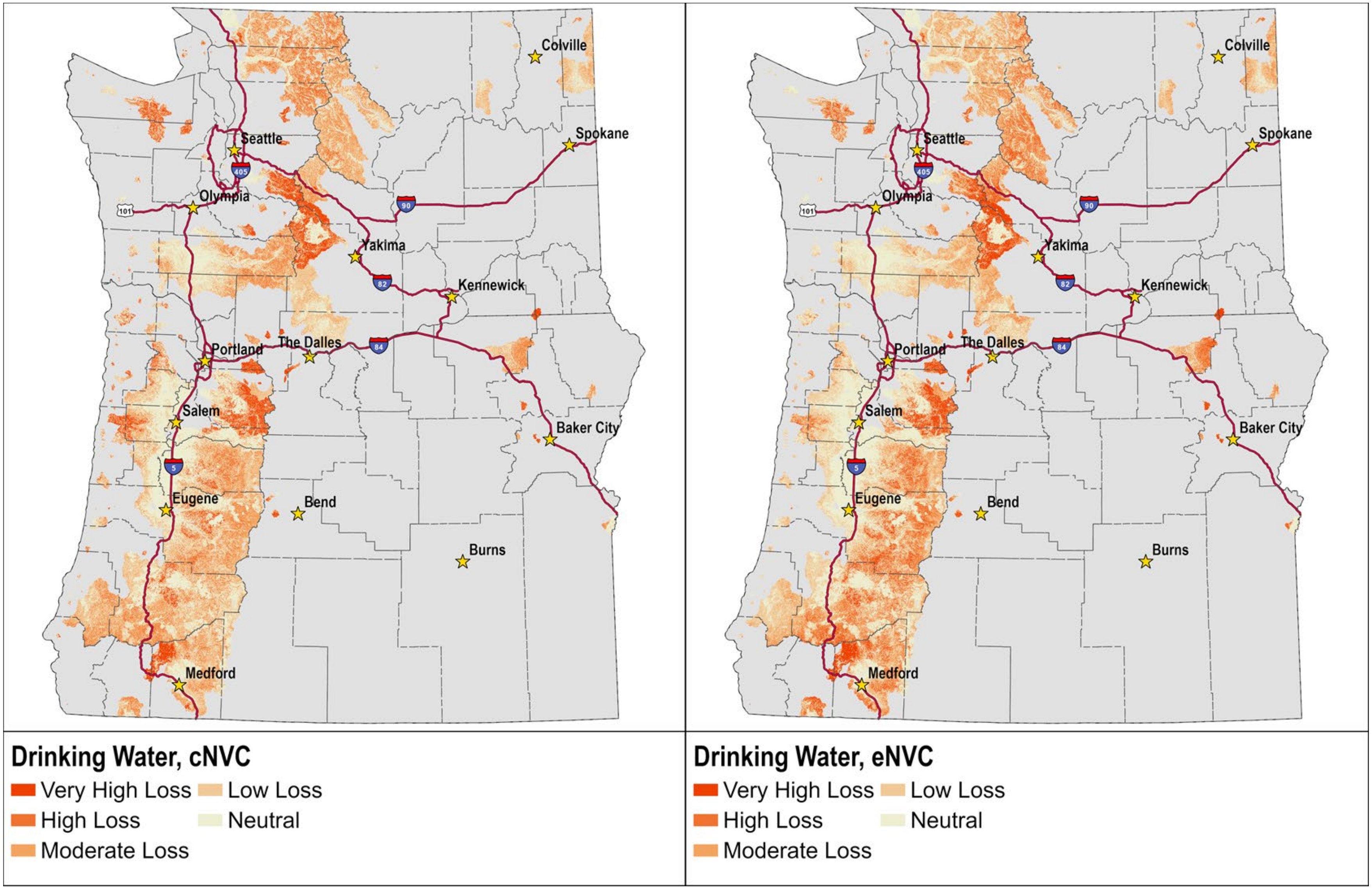

Figure 33. Conditional net value change (cNVC, left) and expected net value change (eNVC, right) for the Drinking Water HVRA in the PNW QWRA 2023.

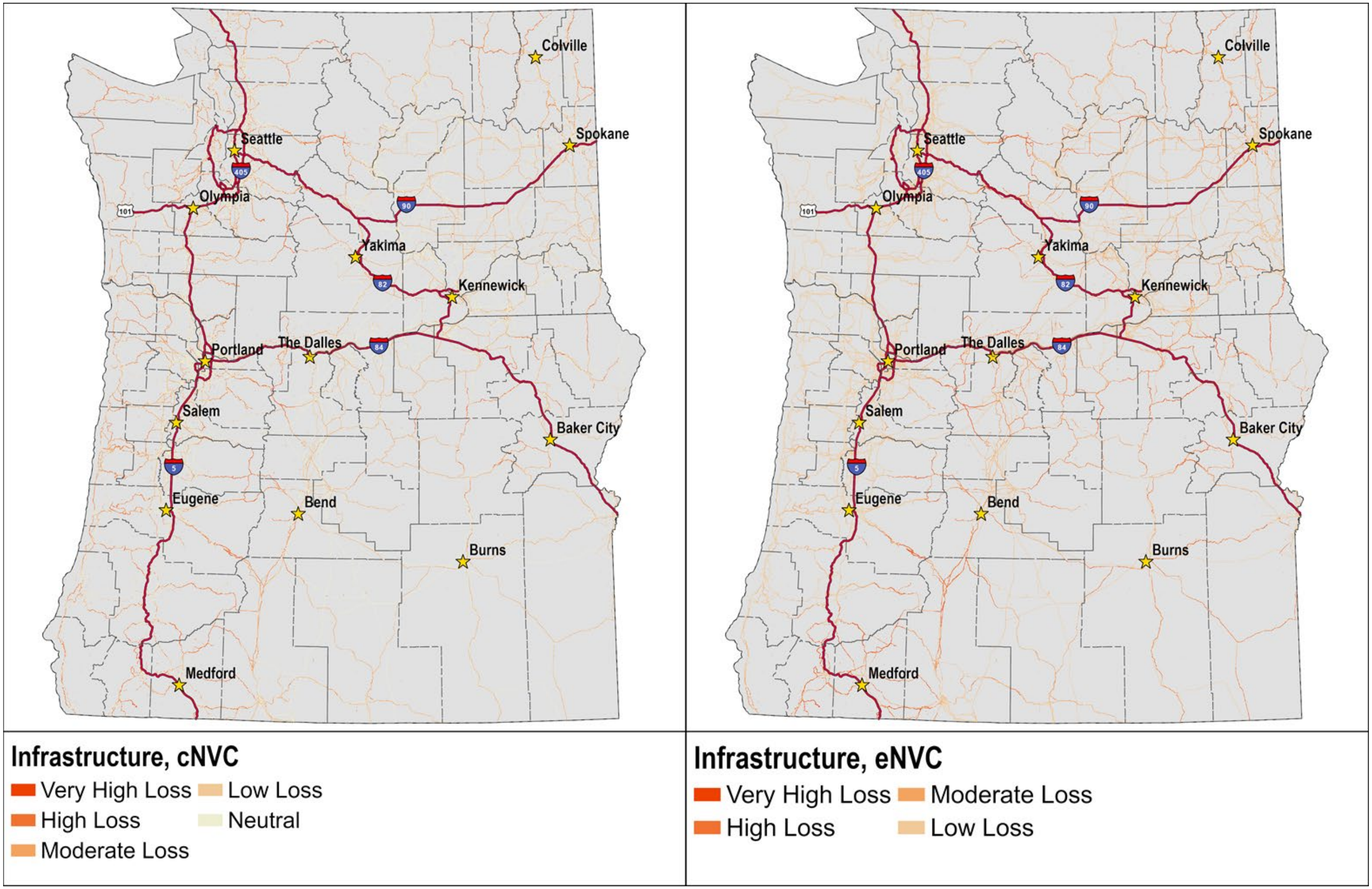

Figure 34. Conditional net value change (cNVC, left) and expected net value change (eNVC, right) for the Infrastructure HVRA in the PNW QWRA 2023.

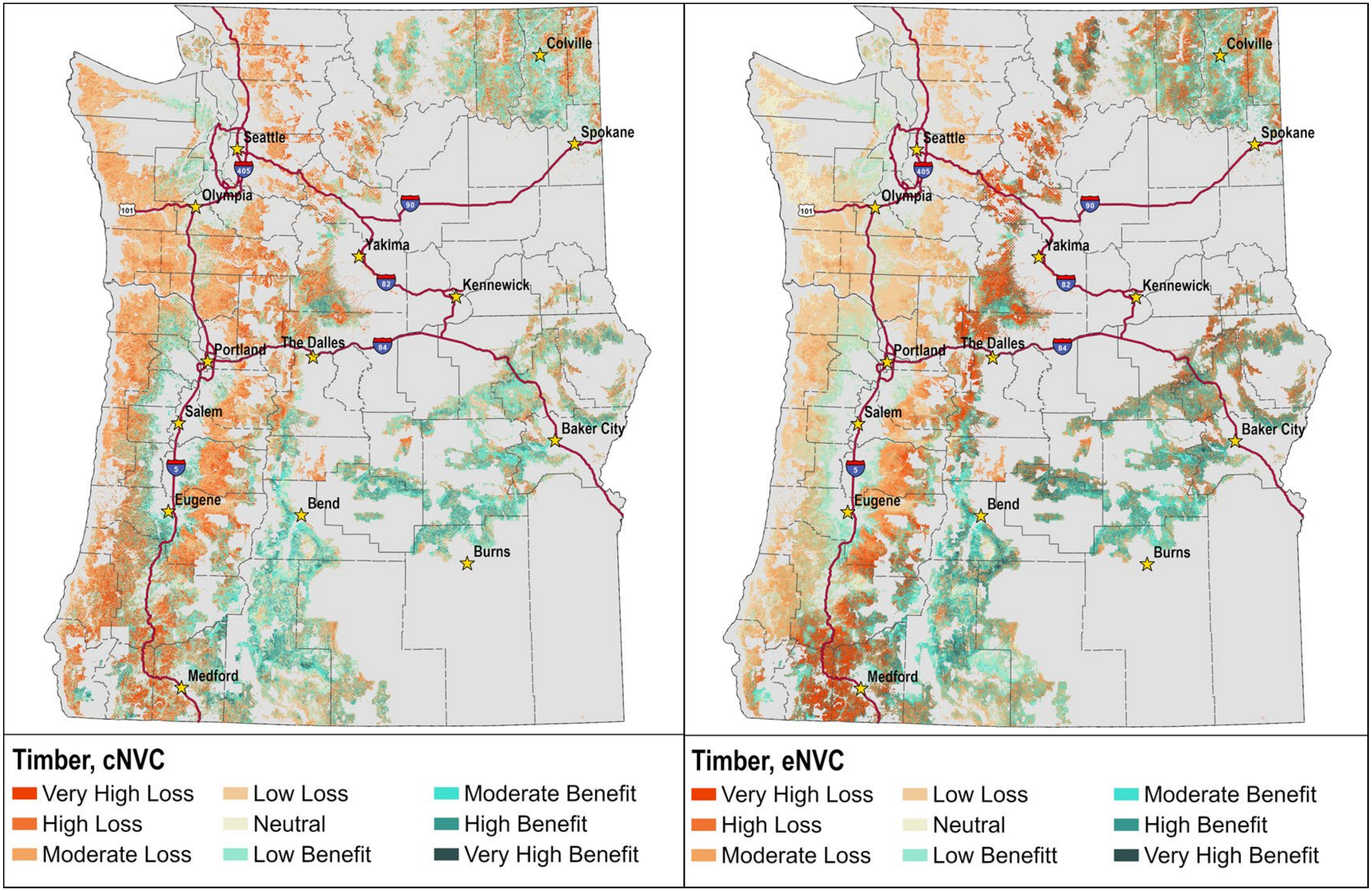

Figure 35. Conditional net value change (cNVC, left) and expected net value change (eNVC, right) for the Timber HVRA in the PNW QWRA 2023.

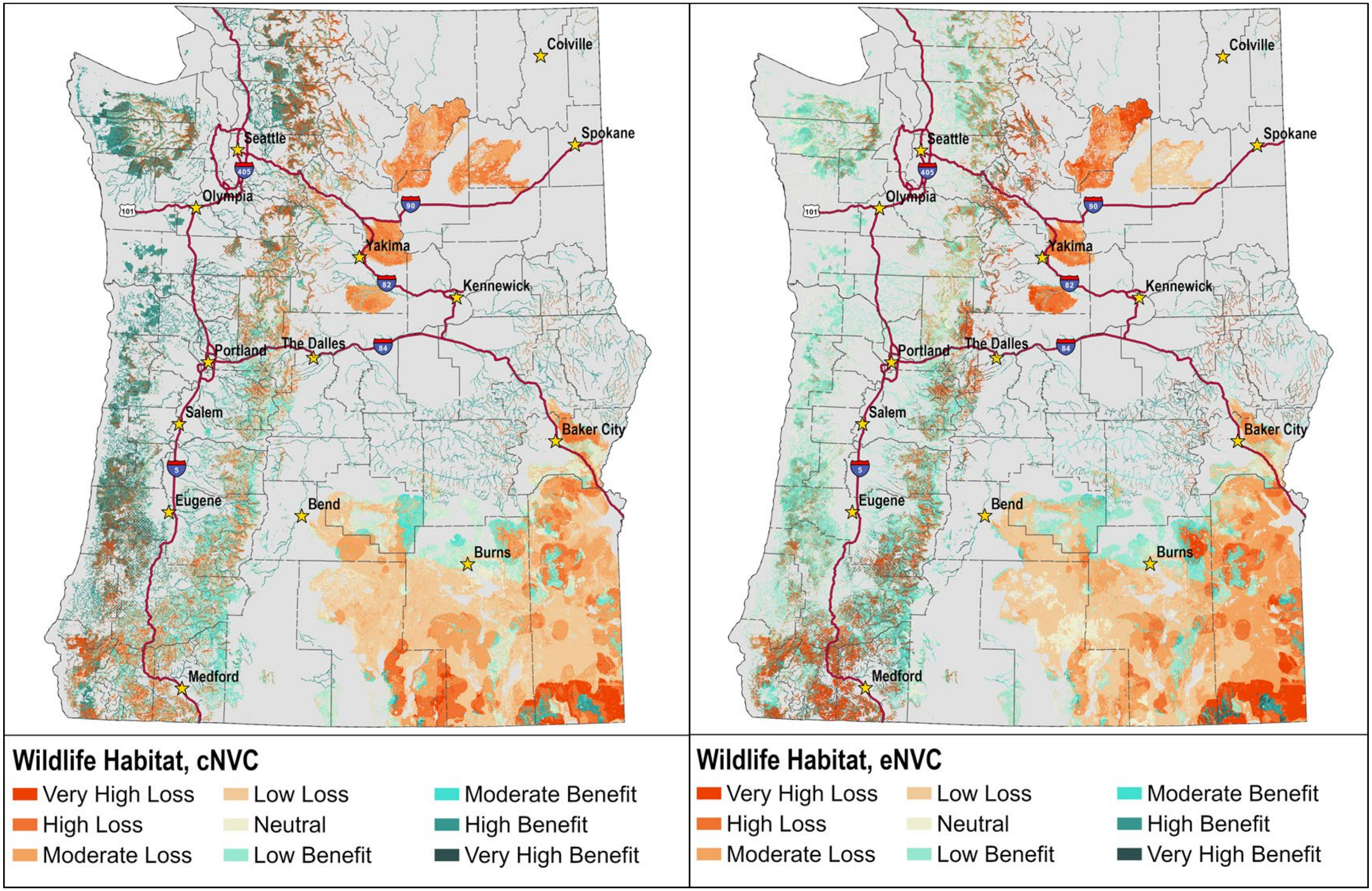

Figure 36. Conditional net value change (cNVC, left) and expected net value change (eNVC, right) for the Wildlife Habitat HVRA in the PNW QWRA 2023.

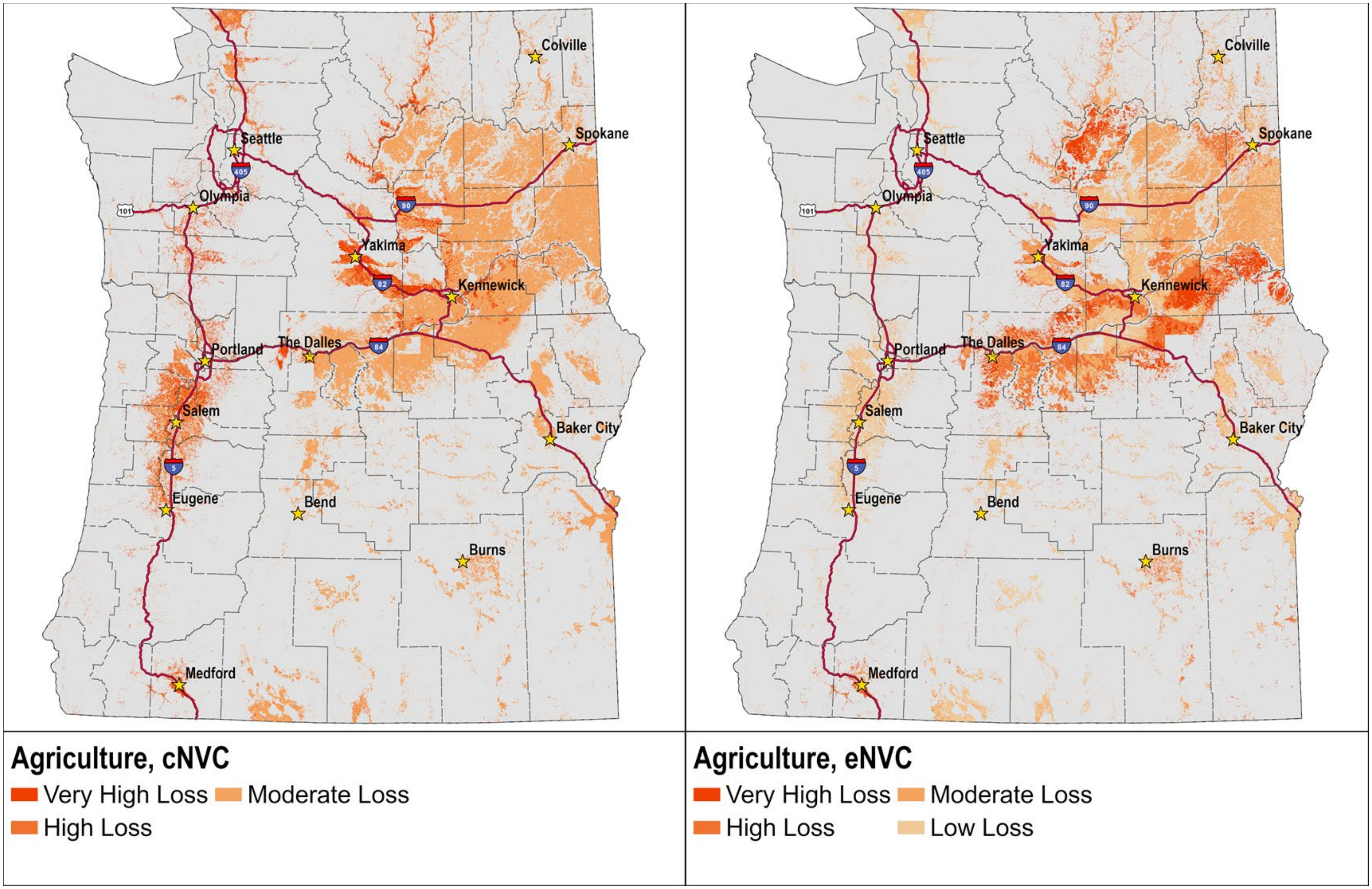

Figure 37. Conditional net value change (cNVC, left) and expected net value change (eNVC, right) for the Agriculture HVRA in the PNW QWRA 2023.

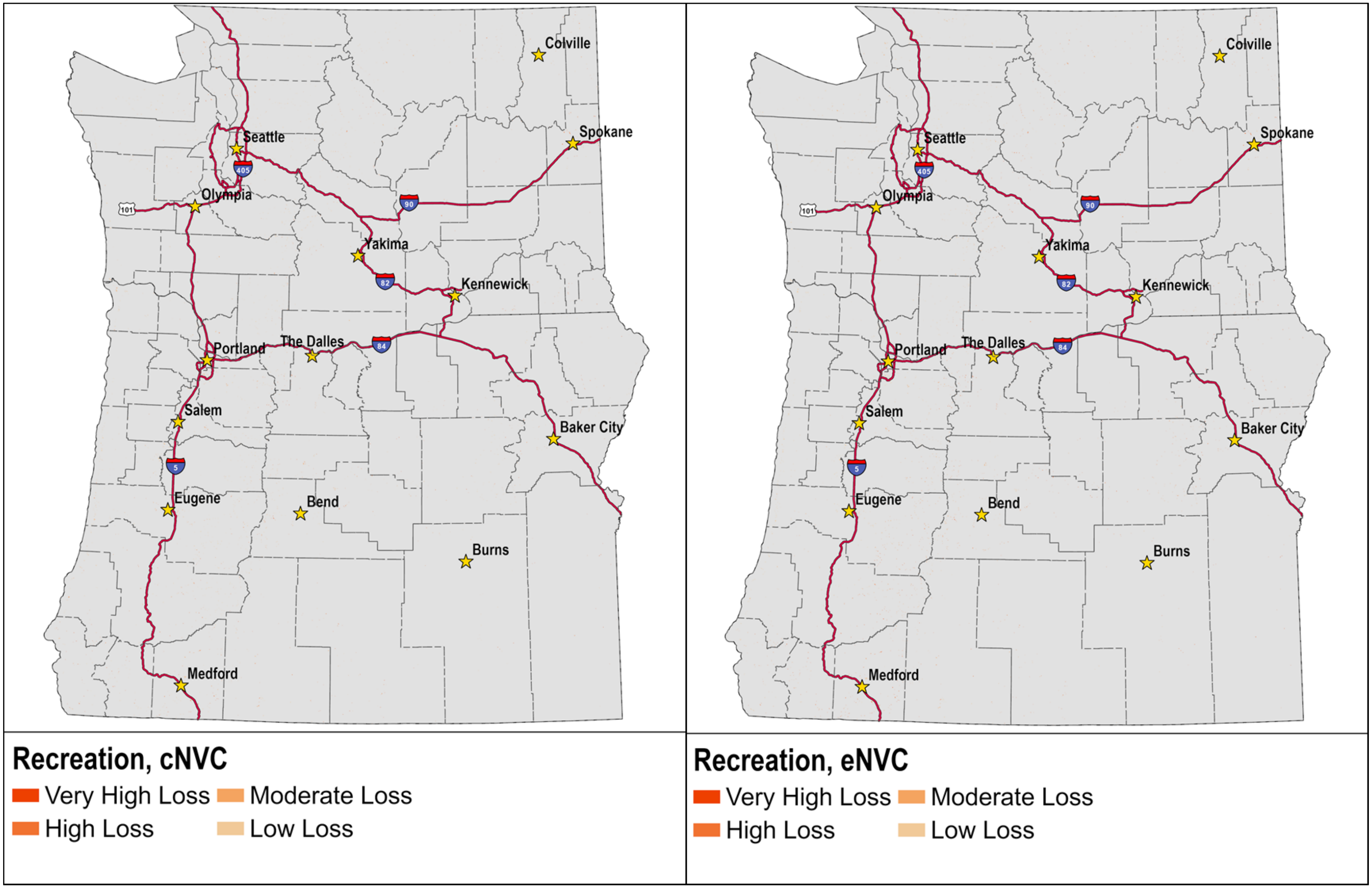

Figure 38. Conditional net value change (cNVC, left) and expected net value change (eNVC, right) for the Recreation HVRA in the PNW QWRA 2023. Note that results are difficult to see because in most cases recreation resources have very small extents.

6 Suggested Uses and Best Practices

6.1 Interpreting Risk Results, Classifying Data and Symbology

Quantitative wildfire risk assessments produce relative risk values for each pixel in the analysis area, reflecting which HVRAs are present, and how those HVRAs would likely respond to fire given the coincident fire hazard characteristics. The risk value is expressed as net value change (NVC), either positive or negative. Expected Net Value Change (eNVC) numbers in particular are usually very small decimals because we multiply susceptibility by burn probability, a small decimal value itself, to calculate eNVC. For some users it may be confusing that very high risk is associated with a value so close to zero, but the magnitude of an NVC number is only meaningful within the context of NVC values from across the rest of the study area because the QWRA framework is an evaluation of *relative* risk.

For prioritization applications, the continuous NVC outputs are usually classified into categories. The classification schemes included with the data are just one way of binning risk values. Importantly, the classification schemes included with the QWRA data are based on the full range of risk values from across Oregon and Washington. Consequently, when clipping QWRA results to a different extent (e.g., county, national forest, watershed, etc.), it is advisable to reclassify the data based on the range of risk values within the new extent.

The classification schemes provided with the data were all based on the same general methodology. First, using the full range of risk values from across the analysis area, we calculated the 5th, 40th, 70th and 90th percentile values of the negative risk values only. Then, we mirrored those percentile values to create class breakpoints for the positive risk values (Table 34).

The provided classification schemes vary based on whether the data represent eNVC or cNVC, and based on whether the data represent integrated risk results (i.e. ieNVC or icNVC) or HVRA-level risk results. For integrated risk results, the percentile breakpoints were calculated using the full range of integrated NVC values. For HVRA-level classification schemes, the percentile breakpoints were calculated using NVC values from that HVRA only.

Table 34. Example of a classification scheme. The negative values in the "high" column are the 5th, 40th, 70th and 90th percentile breakpoint values of all the negative risk values sampled for this example. Note how those breakpoint values (e.g.-0.00074, -0.00019, etc.) are mirrored for the benefit classes.

Risk Value Range		Label
Low	*High*	
-0.73218	-0.00074	Very high loss
-0.00074	-0.00019	High loss
-0.00019	-0.00003	Mod loss
-0.00003	0.00000	Low loss
0.00000	0.00000	Neutral
0.00000	0.00003	Low benefit
0.00003	0.00019	Mod benefit
0.00019	0.00074	High benefit
0.00074	0.73218	Very high benefit

6.2 Integrated vs. Non-Integrated Products

The PNW QWRA generates a wide range of unique representations of risk from which end-users can choose to support their planning needs. When identifying the most appropriate PNW QWRA analytics, one very common consideration is whether to use integrated or non-integrated risk products. The decision depends on what questions you're trying to answer.

Integrated risk products, where risk to multiple HVRAs is combined into a single value, offer a comprehensive representation of risk to the values described in this report. At any location, integrated risk products provide insight into the net effect for all HVRAs present. One advantage to integrated risk products is that they facilitate optimized planning for multiple objectives. When managers want to optimize risk mitigation to several spatially coincident HVRAs, integrated risk analytics make that process simpler than having to compare multiple separate data layers. Another advantage to integrated risk products is that they condense a lot of information into a single data layer which can simplify communication with broad audiences or expedite decision-making during active fire events. One disadvantage to integrated risk products is that, depending on the number of HVRAs included, it can be nearly impossible to tease apart which HVRAs are driving the risk value. Another disadvantage could be that overall relative importance plays a role in integrated risk outputs. In some circumstances, end-users might have significantly different relative importance frameworks than the one used in the QWRA. In that case, end-users need to be thoughtful about whether integrated risk products accurately represent risk for their planning needs, which ultimately depends on how one diagnosis the problem. Putting thought into this stage of a strategy is worth it in the outcome of your effort.

Non-integrated risk products, where risk to each HVRA is represented in a unique data layer, offer comparatively simple representations of risk. Non-integrated risk products facilitate targeted analysis to develop HVRA-specific risk mitigation plans. One advantage of non-integrated risk analytics is that it is much easier to determine what is driving risk at any given location because end-users need only to compare the HVRA data with the fire hazard data to gain insight into fire effects. Likewise, it could be an advantage that relative importance is not a factor in non-integrated risk products. The most obvious disadvantage to using non-integrated risk products is that they do not provide a comprehensive picture of risk and therefore may develop a risk mitigation strategy that only supports one of many values on a landscape This of course can be compounded by personal biases and perspectives, rather than a more collaborative approach.

6.3 Applying QWRA Data to Different Extents

Because the QWRA represents relative risk, all the risk products can be applied to smaller geographies and still meaningfully represent the spatial distribution of risk. When applying QWRA outputs to different geographic extents, consider the following three observations.

First, risk classification schemes might need to be re-designed based on a different range of values. Unless the end-user wants to compare risk values from their local planning landscape to risk across all of Oregon and Washington, risk will need to be reclassified when applying QWRA outputs to a smaller geography. Reclassifying risk values on a smaller planning landscape will illustrate a gradient of risk that is relevant to that particular landscape. Note that depending on the geographic scale and location of the smaller planning landscape, there may not be a significant range in risk values and so end-users might have to be creative with solutions for binning the data.

Second, the relative importance scheme used in the overall QWRA may not be accurate for some planning landscapes or some planning projects. Overall relative importance reflects regional, cross-boundary priorities among the eight HVRAs. In most QWRA applications, the general relative importance hierarchy will likely be similar, but in some cases, it might not be. For instance, in the QWRA, Timber was allocated a larger share of the overall relative importance than Wildlife Habitat, but in some multiple use management areas Wildlife Habitat might be considered more important than Timber. Most users will not be able to re-run the assessment using new relative importance schemes, in which case they are advised to use non-integrated risk products if there is a concern about relative importance.

Third, the spatial data underpinning the QWRA was designed to meet regional planning needs and may not always align with or meet the needs of specific, local planning. When end-users apply the QWRA to locally specific planning needs they may observe mismatches between their own HVRA data and the HVRA data used in the QWRA. Those mismatches could affect how QWRA risk outputs are interpreted.

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8 Appendix A – Summary of PNW QWRA 2023 Sub-HVRAs

Table 35. Summary of each sub-HVRA included in the QWRA. Sub-HVRA short names are included in spatial data file names and may be useful for navigating the spatial data.

HVRA Abbreviation	Sub-HVRA Short Name	Description
PP	PP_VeryLow	Represents residential and non-residential structures where density is > 0 structures - 1 structure per 40 acres
PP	PP_Low	Represents residential and non-residential structures where density is 1 structure per 40 - 1 structure per 20 acres
PP	PP_ModerateLow	Represents residential and non-residential structures where density is 1 structure per 20 - 1 structure per 10 acres
PP	PP_Moderate	Represents residential and non-residential structures where density is 1 structure per 10 - 1 structure per 5 acres
PP	PP_ModerateHigh	Represents residential and non-residential structures where density is 1 structure per 5 - 1 structure per 2 acres
PP	PP_High	Represents residential and non-residential structures where density is 1 structure per 2 - 3 structures per acre
PP	PP_VeryHigh	Represents residential and non-residential structures where density is > 3 structures per acre
INFRA	INFRA_Interstates	Represents interstates across Oregon and Washington
INFRA	INFRA_Highways	Represents highways across Oregon and Washington
INFRA	INFRA_Railroads	Represents railroads across Oregon and Washington
INFRA	INFRA_TransHigh	Represents high vlotage transmission lines where voltage is ≥ 100kV
INFRA	INFRA_TransLow	Represents high vlotage transmission lines where voltage is < 100kV
INFRA	INFRA_Communications	Represents communication sites, including FM transmission towers, AM transmission towers, broadband radio transmitters, cellular towers, microwave service towers, paging transmission towers, land mobile commercial transmission towers, land mobile broadcast towers, antenna structure registrate, TV broadcast contours, TV digital station transmitters, TV analog station transmitters, and TV digital station transmitters

INFRA	INFRA_PowerPlants	Represents electric power plants of multiple types including hydroelectric dams, fossil fuel, nuclear, solar, wind geothermal and biomass
INFRA	INFRA_Substations	Represent electric power substations primarily associated with electric power transmission including facilities and equipment that switch, transform, or regulate electric power at voltages equal to, or greater than, 69 kilovolts
INFRA	INFRA_OilGas	Represents oil and natural gas wells. An oil and natural gas well is a hole drilled in the earth for the purpose of finding or producing crude oil or natural gas; or producing services related to the production of crude or natural gas
INFRA	INFRA_EssentialFacilities	Represent structures that might be essential to community function during and immediately following a wildfire, including: hospitals, EMS stations, fire stations, colleges and universities, local law enforcement, schools, childcare centers, solid waste facilities, nursing homes, public health departments, urgent care facilities, wastewater treatment sites, EPA emergency response facilities, public transit centers, and state government buildings
WH	WH_SpottedOwl_Refugia	Represents areas where the biotic and abiotic characteristics are suitable for nesting, breeding, hunting and dispersal habitat, and are located in fire refugia
WH	WH_SpottedOwl_NonRefugia	Represents areas where the biotic and abiotic characteristics are suitable for nesting, breeding, hunting and dispersal habitat, and are located outside fire refugia
WH	WH_SageGrouse_Focal	Represent focal habitat identified by U.S. Fish and Wildlife as essential strongholds for sage-grouse and of the highest conservation priority
WH	WH_SageGrouse_Priority	Represents priority habitat identified by U.S. Fish and Wildlife and includes areas essential to breeding, late brood-rearing, winter concentration areas, and migration or connectivity corridors
WH	WH_SageGrouse_General	Represents general habitat identified by U.S. Fish and Wildlife and includes areas where special management might need to occur in order to sustain greater sage-grouse populations. It is of the least conservation priority
WH	WH_MarbledMurrelet	Represents habitat mapped as critical habitat by U.S. Fish and Wildlife, Endangered Species Program.
WH	WH_BullTrout	Represents generalized fish distribution in Oregon and Washington
WH	WH_SteelheadTrout	Represents U.S. Fish and Wildlife Critical Habitat designations
WH	WH_CohoSalmon	Represents U.S. Fish and Wildlife Critical Habitat designations

WH	WH_ChinookSalmon	Represents U.S. Fish and Wildlife Critical Habitat designations
TIM	TIM_TribalOther_SizeClass1	Represents tribal-owned forest land other than the Colville Reservation where timber quadratic mean diameter is <10"
TIM	TIM_TribalOther_SizeClass2	Represents tribal-owned forest land other than the Colville Reservation where timber quadratic mean diameter is 10" - 20"
TIM	TIM_TribalOther_SizeClass3	Represents tribal-owned forest land other than the Colville Reservation where timber quadratic mean diameter is > 20"
TIM	TIM_TribalActive_SizeClass1	Represents tribal-owned forest land on the Colville Reservation where timber quadratic mean diameter is <10"
TIM	TIM_TribalActive_SizeClass2	Represents tribal-owned forest land on the Colville Reservation where timber quadratic mean diameter is 10" - 20"
TIM	TIM_TribalActive_SizeClass3	Represents tribal-owned forest land on the Colville Reservation where timber quadratic mean diameter is > 20"
TIM	TIM_PrivateIndustrial_SizeClass1	Represents private industrial forest land where timber quadratic mean diameter is <10"
TIM	TIM_PrivateIndustrial_SizeClass2	Represents private industrial forest land where timber quadratic mean diameter is 10" - 20"
TIM	TIM_PrivateIndustrial_SizeClass3	Represents private industrial forest land where timber quadratic mean diameter is > 20"
TIM	TIM_PrivateNonIndustrial_SizeClass1	Represents private non-industrial forest land where timber quadratic mean diameter is <10"
TIM	TIM_PrivateNonIndustrial_SizeClass2	Represents private non-industrial forest land where timber quadratic mean diameter is 10" - 20"
TIM	TIM_PrivateNonIndustrial_SizeClass3	Represents private non-industrial forest land where timber quadratic mean diameter is > 20"
TIM	TIM_BLMActive_SizeClass1	Represents forest land managed by the U.S. Bureau of Land Management where commercial timber production is the primary management objective including all forested Harvest Land Base, Oregon and California Re-vested Railroad Lands and Coos Bay Wagon Road that are not otherwise designated as Congressionally Reserved or wilderness lands. Quadratic mean diameter is < 10"

TIM	TIM_BLMActive_SizeClass2	Represents forest land managed by the U.S. Bureau of Land Management where commercial timber production is the primary management objective including all forested Harvest Land Base, Oregon and California Re-vested Railroad Lands and Coos Bay Wagon Road that are not otherwise designated as Congressionally Reserved or wilderness lands. Quadratic mean diameter is 10" - 20"
TIM	TIM_BLMActive_SizeClass3	Represents forest land managed by the U.S. Bureau of Land Management where commercial timber production is the primary management objective including all forested Harvest Land Base, Oregon and California Re-vested Railroad Lands and Coos Bay Wagon Road that are not otherwise designated as Congressionally Reserved or wilderness lands. Quadratic mean diameter is > 20"
TIM	TIM_BLMOther_SizeClass1	Represents forest land managed by the U.S. Bureau of Land Management where commercial timber production is a management objective including all remaining forest land managed by the Bureau of Land Management which is neither included in the Active Management sub-HVRA nor designated as Congressionally Reserved or wilderness. Quadratic mean diameter is < 10"
TIM	TIM_BLMOther_SizeClass2	Represents forest land managed by the U.S. Bureau of Land Management where commercial timber production is a management objective including all remaining forest land managed by the Bureau of Land Management which is neither included in the Active Management sub-HVRA nor designated as Congressionally Reserved or wilderness. Quadratic mean diameter is 10" - 20"
TIM	TIM_BLMOther_SizeClass3	Represents forest land managed by the U.S. Bureau of Land Management where commercial timber production is a management objective including all remaining forest land managed by the Bureau of Land Management which is neither included in the Active Management sub-HVRA nor designated as Congressionally Reserved or wilderness. Quadratic mean diameter is > 20"
TIM	TIM_USFSActive_SizeClass1	Represents forested areas within National Forests classified as "active management" where mechanical treatments are allowable to meet wood production targets. Quadratic mean diameter is < 10"
TIM	TIM_USFSActive_SizeClass2	Represents forested areas within National Forests classified as "active management" where mechanical treatments are allowable to meet wood production targets. Quadratic mean diameter is 10" - 20"

TIM	TIM_USFSActive_SizeClass3	Represents forested areas within National Forests classified as "active management" where mechanical treatments are allowable to meet wood production targets. Quadratic mean diameter is > 20"
TIM	TIM_USFSMultipleObjectives_SizeClass1	Represents forested areas within National Forests classified as "active management" where mechanical treatments are restricted and can only be implemented if there is no conflict with other forest plan objectives. Quadratic mean diameter is < 10"
TIM	TIM_USFSMultipleObjectives_SizeClass2	Represents forested areas within National Forests classified as "active management" where mechanical treatments are restricted and can only be implemented if there is no conflict with other forest plan objectives. Quadratic mean diameter is 10" - 20"
TIM	TIM_USFSMultipleObjectives_SizeClass3	Represents forested areas within National Forests classified as "active management" where mechanical treatments are restricted and can only be implemented if there is no conflict with other forest plan objectives. Quadratic mean diameter is > 20"
TIM	TIM_State_SizeClass1	Represents state owned or managed timberland where quadratic mean diameter is < 10"
TIM	TIM_State_SizeClass2	Represents state owned or managed timberland where quadratic mean diameter is 10" - 20"
TIM	TIM_State_SizeClass3	Represents state owned or managed timberland where quadratic mean diameter is > 20"
AG	AG_Annual	Represents areas considered cultivated between 2018 and 2022 and where the most common crop type in that period was an annual crop
AG	AG_Perennial	Represents areas considered cultivated between 2018 and 2022 and where the most common crop type in that period was an perennial crop
REC	REC_LowDeveloped	Represents low development recreation infrastructure on all ownerships in Oregon and Washington including trail heads, toilets, etc.
REC	REC_HighDeveloped	Represents high development recreation infrastructure on all ownerships in Oregon and Washington including ranger stations, developed campsites, interpretive sites, etc.
DW	DW_Lowest	Represents drinking water source provision areas with the lowest per pixel population served
DW	DW_Low	Represents drinking water source provision areas with the low per pixel population served

DW	DW_Moderate	Represents drinking water source provision areas with the moderate per pixel population served
DW	DW_High	Represents drinking water source provision areas with the high per pixel population served
DW	DW_Highest	Represents drinking water source provision areas with the highest per pixel population served
EI	EI_Range_ClassB	Represents good and intermediate condition grasslands where the proportion of perennials is greater than annuals
EI	EI_Range_ClassD	Represents poor condition grasslands where the proportion of annuals is greater than perennials
EI	EI_Range_ClassA	Represents good and intermediate condition shrublands where the proportion of perennials is greater than annuals
EI	EI_Range_ClassC	Represents poor condition shrublands where the proportion of annuals is greater than perennials
EI	EI_Range_JuniperLate_Good	Represents rangelands where encroaching juniper is > 20% of total cover and where the proportion of understory perennials is greater than annuals
EI	EI_Range_JuniperEarly_Good	Represents rangelands where encroaching juniper is 5% - 20% of total cover and where the proportion of understory perennials is greater than annuals
EI	EI_Range_JuniperLate_Poor	Represents rangelands where encroaching juniper is > 20% of total cover and where the proportion of understory annuals is greater than perennials
EI	EI_Range_JuniperEarly_Poor	Represents rangelands where encroaching juniper is 5% - 20% of total cover and where the proportion of understory annuals is greater than perennials
EI	EI_Forests_LateOpen	Represents forests where current s-class is late seral with an open canopy
EI	EI_Forests_Early	Represents forests where current s-class is early seral
EI	EI_Forests_MidOpen	Represents forests where current s-class is mid seral with open canopy
EI	EI_Forests_LateClosed	Represents forests where current s-class is late seral with a closed canopy
EI	EI_Forests_MidClosed	Represents forests where current s-class is mid seral with a closed canopy

9 Appendix B – PNW QWRA 2023 Data Description

9.1 Hazard Data

Wildfire hazard data as formatted and used in the calculation of risk is available in 'FireHazard.gdb.'

Wildfire hazard data includes burn probability and fire intensity raster datasets. All data is represented with 30-meter cell size.

- **BP** – This dataset is the average annual likelihood of wildfire at any given location within the project area. Burn probabilities were modeled by Pyrologix using the large fire simulator FSim. The original modeling was conducted at 120-meter cell size and then resampled to 30-meter cell size. The original BP data was modified as described previously to account for fires plausibly burning on irrigated croplands.
- **FIL** – There are six fire intensity level (FIL) rasters, each representing the probability that when a fire occurs, the flame lengths fall within a specific range. At any single pixel, the six FIL probabilities sum to 100. Fire intensity was modeled by Pyrologix using WildEST and methods described above. All rasters were resampled to a 30-meter cell size. The original FIL datasets were modified as described previously to account for fires plausibly burning on irrigated croplands.
  - **FIL1**- conditional probability that flame lengths are between zero and two feet.
  - **FIL2**- conditional probability that flame lengths are between two and four feet.
  - **FIL3**- conditional probability that flame lengths are between four and six feet.
  - **FIL4**- conditional probability that flame lengths are between six and eight feet.
  - **FIL5**- conditional probability that flame lengths are between eight and 12 feet.
  - **FIL6**- conditional probability that flame lengths are greater than 12 feet.

- **iCFL**- This dataset represents the mean conditional flame length. For each pixel, it was calculated as the sum product of all FIL rasters and the midpoint flame length of each FIL class. For FIL6 we used a midpoint flame length of 100 feet to represent torching trees.

9.2 HVRA Data

Two types of HVRA data are available. The first is descriptive. Descriptive HVRA data represents the extent of each sub-HVRA and includes attribute information about covariates. Descriptive HVRA is intended to provide users with an understanding of how and where HVRAs were mapped. In contrast, the risk calculation HVRA spatial data include a unique raster for each sub-HVRA as formatted for risk calculations. When used in conjunction with the PNW QWRA 2023 excel workbook, risk calculation HVRA data will allow users to re-produce or re-run an alternative risk assessment for landscapes in Oregon and Washington.

- **HVRAs_Descriptive_v2.gdb -** This zipped folder contains a geodatabase of raster files representing all sub-HVRAs used in the development of the 2023 Pacific Northwest Quantitative Wildfire Risk Assessment (QWRA).The data included here were used to map the extent of and characterize sub-HVRAs for all HVRAs in the QWRA.The data layers are not formatted for the actual risk assessment, but rather are formatted and attributed to give viewers the most complete information regarding each HVRA or sub-HVRA, including covariates that were used to determine sub-HVRA response functions. All rasters are 30-m resolution and projected in

NAD_1983_USFS_R6_Albers. For more details on data sources and methods refer to the QWRA Methods Report. All raster names begin with the HVRA code:

- PP = People and Property
- INFRA = Infrastructure
- TIM = Timber
- DW = Drinking Water
- AG = Agriculture
- REC = Recreation Infrastructure
- EI = Ecological Integrity
- WILD = Wildlife Habitat

For HVRAs where constituent sub-HVRAs are not spatially coincident (e.g. People and Property) there may be a single raster which includes detailed spatial data for all sub-HVRA in which case the HVRA code is followed by "_combine". In cases, where sub-HVRAs are spatially coincident (e.g. Wildlife) then sub-HVRAs may be represented in unique rasters in which case the HVRA code will be followed by an abbreviated description of the sub-HVRA - e.g. "WILD_Chinook" is the layer for the Chinook salmon sub-HVRA within the Wildlife HVRA.

- **HVRAs_RiskCalcs_v2.zip -** This zipped folder contains a geodatabase of raster files representing all sub-HVRAs as formatted for calculating risk in the 2023 Pacific Northwest Quantitative Wildfire Risk Assessment (QWRA). Rasters in this geodatabase, as compared to rasters in 'HVRA_Descriptive_v2.zip,' are suitable for re-calculating or re-producing risk results when used in conjunction with 'PNWQWRA_2023_workbook.xlsx'. There is a unique raster for each sub-HVRA. Raster values are a six-digit code where the first two values represent the HVRA, the middle two values indicate which sub-HVRA, and the last two values indicate which covariate if any. Raster values correspond to the look-up table which can be found in 'PNWQWRA_2023_workbook.xlsx' in the worksheet titled "LookUpTable." All rasters are 30-m resolution and projected in NAD_1983_USFS_R6_Albers.

9.3 Risk Results

Risk results are represented in three geodatabases. Raster file names include an HVRA code so that each layer is associated with an HVRA. **PP** = People and Property; **INFRA** = Infrastructure; **TIM** = Timber; **DW** = Drinking Water; **AG** = Agriculture; **REC** = Recreation; **EI** = Ecological Integrity; **WILD** = Wildlife

- **ExpectedNVC.gdb**- includes 84 rasters representing expected net value change (eNVC) to all sub-HVRAs (n = 75), HVRAs (n = 8) and integrated across all HVRAs (n = 1). Expected net value change is a risk-neutral metric which is calculated as the sum-product of burn probability and value change over a range of plausible fire intensities.
  - **weNVC_***: represent eNVC risk for individual sub-HVRAs. The file name includes a brief descriptor of the sub-HVRA.
  - **HVRA_weNVC_***: represent eNVC risk for HVRAs. Each HVRA-level raster is the sum of all constituent sub-HVRA eNVC.
  - **ieNVC**: expected net value change integrated across all HVRAs. This layer is the sum of all HVRA-level eNVC rasters.
- **ConditionalNVC.gdb**- includes 84 rasters representing conditional net value change (cNVC) to all sub-HVRAs (n = 75), HVRAs (n = 8) and integrated across all HVRAs (n = 1). Conditional net value

change is a risk-neutral metric which includes anticipated value of change given the probability of burning at different intensity levels. Notably, cNVC does not account for annual burn probability.

- **wcNVC_***: represent cNVC risk for individual sub-HVRAs. The file name includes a brief descriptor of the sub-HVRA.
- **HVRA_wcNVC_***: represent cNVC risk for HVRAs. Each HVRA-level raster is the sum of all constituent sub-HVRA cNVC.
- **icNVC**: conditional net value change integrated across all HVRAs. This layer is the sum of all HVRA-level cNVC rasters.

10 Appendix C Additional Hazard Products Available for the Pacific Northwest.

The focus of this report is largely on development of the PNW QWRA 2023 which is framed to represent wildfire risk on an existing landscape. In addition to the fire hazard layers which serve as the foundation of the PNW QWRA 2023, Pyrologix produced additional fire hazard analytics including common fire management analytics like suppression difficulty index, wildfire hazard potential and wildfire risk to potential structures. Furthermore, Pyrologix generated these and other hazard-related analytics on a current landscape, a future landscape where existing disturbances have been allowed to re-grow, and a “treated” landscape which represents a hypothetical situation in which all timbered pixels have received some kind of fuel reduction treatment. These additional analytics can be used as standalone products or in concert with the HVRA data described above to model risk and possible changes in risk. All products listed were produced by Pyrologix LLC under contract by the USDA Forest Service. The specific datasets are available upon request. Requests can be directed to:

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10.1 Intent of additional wildfire hazard deliverables

Wildfire risk varies spatially and temporally. To facilitate a better understanding of how risk changes over space and time, its necessary to frame wildfire hazard under specific scenarios. During the spring of 2022 additional calibration workshops were held to create different versions of the PNW landscape and facilitate additional fire hazard modeling. The focus of these workshops was refining the LANDFIRE data and modeling inputs to be applied to a high herbaceous scenario fuelscape, a treated fuelscape, and a 2032 fuelscape. Each has a unique purpose and application. The deliverables associated with each fuelscape are listed below.

Fire managers have known for decades that the largest fires in rangelands typically occur in response to an increase in the “grass crop.” When herbaceous loading is below average, we typically see fewer larger fires and lower acreage burned. In contrast, an increase in loading, represented by a different choice in fuel model can set the stage for increased large fire size and/or intensity. The high herbaceous results can be used to demonstrate how the fire environment changes in response in biomass fluctuation. When compared against the fire hazard outputs using the 2022 fuelscape, its possible to objectively contrast the significance of herbaceous loading changes and if desired quantify changes in risk to HVRAs.

The treated landscape reflects all timbered pixels receiving a generalized fuel treatment. Its known that residual fuel composition after a treatment can vary based upon objectives and methods, yet there are advantages to quickly being able to quantify changes in fire hazard resulting from active management. Fuel treatments generally result in a reduced surface fuel loading (captured by a different fuel model), increased canopy base height, reduced canopy bulk density and canopy cover. Alone, this dataset is purely theoretical. However, when paired with others it can be leveraged to show the effects of proactive fuels investments and how they can change the risk profile to a specific HVRA or a suite of HVRAs. Fire hazard outputs using the treated fuelscape are not intended to replace the need for detailed modeling, yet this dataset can be used to quickly determine residual fire hazard or risk to select pixels.

The 2032 fuelscape applies LANDFIRE disturbance rules to grow out the fuels within recently burned areas. Fuel model assignment is reflective of known post-fire regeneration trends, in some cases capturing type conversion (i.e. brush fields replacing what was formerly timber). Additionally, a regression analysis on each FOA was used to determine the trajectory of both large fire occurrence and extent. Calibration targets for FSim reflect the large fire trendline of each FOA, extrapolated to 2032. This results in a marked increase in burn probability in some areas and relatively stable trend in others. The application or disturbance rules and calibration targets factors in changes in successional trajectory on fuel composition and indirectly captures the results of a changing climate. The wildfire hazard deliverables using this landscape are intended for site specific application. Its impossible to know where large fires will occur in the future, but the results can be applied to project future risk in those areas that have seen widespread, recent wildfires.

Table 36. All available, additional hazard data for Oregon and Washington.

<table>
<tr><th rowspan="2">Product Category</th><th rowspan="2">Deliverable</th><th colspan="6">Fuelscapes</th><th rowspan="2">Notes</th></tr>
<tr><th>2022</th><th>2022 treated</th><th>2032</th><th>2022 high herb</th><th>2032 high herb</th><th>2022 treated high herb</th></tr>
<tr><td rowspan="8">Fuelscape development (30-m resolution)</td><td>FBFM</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td rowspan="8">LANDFIRE data was adjusted during multiple workshops and differs from national datasets. Changes were driven by SMEs from throughout PNW. The 6 different landscapes produced are intended for facilitating scenario modeling. The 2022 fuelscape (also known as landscape file or LCP) was used as the basis for current condition wildfire hazard modeling.</td></tr>
<tr><td>CBH</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>CBD</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>CC</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>CH</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Slope</td><td colspan="6">✓</td></tr>
<tr><td>Aspect</td><td colspan="6">✓</td></tr>
<tr><td>Elevation</td><td colspan="6">✓</td></tr>
<tr><td rowspan="2">FSim modeling</td><td>Burn Probability (120m upsampled to 30m)</td><td>✓</td><td>-</td><td>✓</td><td>-</td><td>-</td><td>-</td><td>Calibration for current landscape and treated landscape were the same, only the fuels were adjusted. Treated fuelscape uses generalized treatment prescription (fuel model change, increased CBH, slight reduction in CBH, etc). 2032 landscape uses LF disturbance rules to "grow out fuels" and calibration adjusted based regression model for each FOA.</td></tr>
<tr><td>Ignitions</td><td>✓</td><td>-</td><td>✓</td><td>-</td><td>-</td><td>-</td><td>Ignitions for each Fire Occurrence Area (FOA).</td></tr>
</table>

	Event Set - perimeters	✓	-	✓	-	-	-	Event set can be used for transmitted-risk analysis. Perimeters are organized by FOA.
	Calibration Files	✓	-	✓	-	-	-	Fsim input files by FOA. Includes ERC stream for each season, FRISK, FDIST, ADJ, FMS files. Only necessary for rerunning Fsim model.

Product Category		**Deliverable**	**Fuelscapes**						**Notes**
			2022	**2022 treated**	**2032**	**2022 high herb**	**2032 high herb**	**2022 treated high herb**	
Fire characteristics modeling with WildEST (30-m resolution)	Flame-front characteristics	Characteristic Flame Length	✓	✓	✓	✓	✓	✓	Weighted-average FL over 216 weather types.
		Characteristic Fireline Intensity	✓	✓	✓	✓	✓	✓	Weighted-average FLI over 216 weather types.
		Characteristic Rate of Spread	✓	✓	✓	✓	✓	✓	Weighted-average ROS over 216 weather types.
		Characteristic Heat per Unit Area	✓	✓	✓	✓	✓	✓	Weighted-average HPA over 216 weather types.
		Fire Intensity Scale	✓	✓	✓	✓	✓	✓	Log-10 of the maximum fireline intensity (kW/m) under any of 216 weather types.
		Fire Type Probabilities	✓	✓	✓	✓	✓	✓	Locations without a forest canopy are only "surface fire". Locations with a forest canopy can be any of the the following: underburn; low-, mid- or high-grade passive crown fire; or active crown fire.
		Operational Control Probabilities	✓	✓	✓	✓	✓	✓	Probability of headfire flame length exceeding 4 feet (limit of manual fire control), 8 feet (mechanical control) and 11 feet (extreme fire behavior). Three separate rasters for each fuelscape.
		Fire Effects Flame Length Probabilities	✓	✓	✓	✓	✓	✓	Probability of flame-front flame length in each of six standard Fire Intensity Levels, after accounting for the effect of non-

									heading spread directions on flame length. Six rasters that sum to 1.0.

Product Category		Deliverable	Fuelscapes						Notes
			2022	2022 treated	2032	2022 high herb	2032 high herb	2022 treated high herb	
Fire characteristics modeling with WildEST (30-m resolution)	Ember characteristics	Conditional Ember Production Index	✓	✓	✓	✓	✓	✓	A relative index of the potential for a pixel to produce embers if a fire were to occur, a function of fuel, weather and topography.
		Conditional Ember Load Index	✓	✓	✓	✓	✓	✓	A relative index of the potential for a pixel to receive embers from surrounding land if a fire were to occur.
		Conditional sources of ember load to buildings	✓	✓	✓	✓	✓	✓	A relative index of the potential for a pixel to produce embers that land at a location where buildings exist.
		Ember Production Index	✓	✓	✓	✓	✓	✓	A relative index of the annualized potential for a pixel to produce embers after accounting for the pixels burn probability.
		Ember Load Index	✓	✓	✓	✓	✓	✓	A relative index of the annualized potential for a pixel to receive embers after accounting for the burn probability of the surrounding pixels.
		Sources of ember load to buildings	✓	✓	✓	✓	✓	✓	A relative index of the annualized potential for a pixel to produce embers (after accounting for the BP of the surrounding pixels) that land at a location where buildings exist.
	Wildfire risk to	Conditional Risk to Potential Structures	✓	✓	✓	✓	✓	✓	WRC-style measure of conditional risk to buildings

		Risk to Potential Structures	✓	✓	✓	✓	✓	✓	WRC-style measure of annualized risk to buildings
		Damage Potential	✓	✓	✓	✓	✓	✓	Proprietary index of conditional risk to structures—incorporates fire intensity and ember load
		Structure Exposure Score	✓	✓	✓	✓	✓	✓	Proprietary index of annualized risk to structures—incorporates fire intensity, ember load, and burn probability
Composite measures		Wildfire Hazard Potential	✓	✓	✓	✓	✓	✓	Dillon and Menakis model, but generated from the custom fire modeling instead of from the national products.
		Suppression Difficulty Index	✓	✓	✓	✓	✓	✓	The SDI model on the custom fire modeling.

Appendix F: Fire District Data Summary Tables

Highly Valued Resources and Assets (HVRAs)

Table F-1 HVRA Acreage per Fire District[1,2]

Fire District	HVRA Categories								
	Agriculture	Ecological Integrity	Infrastructure	People and Property	Timber	Wildlife Habitat	Recreation (Miles)	Recreation (Count)	Total FD Acres
ALBION - FIRE DISTRICT 11	15,634	2,127	2,730	1,631	315	0	0	1	**33,846**
COLFAX - FIRE DISTRICT 11	28,900	2,764	4,830	3,255	762	0	0	1	**53,860**
COLFAX FD	268	410	534	934	158	0	0	0	**2,576**
COLTON/UNIONTOWN - FD14	33,510	1,594	6,172	2,945	543	60	0	4	**95,764**
DIAMOND - FIRE DISTRICT 11	14,460	2,281	1,088	1,079	207	0	0	0	**36,102**
DUSTY/ALMOTA/ONECHO-FD13	45,736	5,694	4,858	2,375	527	1,086	0	1	**113,538**
ENDICOTT - FIRE DISTRICT 6	32,852	34,367	2,727	1,279	155	0	0	0	**116,549**
FARMINGTON FIRE DEPT	44	11	12	170	0	0	0	0	**246**
FIRE DISTRICT 12	60,011	1,287	7,371	6,644	215	54	6	0	**108,143**
GARFIELD - FIRE DISTRICT 3	20,762	1,165	2,020	1,340	482	0	0	0	**46,724**
GARFIELD FD & FD 3	227	16	153	291	4	0	0	0	**606**
LACROSSE - FIRE DISTRICT 8	67,476	118,113	9,715	1,768	88	200	0	3	**247,528**
LACROSSE FD & FD 8	21	14	93	186	1	0	0	0	**209**
LAMONT - FIRE DISTRICT 5	17,889	19,098	1,421	855	38	0	8	0	**68,986**
MALDEN FD & FD 7	26	74	14	96	30	0	1	0	**441**
OAKESDALE/FARMINGTON-FD10	42,834	1,717	2,572	1,903	74	0	4	0	**73,823**
PALOUSE - FIRE DISTRICT 4	24,642	2,072	3,916	2,829	659	0	0	1	**39,926**
PULLMAN FIRE STATION 1	379	159	1,109	2,107	11	0	1	0	**3,585**
PULLMAN FIRE STATION 2	713	272	606	1,529	7	0	0	0	**3,233**
PULLMAN MOSCOW AIRPORT FD	138	24	50	28	1	0	0	0	**434**
ROSALIA - FIRE DISTRICT 7	42,179	5,274	3,725	2,661	1,758	0	20	1	**88,650**
ST JOHN - FIRE DISTRICT 2	54,401	26,064	6,356	3,450	448	0	19	1	**169,680**
STEPTOE - FIRE DISTRICT 11	21,492	1,574	1,546	1,359	456	0	0	1	**38,804**
TEKOA - FIRE DISTRICT 1	25,648	1,455	3,013	1,645	341	0	10	0	**44,248**
Total	**550,242**	**227,625**	**66,630**	**42,359**	**7,281**	**1,401**	**67**	**14**	**1,387,501**

[1] Values rounded to the nearest whole number
Source: (McEvoy, Dunn, and Rickert 2023)

Table F-2. HVRA Percent of Total Acreage per Fire District

Fire District/Department	Agriculture	Ecological Integrity	Infrastructure	People and Property	Timber	Wildlife Habitat
ALBION - FIRE DISTRICT 11	46.22%	0.01%	8.07%	4.82%	0.93%	0.00%
COLFAX - FIRE DISTRICT 11	53.69%	0.00%	8.97%	6.05%	1.42%	0.00%
COLFAX FD	10.41%	0.11%	20.75%	36.27%	6.14%	0.00%
COLTON/UNIONTOWN - FD14	35.01%	0.00%	6.45%	3.08%	0.57%	0.06%
DIAMOND - FIRE DISTRICT 11	40.08%	0.01%	3.02%	2.99%	0.57%	0.00%
DUSTY/ALMOTA/ONECHO-FD13	40.31%	0.00%	4.28%	2.09%	0.46%	0.96%
ENDICOTT - FIRE DISTRICT 6	28.20%	0.00%	2.34%	1.10%	0.13%	0.00%
FARMINGTON FIRE DEPT	17.98%	1.81%	4.79%	68.95%	0.00%	0.00%
FIRE DISTRICT 12	55.53%	0.00%	6.82%	6.15%	0.20%	0.05%
GARFIELD - FIRE DISTRICT 3	44.47%	0.00%	4.33%	2.87%	1.03%	0.00%
GARFIELD FD & FD 3	37.52%	0.77%	25.32%	48.10%	0.66%	0.00%
LACROSSE - FIRE DISTRICT 8	27.27%	0.00%	3.93%	0.71%	0.04%	0.08%
LACROSSE FD & FD 8	10.09%	1.81%	44.20%	89.04%	0.48%	0.00%
LAMONT - FIRE DISTRICT 5	25.95%	0.00%	2.06%	1.24%	0.05%	0.00%
MALDEN FD & FD 7	5.86%	0.25%	3.18%	21.83%	6.82%	0.00%
OAKESDALE/FARMINGTON-FD10	58.06%	0.00%	3.49%	2.58%	0.10%	0.00%
PALOUSE - FIRE DISTRICT 4	61.76%	0.01%	9.81%	7.09%	1.64%	0.00%
PULLMAN FIRE STATION 1	10.56%	0.16%	30.94%	58.80%	0.31%	0.00%
PULLMAN FIRE STATION 2	22.07%	0.16%	18.77%	47.30%	0.22%	0.00%
PULLMAN MOSCOW AIRPORT FD	31.80%	1.23%	11.49%	6.46%	0.23%	0.00%
ROSALIA - FIRE DISTRICT 7	47.61%	0.00%	4.20%	3.00%	1.83%	0.00%
ST JOHN - FIRE DISTRICT 2	32.08%	0.00%	3.75%	2.03%	0.26%	0.00%
STEPTOE - FIRE DISTRICT 11	55.42%	0.01%	3.99%	3.50%	1.15%	0.00%
TEKOA - FIRE DISTRICT 1	58.01%	0.00%	6.81%	3.72%	0.77%	0.00%

[1] Values rounded to the 100th decimal place
[2] Percentage values formatted to illustrate relative values per HVRA category for each Fire District or Department
Source: (McEvoy, Dunn, and Rickert 2023)

Wildfire Risk Metrics

Integrated Conditional Net Value Change and Expected Net Value Change (icNVC and ieNVC)

Table F-3. icNVC and ieNVC Acreage by Fire District

Fire District	ieNVC				icNVC					
	Moderate-High Loss	Low-Moderate Loss	Neutral	No Value	High Loss	Moderate Loss	Low Loss	Neutral	Beneficial	No Value
ALBION - FIRE DISTRICT 11	0	3	20,052	13,791	817	14,627	1,923	1,449	1,238	13,791
COLFAX - FIRE DISTRICT 11	0	0	35,209	18,652	1,894	26,712	3,183	2,020	1,400	18,651
COLFAX FD	1	0	1,527	1,048	78	230	414	632	174	1,048
COLTON/UNIONTOWN - FD14	0	45	41,066	54,654	1,284	31,877	3,474	4,079	396	54,654
DIAMOND - FIRE DISTRICT 11	0	13	17,704	18,385	512	13,744	1,255	862	1,345	18,385
DUSTY/ALMOTA/ONECHO-FD13	0	3	56,444	57,091	1,955	43,213	5,536	2,613	3,130	57,091
ENDICOTT - FIRE DISTRICT 6	0	0	68,458	48,091	1,252	31,171	28,025	3,028	4,969	48,104
FARMINGTON FIRE DEPT	0	0	197	49	17	33	56	88	4	49
FIRE DISTRICT 12	0	1	68,016	40,126	2,843	56,688	4,327	3,690	469	40,127
GARFIELD - FIRE DISTRICT 3	5	4	23,950	22,764	625	19,911	1,305	1,265	854	22,764
GARFIELD FD & FD 3	0	0	507	98	24	207	89	183	4	98
LACROSSE - FIRE DISTRICT 8	0	8	188,731	58,789	3,323	63,569	99,801	11,400	10,638	58,797
LACROSSE FD & FD 8	0	0	198	11	45	8	66	79	0	11
LAMONT - FIRE DISTRICT 5	0	193	37,575	31,217	582	17,118	13,335	1,811	4,897	31,243
MALDEN FD & FD 7	0	0	190	250	3	26	42	81	39	250
OAKESDALE/FARMINGTON-FD10	0	1,141	45,462	27,220	1,424	41,098	1,292	1,382	1,406	27,220
PALOUSE - FIRE DISTRICT 4	0	12	29,563	10,351	1,790	22,726	2,342	1,442	1,275	10,351
PULLMAN FIRE STATION 1	2	0	2,678	905	231	250	468	1,666	65	905
PULLMAN FIRE STATION 2	2	7	2,512	713	203	611	292	1,230	184	713
PULLMAN MOSCOW AIRPORT FD	0	0	212	222	8	122	13	58	10	222

Fire District	ieNVC				icNVC					
	Moderate-High Loss	Low-Moderate Loss	Neutral	No Value	High Loss	Moderate Loss	Low Loss	Neutral	Beneficial	No Value
ROSALIA - FIRE DISTRICT 7	39	13,199	37,589	37,822	1,462	40,457	4,203	2,310	2,386	37,832
ST JOHN - FIRE DISTRICT 2	8	4,010	81,006	84,657	2,308	51,396	20,444	4,690	6,185	84,657
STEPTOE - FIRE DISTRICT 11	0	7	24,386	14,411	800	20,485	1,130	955	1,023	14,411
TEKOA - FIRE DISTRICT 1	3	779	28,438	15,028	1,183	24,324	1,384	1,274	1,044	15,039
Total	**60**	**19,425**	**811,670**	**556,345**	**24,663**	**520,603**	**194,399**	**48,287**	**43,135**	**556,413**

Values rounded to the nearest whole number
Source: (McEvoy, Dunn, and Rickert 2023)

Table F-4. ieNVC and icNVC Percent of Total Acreage per Fire District[1]

Fire District	ieNVC				icNVC					
	Moderate-High Loss[2]	Low-Moderate Loss	Neutral	No Value	High Loss[2]	Moderate Loss	Low Loss	Neutral	Beneficial	No Value
ALBION - FIRE DISTRICT 11	0.00%	0.01%	100.06%	0.00%	2.42%	43.24%	5.69%	4.28%	3.66%	40.77%
COLFAX - FIRE DISTRICT 11	0.00%	0.00%	100.06%	0.00%	3.52%	49.63%	5.91%	3.75%	2.60%	34.65%
COLFAX FD	0.04%	0.00%	100.01%	0.00%	3.03%	8.93%	16.08%	24.55%	6.76%	40.70%
COLTON/UNIONTOWN - FD14	0.00%	0.05%	100.02%	0.00%	1.34%	33.31%	3.63%	4.26%	0.41%	57.11%
DIAMOND - FIRE DISTRICT 11	0.00%	0.04%	100.03%	0.00%	1.42%	38.09%	3.48%	2.39%	3.73%	50.96%
DUSTY/ALMOTA/ONECHO-FD13	0.00%	0.00%	100.06%	0.00%	1.72%	38.08%	4.88%	2.30%	2.76%	50.31%
ENDICOTT - FIRE DISTRICT 6	0.00%	0.00%	100.06%	0.00%	1.07%	26.76%	24.06%	2.60%	4.27%	41.30%
FARMINGTON FIRE DEPT	0.00%	0.00%	99.96%	0.00%	6.91%	13.41%	22.75%	35.76%	1.63%	19.91%
FIRE DISTRICT 12	0.00%	0.00%	100.06%	0.00%	2.63%	52.45%	4.00%	3.41%	0.43%	37.13%
GARFIELD - FIRE DISTRICT 3	0.01%	0.01%	100.05%	0.00%	1.34%	42.64%	2.79%	2.71%	1.83%	48.75%
GARFIELD FD & FD 3	0.00%	0.00%	100.13%	0.00%	3.97%	34.20%	14.71%	30.24%	0.66%	16.19%
LACROSSE - FIRE DISTRICT 8	0.00%	0.00%	100.05%	0.00%	1.34%	25.69%	40.34%	4.61%	4.30%	23.77%
LACROSSE FD & FD 8	0.00%	0.00%	99.85%	0.00%	21.50%	3.82%	31.53%	37.74%	0.00%	5.26%
LAMONT - FIRE DISTRICT 5	0.00%	0.28%	99.78%	0.00%	0.84%	24.83%	19.34%	2.63%	7.10%	45.32%
MALDEN FD & FD 7	0.00%	0.00%	99.96%	0.00%	0.68%	5.91%	9.54%	18.40%	8.86%	56.79%
OAKESDALE/FARMINGTON-FD10	0.00%	1.55%	98.52%	0.00%	1.93%	55.71%	1.75%	1.87%	1.91%	36.90%
PALOUSE - FIRE DISTRICT 4	0.00%	0.03%	100.04%	0.00%	4.49%	56.96%	5.87%	3.61%	3.20%	25.94%
PULLMAN FIRE STATION 1	0.06%	0.00%	99.99%	0.00%	6.45%	6.98%	13.06%	46.49%	1.81%	25.26%
PULLMAN FIRE STATION 2	0.06%	0.22%	99.78%	0.00%	6.28%	18.91%	9.04%	38.07%	5.69%	22.07%
PULLMAN MOSCOW AIRPORT FD	0.00%	0.00%	100.10%	0.00%	1.85%	28.14%	3.00%	13.38%	2.31%	51.20%
ROSALIA - FIRE DISTRICT 7	0.04%	14.90%	85.13%	0.00%	1.65%	45.67%	4.74%	2.61%	2.69%	42.71%
ST JOHN - FIRE DISTRICT 2	0.00%	2.36%	97.70%	0.00%	1.36%	30.31%	12.06%	2.77%	3.65%	49.92%
STEPTOE - FIRE DISTRICT 11	0.00%	0.02%	100.05%	0.00%	2.06%	52.83%	2.91%	2.46%	2.64%	37.16%
TEKOA - FIRE DISTRICT 1	0.01%	1.76%	98.30%	0.00%	2.68%	55.01%	3.13%	2.88%	2.36%	34.01%

[1] Values rounded to the 100th decimal place
[2] Moderate-High (ieNVC) and High (icNVC) Loss Percentages formatted to illustrate relative values ranging from lower (orange) to higher (red). These values indicate Fire Districts with higher relative proportions of wildfire risk (icNVC and ieNVC).
Source: (McEvoy, Dunn, and Rickert 2023)

Community Wildfire Risk Reduction Zones (CWiRRZ): Exposure and Transmission Zones

Table F-5. CWiRRZ Exposure and Transmission Zones Acreage by Fire District/Department

Fire District	Exposure			Wildfire Transmission Zone						
	Direct	Indirect	Minimal	Outlying Wildlands	Agriculture	Grass	Non-Vegetated	Shrub	Tree	Total
ALBION - FIRE DISTRICT 11	1,846	1,420	22	0	25,455	3,227	783	668	418	**33,850**
COLFAX - FIRE DISTRICT 11	3,777	2,328	99	0	36,984	6,728	1,145	1,568	1,043	**53,861**
COLFAX FD	894	583	21	0	235	315	26	241	192	**2,579**
COLTON/UNIONTOWN - FD14	2,771	1,501	243	8,608	54,248	16,793	2,496	6,406	544	**95,786**
DIAMOND - FIRE DISTRICT 11	1,232	731	14	89	21,582	10,295	687	1,054	293	**36,110**
DUSTY/ALMOTA/ONECHO-FD13	4,147	2,146	70	4,089	56,671	35,583	2,318	5,537	785	**113,565**
ENDICOTT - FIRE DISTRICT 6	3,909	2,412	1	3,658	39,951	54,562	1,657	9,517	341	**116,560**
FARMINGTON FIRE DEPT	119	43	46	0	18	1	11	2	0	**244**
FIRE DISTRICT 12	4,499	949	451	13	92,002	5,617	3,083	1,278	230	**108,152**
GARFIELD - FIRE DISTRICT 3	1,453	0	48	0	39,651	2,642	1,523	549	766	**46,734**
GARFIELD FD & FD 3	167	0	188	0	232	3	12	1	0	**603**
LACROSSE - FIRE DISTRICT 8	7,811	1,997	7	29,339	49,419	120,376	3,525	29,757	441	**247,571**
LACROSSE FD & FD 8	64	147	0	0	0	0	0	0	0	**211**
LAMONT - FIRE DISTRICT 5	2,216	1,044	4	4,920	25,102	23,415	1,289	10,324	111	**68,984**
MALDEN FD & FD 7	246	128	0	0	0	10	0	23	33	**440**
OAKESDALE/FARMINGTON-FD10	1,327	346	273	0	62,122	6,110	2,287	1,202	157	**73,831**
PALOUSE - FIRE DISTRICT 4	2,270	773	356	0	30,068	3,384	1,144	769	1,001	**39,933**
PULLMAN FIRE STATION 1	859	0	1,761	0	681	183	52	31	16	**3,586**
PULLMAN FIRE STATION 2	1,028	0	1,312	0	693	76	60	62	4	**3,239**
PULLMAN MOSCOW AIRPORT FD	113	0	70	0	133	61	43	14	0	**435**
ROSALIA - FIRE DISTRICT 7	3,494	589	330	0	60,735	12,902	2,365	4,561	3,396	**88,654**
ST JOHN - FIRE DISTRICT 2	6,239	3,230	27	2,837	81,441	54,355	3,601	14,488	957	**169,700**
STEPTOE - FIRE DISTRICT 11	1,304	593	113	0	28,288	5,707	1,087	809	771	**38,808**
TEKOA - FIRE DISTRICT 1	1,336	1,074	73	0	35,512	3,520	1,482	683	569	**44,252**
Total	**53,122**	**22,035**	**5,530**	**53,554**	**741,222**	**365,866**	**30,677**	**89,543**	**12,068**	**1,387,687**

Values rounded to the nearest whole number
Source: (Dillon et al. 2024)

Table F-6. CWiRRZ Exposure and Transmission Zone Percent of Total Acreage by Fire District/Department

Fire District	Exposure			Wildfire Transmission Zone					
	Direct	Indirect	Minimal	Outlying Wildlands	Agriculture	Grass	Non-Vegetated	Shrub	Tree
ALBION - FIRE DISTRICT 11	5.46%	4.20%	0.07%	0.00%	75.26%	9.54%	2.32%	1.98%	1.24%
COLFAX - FIRE DISTRICT 11	7.02%	4.33%	0.18%	0.00%	68.71%	12.50%	2.13%	2.91%	1.94%
COLFAX FD	34.72%	22.66%	0.81%	0.00%	9.14%	12.22%	1.01%	9.36%	7.45%
COLTON/UNIONTOWN - FD14	2.90%	1.57%	0.25%	8.99%	56.68%	17.55%	2.61%	6.69%	0.57%
DIAMOND - FIRE DISTRICT 11	3.42%	2.03%	0.04%	0.25%	59.82%	28.53%	1.90%	2.92%	0.81%
DUSTY/ALMOTA/ONECHO-FD13	3.65%	1.89%	0.06%	3.60%	49.94%	31.36%	2.04%	4.88%	0.69%
ENDICOTT - FIRE DISTRICT 6	3.36%	2.07%	0.00%	3.14%	34.30%	46.84%	1.42%	8.17%	0.29%
FARMINGTON FIRE DEPT	48.26%	17.35%	18.71%	0.00%	7.23%	0.54%	4.52%	0.72%	0.00%
FIRE DISTRICT 12	4.16%	0.88%	0.42%	0.01%	85.13%	5.20%	2.85%	1.18%	0.21%
GARFIELD - FIRE DISTRICT 3	3.11%	0.00%	0.10%	0.00%	84.92%	5.66%	3.26%	1.18%	1.64%
GARFIELD FD & FD 3	27.56%	0.00%	31.01%	0.00%	38.33%	0.55%	2.06%	0.11%	0.00%
LACROSSE - FIRE DISTRICT 8	3.16%	0.81%	0.00%	11.86%	19.97%	48.66%	1.42%	12.03%	0.18%
LACROSSE FD & FD 8	30.81%	70.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
LAMONT - FIRE DISTRICT 5	3.21%	1.51%	0.01%	7.14%	36.41%	33.96%	1.87%	14.98%	0.16%
MALDEN FD & FD 7	55.98%	29.00%	0.00%	0.00%	0.05%	2.32%	0.00%	5.15%	7.48%
OAKESDALE/FARMINGTON-FD10	1.80%	0.47%	0.37%	0.00%	84.21%	8.28%	3.10%	1.63%	0.21%
PALOUSE - FIRE DISTRICT 4	5.69%	1.94%	0.89%	0.00%	75.36%	8.48%	2.87%	1.93%	2.51%
PULLMAN FIRE STATION 1	23.98%	0.00%	49.14%	0.00%	18.99%	5.10%	1.46%	0.87%	0.44%
PULLMAN FIRE STATION 2	31.82%	0.00%	40.60%	0.00%	21.45%	2.35%	1.85%	1.91%	0.13%
PULLMAN MOSCOW AIRPORT FD	25.96%	0.00%	16.26%	0.00%	30.78%	14.00%	10.00%	3.18%	0.00%
ROSALIA - FIRE DISTRICT 7	3.94%	0.67%	0.37%	0.00%	68.56%	14.56%	2.67%	5.15%	3.83%
ST JOHN - FIRE DISTRICT 2	3.68%	1.90%	0.02%	1.67%	48.03%	32.05%	2.12%	8.54%	0.56%
STEPTOE - FIRE DISTRICT 11	3.36%	1.53%	0.29%	0.00%	72.95%	14.72%	2.80%	2.09%	1.99%
TEKOA - FIRE DISTRICT 1	3.02%	2.43%	0.16%	0.00%	80.32%	7.96%	3.35%	1.54%	1.29%

Values rounded to the 100th decimal place
Source: (Dillon et al. 2024)