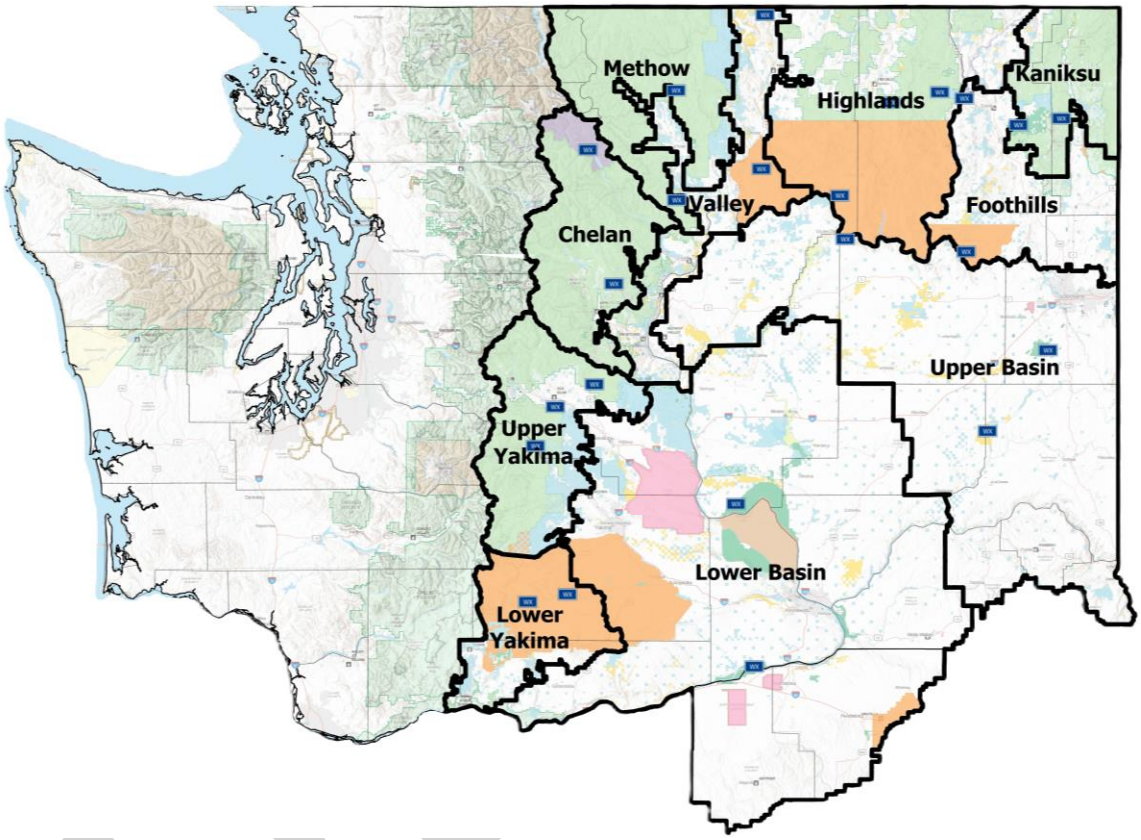
EASTERN WASHINGTON

INTERAGENCY FIRE DANGER OPERATING PLAN



2026

VERSION 1.0

EASTERN WASHINGTON

INTERAGENCY FIRE DANGER OPERATING PLAN

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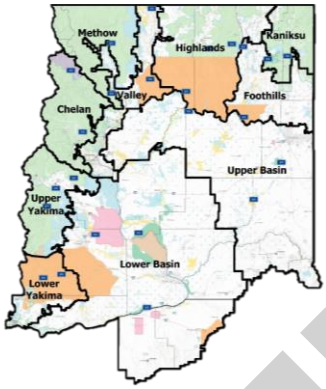


1 INTRODUCTION

1.1 Purpose

The public, industry, and agency personnel expect the interagency wildland fire management agencies to implement appropriate and timely decisions which ultimately result in safe, efficient, and effective wildland fire management actions.

The Eastern Washington Interagency Fire Danger Operating Plan (EWA FDOP) is intended to establish and document interagency planning and response levels based upon an assessment of vegetation, climate, topography, and analysis of historical weather and fire data. The plan provides a science-based tool for incorporating a measure of risk associated with decisions that have the potential to influence the safe and effective management of wildland fire.

Interagency policy and guidance regarding the development of Fire Danger Operating Plans (FDOP) can be found in the Interagency Standards for Fire & Aviation Operations (Red Book) [1]. Agency-specific direction for development of Fire Danger Operating Plans may also apply.

1.2 Operating Plan Objectives

- Provide a tool for agency administrators, fire managers, dispatchers, agency cooperators, and firefighters to correlate fire danger ratings with appropriate fire business decisions.
- Develop Fire Danger Rating Areas (FDRA) based on similar climate, vegetation, and topography.
- Document an interagency fire weather monitoring network consisting of Remote Automatic Weather Stations (RAWS) [2].
- Define the fire problem and determine the most appropriate fire danger-based decision tool to mitigate the issue.
- Determine relevant decision points for fire management actions based upon an analysis of historical fire weather and fire occurrence data.
- Identify seasonal risk analysis criteria, establish general fire severity thresholds, and develop fire danger pocket cards for distribution.
- Document the most effective methods for fire managers to communicate potential fire danger to cooperating agencies, industry, and the public.
- Identify program needs and suggest improvements for implementation of the fire danger operating plan.

1.3 Application

The Eastern Washington Interagency Fire Danger Operating Plan guides the application of the National Fire Danger Rating System (NFDRS) through the use of decision points and management actions associated with system outputs. Interagency decision points are developed and documented herein. The mitigating fire management actions taken at each decision point are defined in Supplemental Action Plans (SAP) with general descriptions below. Further development of Supplemental Action Plans and associated management actions are agency-specific and established by each representative agency and/or unit (Figure 1).

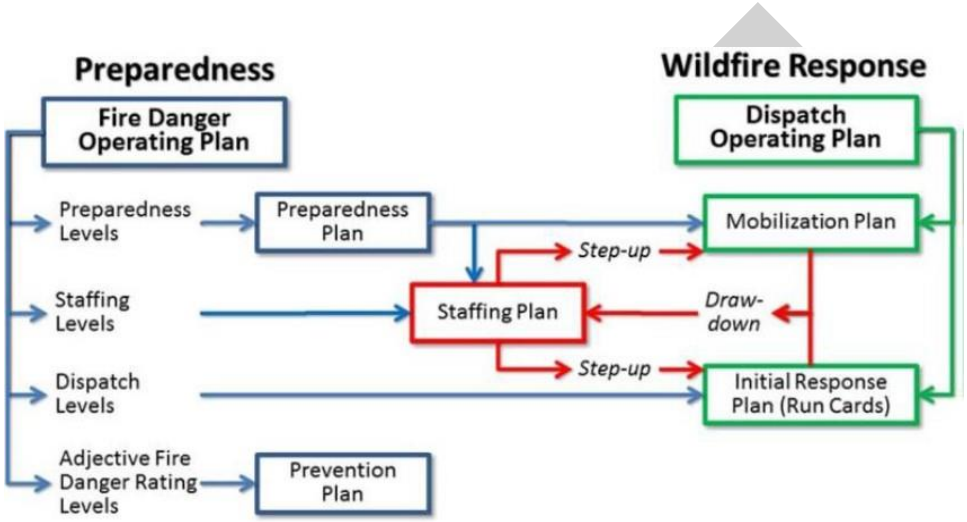


Figure 1. Interagency Fire Danger Operating Plan and development of decision point thresholds tiered to support Supplemental Actions Plans.

1.3.1 Staffing Plan

The Staffing Plan describes actions to ensure sufficient unit resource capability to respond to unplanned ignitions during short periods, one to several burn periods. It combines decision points with other short-term events. Examples include forecasted fire weather warnings (red flag), fire weather watches, lightning, and may include other pre-planned events or holidays (i.e., Fourth of July). Interagency staffing level decision points and calculations are identified and documented in the EWA FDOP. Signatory agencies and/or units may further develop and maintain separate Staffing Plans based on interagency decision points.

1.3.2 Initial Response Plan

Initial Response Plans, also referred to as “run cards” specify the fire management response to an unplanned ignition within a defined geographic area such as an FDRA or strategic response zone based on fire danger, fire management objectives, and resource availability. The Initial Response Plan, contained within the Mobilization Plan, is updated annually. Interagency response levels and calculations are identified and documented in the EWA FDOP. Signatory agencies and/or units may further develop and maintain separate Initial Response and Mobilization Plans based on interagency decision points.

1.3.3 Preparedness Plan

The Preparedness Plan describes actions to ensure sufficient unit resource capability to respond to unplanned ignitions for longer periods, several days to weeks. It combines decision points with mid- to long-term events. Examples include drought, peak of fire season, or local fire activity and resource availability. Interagency preparedness level decision points and preparedness level calculations are identified and documented in the EWA FDOP. Signatory agencies and/or units may further develop and maintain separate Preparedness Plans based on interagency decision points.

1.3.4 Prevention Plan

Prevention Plans document the wildland fire problems and outline efforts regarding wildfire prevention and communication to the public (i.e., fire danger adjectives) and commercial target groups as well as via education and mitigation efforts. An interagency analysis of the fire problem and associated target group, as well as interagency decision points when fire danger communications and prevention efforts should be considered, are identified and documented in the EWA FDOP. Signatory agencies and/or units may further develop and maintain separate Prevention Plans based on interagency decision points.

1.3.5 Restriction Plan

Restriction Plans document the wildland fire problem and outline efforts regarding public and commercial (i.e., industrial fire precaution levels) fire restrictions and/or closures (i.e., campfires, target shooting, debris burning, and other specific activities). An interagency analysis of the fire problem and associated target group, as well as interagency decision points when restrictions and/or closures should be considered are identified and documented in the EWA FDOP. Signatory agencies and/or units may further develop and maintain separate Restriction Plans based on interagency decision points.

2 FIRE DANGER PLANNING AREA INVENTORY AND ANALYSIS

2.1 Administrative Units

The EWA FDOP supports consistent application of fire danger decisions applied across multiple agency jurisdictional boundaries (Table 1). Wildland fire management and suppression responsibilities are shared among federal, state, and local cooperators (Table 2). Ownership by acres and percent for individual FDRA are exhibited in Appendix A.1.

Cooperator	Unit
US Forest Service	Okanogan-Wenatchee National Forest
US Forest Service	Colville National Forest
Washington Department of Natural Resources	Northeast Region
Washington Department of Natural Resources	Southeast Region
National Park Service	North Cascades National Park, Ross Lake National Recreation Area, Lake Chelan National Recreation Area
National Park Service	Lake Roosevelt National Recreation Area
Bureau of Land Management	Spokane District
US Fish and Wildlife Service	Central Washington National Wildlife Refuge Complex
US Fish and Wildlife Service	Mid-Columbia River National Wildlife Refuge Complex
US Fish and Wildlife Service	Inland Northwest National Wildlife Refuge Complex
Tribal	Confederated Tribes of the Colville Reservation
Tribal	Spokane Tribe of Indians
Tribal	Confederated Tribes and Bands of the Yakama Nation

Table 1. Administrative unit cooperators for the EWA FDOP.

Ownership	Acres	Percent
Private	16,857,760	58%
US Forest Service	5,275,407	18%
Tribal	2,938,249	10%
State	2,212,299	8%
Bureau of Land Management	409,352	1%
Department of Defense	398,561	1%
US Fish and Wildlife Service	327,903	1%
National Park Service	237,238	1%
Department of Energy	210,468	1%
Bureau of Reclamation	36,554	< 1%
County	30,725	< 1%
Total	28,959,716	100%

Table 2. Administrative ownership by acres and percent for the EWA FDOP.

2.2 Weather

2.2.1 Weather Stations

Remote Automatic Weather Stations (RAWS) within the EWA FDOP used to generate NFDRS outputs comply with National Wildfire Coordinating Group (NWCG) weather station standards and guidelines (PMS 426-3) [2] (Table 3, Figure 2). All RAWS receive at minimum one annual on-site maintenance visit by local or contracted personnel to ensure all components comply with station standards.

FDRA	Station	NWS (ID)	Elevation (ft.)	Agency	Installed
Methow	First Butte	452006	5,509	USFS	1991-07-29
Methow	Douglas Ingram Ridge	452035	3,566	USFS	1996-05-08
Chelan	Stehekin-Airstrip	452121	1,230	NPS	2003-05-01
Chelan	Dry Creek	452134	3,661	USFS	1987-05-04
Upper Yakima	Peoh Point	452206	4,020	S&PF	1986-01-01
Upper Yakima	Swauk	452219	3,480	USFS	1997-06-15
Upper Yakima	Sawmill Flats	452221	3,000	USFS	1997-05-27
Lower Yakima	Mill Creek	452304	2,820	BIA	2001-09-25
Lower Yakima	Signal Peak	452307	5,052	BIA	2001-09-25
Valley	Oroville	452039	1,450	BLM	1992-01-16
Valley	Kramer	452040	2,720	BIA	1993-02-17
Upper Basin	Spring Canyon	453002	1,340	NPS	1994-03-31
Upper Basin	Cheney	453506	2,230	FWS	2002-06-04
Upper Basin	Escure	453601	1,740	BLM	2001-08-16
Lower Basin	Umatilla	351316	270	FWS	2002-06-06
Lower Basin	Saddle Mountain	452701	634	FWS	2002-07-18
Highlands	Nespelem	452009	1,900	BIA	1990-08-28
Highlands	Lane Creek	452511	4,430	USFS	2002-07-02
Highlands	Iron Mountain	452512	4,350	USFS	2003-10-23
Kaniksu	Tacoma Creek	453413	3,240	USFS	2002-06-30
Kaniksu	Little Pend Oreille	453416	2,045	FWS	2002-06-04
Foothills	Kettle Falls	452916	1,310	NPS	1995-07-19
Foothills	Wellpinit	452918	2,240	BIA	2002-06-04

Table 3. Fire Danger Rating Area Remote Automatic Weather Station selections to generate NFDRS outputs for the EWA FDOP (2005-2024).

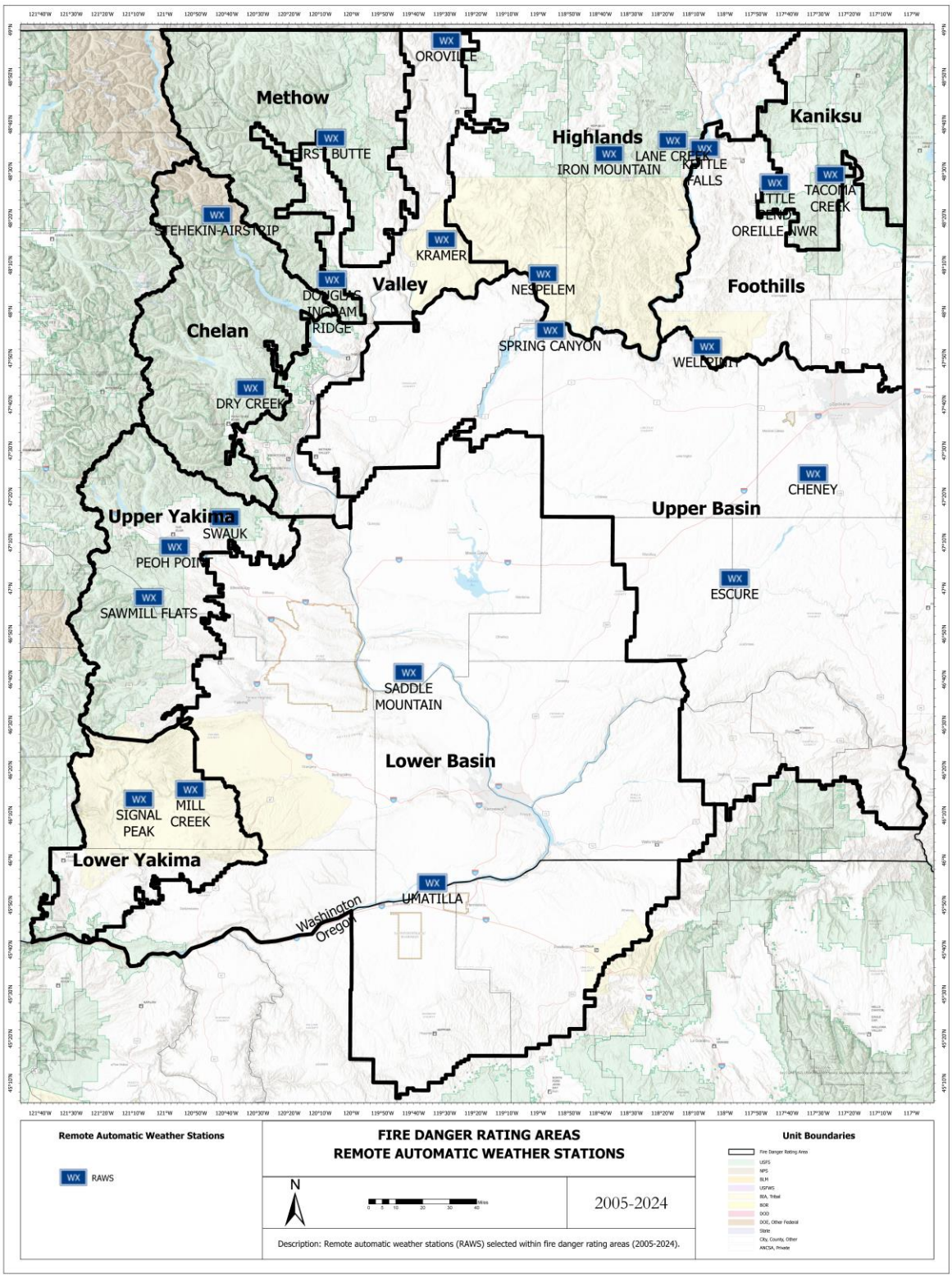


Figure 2. Fire Danger Rating Area Remote Automatic Weather Station locations selected for the EWA FDOP (2005-2024).

2.2.2 Weather Data

Remote Automatic Weather Station hourly weather data for the period of 2005-2024 was obtained from the Fire Environment Mapping System (FEMS) [3] and serves as the replacement for the former deprecated Weather Information Management System (WIMS) as of October 1, 2025. National standardization and updates to the FEMS dataset include:

- Period of record has been truncated to begin 2005 or when a station was installed on or after 2005 to align with standardized solar radiation inputs.
- Current official period of record of 2005-2022 used in the analysis includes quality checked and gap-filled hourly weather data.
- The quality checking process included comparing FEMS RAWS hourly weather data vs. National Weather Service gridded-weather data to detect and identify anomalies among the two datasets. FEMS hourly weather flag values appended to FW21 weather file outputs reflect three flag classes including original hourly values (0), original hourly values missing and replaced with estimated values using gridded weather inputs (1), and original hourly values deemed suspicious (i.e., outliers) but not replaced (2).
- Once daily applied automated snow flags utilizing remotely sensed Snow Data Assimilation Systems (SNODAS) [4] data to account for snow coverage and depth.
- Ability to generate daily maximums, the highest value (i.e., ERC or BI) recorded during the 24-hour period (midnight to midnight) for each station.
- Inability to aggregate multiple RAWS stations into Special Interest Groups (SIGS).
- Station catalogue slope class set to 1 (0-25%) for all stations.
- Station catalogue grass type set to perennial for all stations.
- Station catalogue latitude, longitude, and elevation updated for all stations.
- Station catalogue average annual precipitation updated for all stations.
- Station catalogue Keetch-Byram Drought Index (KBDI) drought load transfer disabled.
- Station catalogue national defaults for Growing Season Index (GSI) have been retained.

2.3 Fire Danger Rating Areas

A Fire Danger Rating Area (FDRA) is defined as a large geographic area relatively homogenous with respect to climate, vegetation, and topography. Because of these similarities it can be assumed that fire danger within an FDRA is relatively uniform. Fire Danger Rating Areas were developed through spatial delineation of climate, vegetation, and topography (Appendix A.2). After these environmental factors were considered independently, they were interpolated to form draft FDRA. Final FDRA were formed by further edge matching FDRA to best align, when feasible, with fire weather forecast zones, jurisdictional units, county, and dispatch boundaries (Figure 3, Table 3, Appendix A.2).

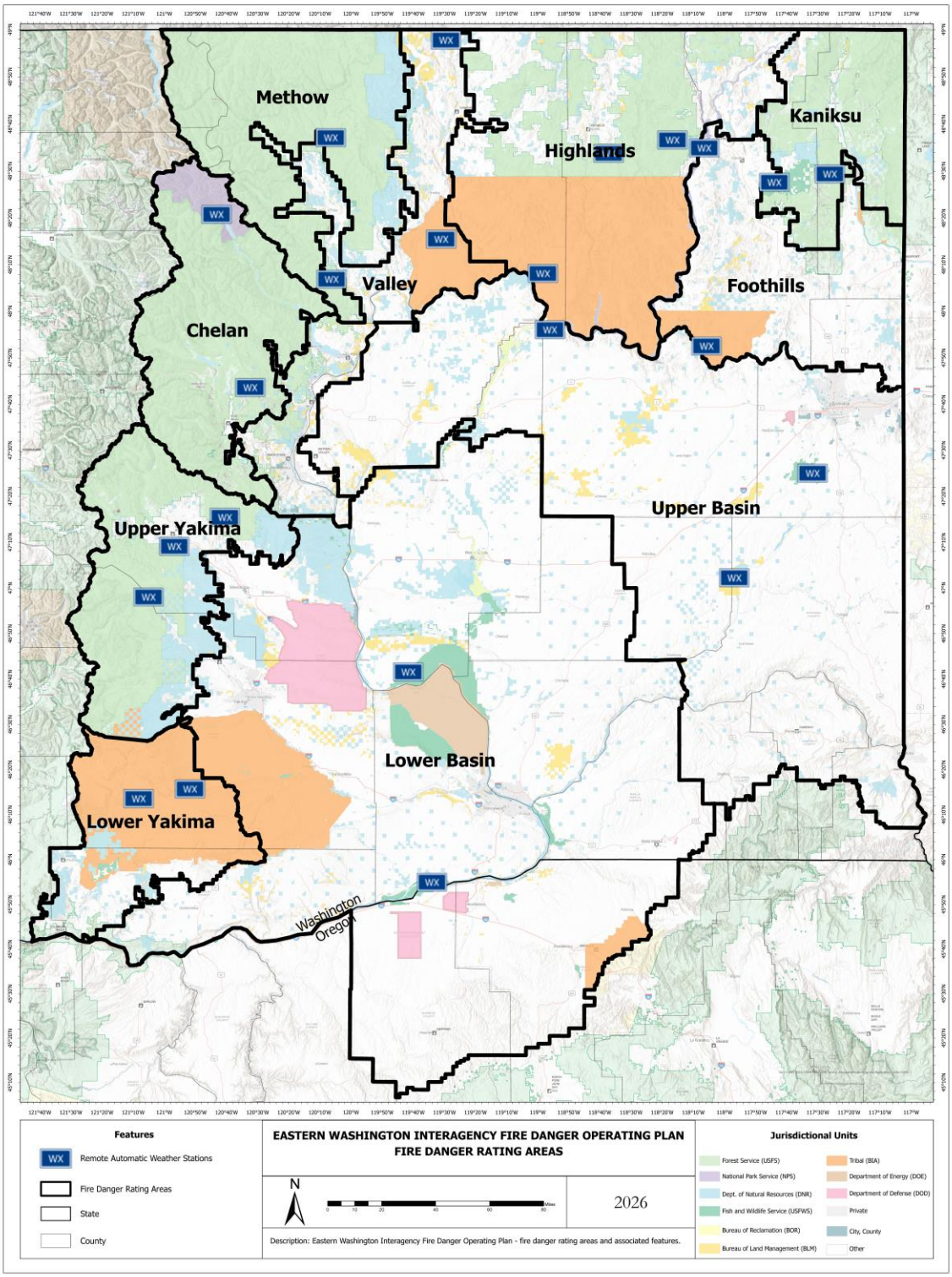


Figure 3. Final Fire Danger Rating Area boundaries for the EWA FDOP.

FDRA	Elevation (ft.)	Slope (%)	Precipitation (inches)	Scott & Burgan (FBFM 40)	Size (acres)	Percent (%)
Methow	5,206	39	32	165	1,679,974	6%
Chelan	4,491	49	48	165	1,492,502	5%
Upper Yakima	3,992	29	42	165	1,566,149	5%
Lower Yakima	2,936	13	32	165	1,174,716	4%
Valley	2,021	20	13	102	1,478,896	5%
Upper Basin	2,188	6	14	93	6,531,235	23%
Lower Basin	1,295	5	9	102	9,757,940	34%
Highlands	3,238	23	19	162	2,793,981	10%
Kaniksu	3,641	27	33	165	966,813	3%
Foothills	2,398	14	22	162	1,516,025	5%

Table 3. Fire Danger Rating Areas displaying LANDFIRE median elevation, median slope, annual median precipitation (PRISM), majority Scott and Burgan fire behavior fuel models (FBFM40), total size and percent.

2.3.1 Fire Danger Rating Area Descriptions

The following Fire Danger Rating Area descriptions that best align with state regional descriptions, were sourced from the Western Regional Climate Center climate narratives for the state of Washington [5].

2.3.1.1 East Slope Cascades | Methow - Chelan - Upper Yakima - Lower Yakima

General Location: The area extends from the summit of the Cascades eastward for distances varying from 25 to 75 miles and from the Canadian Border to the Columbia River. The area was further broken from north to south after the initial analysis along major hydrological divides and the Yakama response boundary to reduce total FDRA size and account for changes in slope, fire business, and fire response.

Vegetation: Predominately mixed conifer timber types (spruce, fir, hemlock, larch, yew), high elevation pines, and presence of rock features at higher elevations transitioning to deciduous and low elevation pine forest types (ponderosa) with interspersed regeneration, understory shrubs, and grass as elevations generally decrease from west to east. The general majority fire behavior fuel model (FBFM40) can be characterized as timber understory – very high load, dry climate timber-shrub TU5 (165).

Climate: One of the outstanding features of the climate is the decrease in precipitation along the eastern slope of the mountains as the distance from the summit increases and the elevation decreases. For example, within a distance of 20 miles the average annual precipitation decreases from 92 inches at Stampede Pass (3,958 ft.) to 22 inches at Cle Elum (1,920 ft.). The average winter season snowfall decreases from approximately 400 inches near the summit of the mountains to about 75 inches at 2,000 feet above sea level. In elevations above 3,000 feet snow can be expected in October; however, it generally does not accumulate on the ground until after the first of November. In July the average maximum temperature ranges from 70° to 85° F and the minimum temperature from 45° to 50° F. In the lower elevations, maximum temperatures exceed 90° F on 15 to 20 days each summer, and 80° F or higher is usually recorded in the higher elevations. In elevations below 3,000 feet, maximum temperatures have reached 100 ° to 105° F.

Topography: In an easterly direction elevation decreases from the summit of the Cascade Mountain Range to approximately 2,000 feet above sea level.

2.3.1.2 Okanogan-Big Bend | Valley

General Location: The area includes fruit producing valleys along the Okanogan, Methow, and Columbia Rivers, grazing land along the southern Okanogan Highlands, the Waterville Plateau, and part of the channeled scablands.

Vegetation: Predominately composed of various types of annual and perennial grasses, forbs, and brush interspersed with various orchard types. Mixed conifer forest types exist with increases in elevation. The general majority fire behavior fuel model (FBFM40) can be characterized as low load, dry climate grass GR2 (102).

Climate: Annual precipitation increases from 11 inches in the valley to 16 inches over portions of the Plateau. Winter season snowfall varies from 30 to 70 inches. Both rainfall and snowfall increase in higher elevations. Snow can be expected after the first of November and to remain on the ground from the first of December until March or April. In July the average maximum temperature is between 85° to 90° F, and the minimum is in the lower 50's. Maximum temperatures reach 100° F or higher on a few afternoons each summer, and 105° to 113° F have been recorded.

Topography: Elevation varies from approximately 1,000 feet in the lower river valleys to 3,000 feet over the Waterville Plateau and Okanogan Highlands. North-south ranges of mountains extending into southern British Columbia reach elevations of 4,000 to 5,000 feet within a few miles of the Okanogan River.

2.3.1.3 Central Basin | Upper Basin – Lower Basin

General Location: The Central Basin includes the Ellensburg Valley, the central plains area in the Columbia Basin south from the Waterville Plateau to the Oregon border and east to near the Palouse River. The southeastern Lower Basin Fire Danger Rating Area boundary extends into Oregon and was snapped to the existing Blue Mountains FDOP in which portions are within the Blue Mountains Interagency Dispatch Center (BMICC) area of response.

Vegetation: Predominately composed of various types of annual and perennial grasses, forbs, interspersed with shrubland and various orchard and cropland types. The general majority fire behavior fuel models (FBFM40) can be characterized as an assortment of low load, dry climate grass GR2 (102) and agricultural land NB3 (93).

Climate: This is the lowest and driest section in eastern Washington. Annual precipitation ranges from seven inches in the drier localities along the southern slopes of the Saddle Mountains, Frenchman Hills and east of Rattlesnake Mountains, to 15 inches in the vicinity of the Blue Mountains. Summer precipitation is usually associated with thunderstorms. During July and August, it is not unusual for four to six weeks to pass without measurable rainfall. In July the average maximum temperature is in the lower 90's, and the minimum temperature is in the upper 50's. Maximum temperatures reach 100° to 105° on a few afternoons each summer.

Topography: Elevation increases from approximately 400 feet at the confluence of the Snake and Columbia Rivers to 1,300 feet near the Waterville Plateau and 1,800 feet along the eastern edge of the area.

2.3.1.4 Northeastern | Highlands - Kaniksu - Foothills

General Location: The northeastern and higher elevations of the Okanogan Highlands, the Selkirk Mountains, and the lower elevations southward to the vicinity of the Spokane River are included in the northeastern area.

Vegetation: Predominately at higher elevations, mixed conifer timber types and high elevation pines occur transitioning to deciduous and low elevation pine forest types (ponderosa) interspersed with shrubs and grasses along with various types of orchards and croplands as elevations decrease. The general majority fire behavior fuel models (FBFM40) can be characterized as an assortment of moderate load, humid climate timber-shrub TU2 (162) and very high load, dry climate timber-shrub TU5 (165).

Climate: The average annual precipitation increases in a northeasterly direction from 17 inches in the Spokane area to 28 inches in the northeastern corner of the state. In July, the average maximum temperature is 85° to 90° and the minimum temperature 45° to 50° F. Maximum temperatures reach 100° F on a few afternoons each summer and temperatures between 105° to 110° F have been recorded.

Topography: Ranges of mountains in this section of the state are separated by narrow north-south valleys. The elevation increases from 2,000 feet in the valleys to 6,000 feet along the higher ridges.

3 FIRE DANGER PROBLEM ANALYSIS

To apply a fire danger system that will assist managers with fire management decisions, ignition problems need to be identified, quantified, framed, and associated with a specific target group to determine the most appropriate fire danger-based decision tool to mitigate the specified issue.

3.1 Fires

Exploratory examination using Visible Infrared Imaging Radiometer Suite (VIIRS) and/or Moderate Resolution Imaging Spectroradiometer (MODIS) satellite-based sensors in the acquisition of heat detections as percentile counts per day, sourced from the Fire for Information Resource Management System (FIRMS) [6] in lieu of fire occurrence was assessed to consider and approximate large fire growth as indicated by heat detection counts and/or intensity (i.e., fire radiative power or FRP). However, fire occurrence was selected as a better representation and alignment with the intent of NFDRS as a pre-suppression tool to account for all potential fire occurrences as opposed to predominately large fire growth.

3.1.1 Fire Occurrence Data

Twenty years (2005-2024) of fire occurrence data was used for the analysis in the Eastern Washington Interagency Fire Danger Operating Plan. Fire occurrence data was sourced from two datasets and aggregated for the twenty-year fire occurrence period of record. All available fire occurrence data within Fire Danger Rating Areas were utilized as signatories expressed interest in participation of the EWA FDOP.

Fire occurrence from 2005-2020 was obtained from the Spatial Wildfire Occurrence Data for the United States, 1992-2020 (FPA FOD, 6th Edition) [7] and serves as the most complete and accurate fire dataset acquired from reporting systems of federal, state, and local fire organizations. Fires prior to 2005 were dropped to align with available FEMS RAWS hourly weather data beginning 2005.

Fire occurrence from 2021-2024 was obtained and appended from InFORM [8] to include data sources from the Integrated Reporting of Wildfire-Fire Information (IRWIN) and filters included all incident status fires, wildfires, all jurisdictions, for all fires within Fire Danger Rating Areas.

Fire occurrence summary statistics for Eastern Washington (Figure 4) and for individual FDRA displaying spatial origin locations, percentile fire sizes, and charts exhibiting count, acres, discovery month, size class, cause class, and fires per fire days are shown in the Appendix A.5-A.15.

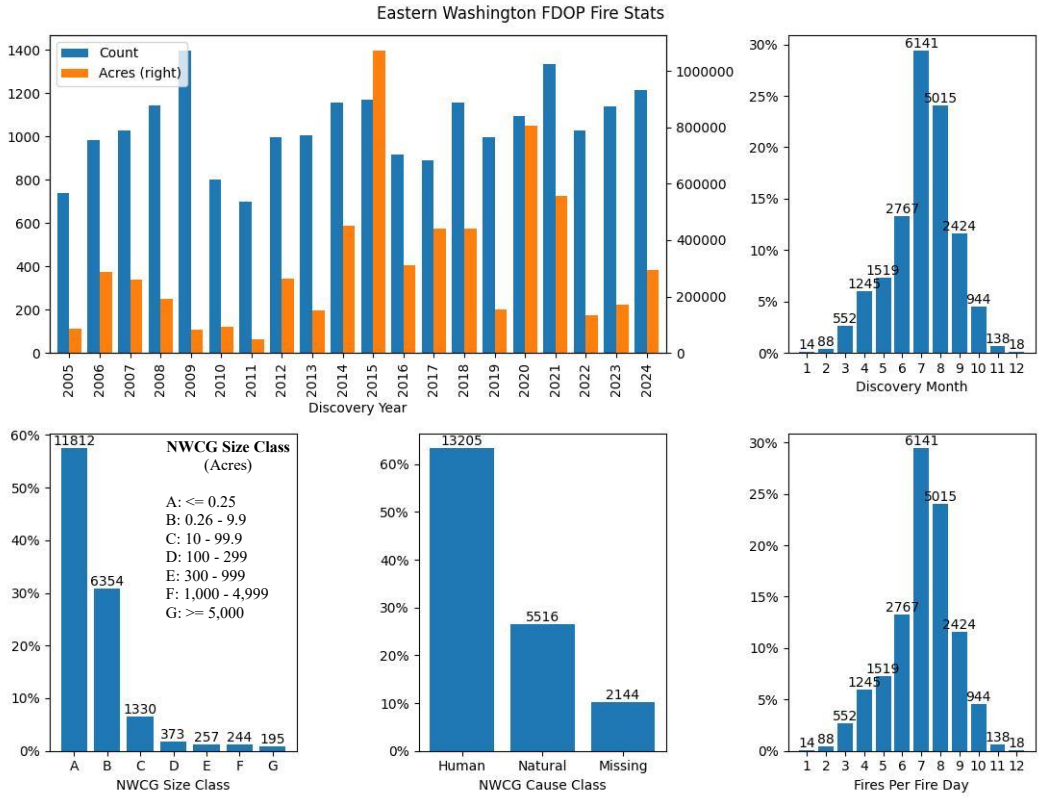


Figure 4. Fire occurrence summary statistics for the EWA FDOP (2005-2024).

3.2 Identification and Definition of the Fire Problem

The ability to regulate, educate, or control a user group is based upon the interface method and how quickly they can react to the action taken. Consequently, the most appropriate decision tool would depend upon the sensitivity of the target group to the implementation of the action. In addition, each action will result in positive and/or negative impacts to a user group. In selecting a component and/or index, several factors must be considered:

- Affected Target Group: The group of people commonly associated with the problem (i.e., agency, industry, or the public).

- Agency: Employees of the federal, state, and local governments involved in the cooperative effort to manage wildland fires. This includes federal, state, and county land

management employees along with volunteer fire departments who share a similar protection mission to manage wildland fires.

- Industry: Employees affiliated with organizations which utilize natural resources and/or obtain permits or leases to conduct commercial activities on federal, state, or private lands. These entities or activities could include ranchers, wilderness camps, railroads, mines, timber harvesting, filming, building construction, oil and gas, electric generation, guiding services, etc.

- Public: Individuals who use public lands for non-commercial purposes such as off highway vehicle use, camping, hiking, hunting, fishing, skiing, firewood gathering, agriculture, mountain biking, general travel, and recreation. This group also includes those living within the Wildland Urban Interface (WUI).

- Problem Definition: This is the problem specific to the area of concern and includes ignition causes. The problem is framed to focus on the wildland fire management issue associated with a specific target group.

- Workload Description: This is the unit's suppression workload. Human-caused fires are usually described in terms of an ignition cause related to public and/or industrial target groups. Natural caused (i.e., lightning) fire workload is usually described as the unit's workload. For example, lightning is not the "problem" but rather the problem is the local unit's ability to respond to multiple ignitions in exceedance of staffing capabilities.

- Degree of Control: This is a general description of how much control the fire management agencies have over the target group (i.e., low to high). This is a measure of how quickly the affected target group can respond to changing fire danger levels.

- Communication: Various methods of communication are utilized to influence an affected target group to change their behavior. Depending upon the specific target group, communication may include face-to-face verbal conversations, radio, telephone, email, newspaper, television, signing, posting, text messages, etc.

- Component and Index: Sensitivity of the NFDRS outputs should be commensurate with the ability to react or communicate to the target group. For example, Energy Release Component (ERC) is relatively stable, displays a seasonal trend, and is indicative of conditions in which fires exhibit resistance to control. Spread Component (SC) is sensitive to wind and weighted to fine fuel moistures which can rapidly change. In comparison, Burning Index (BI) is a combination of ERC and SC. Burning Index has a higher degree of daily variability, does not have an underlying seasonal trend, and is indicative of the conditions in which fires exhibit resistance to containment.

- Management Action: The actions or applications are pre-defined and taken at breakpoints determined through an analysis of fire danger indices and fire occurrence using appropriate components and indexes. Collectively the decision points represent levels of fire danger applied as a communication mechanism to specific target groups. The intent is to minimize the risk of fire ignition problems by controlling or influencing a specific target group (i.e., agency, industry, and/or the public).

3.3. Fire Occurrence Problem and Target Group Association

The ability to identify and define fire occurrence problems (Table 4, Table 5) associated with target groups and development of communication and management tools (Table 6, Table 7) is essential for fire problem mitigation and management. Fire occurrence problems displaying general cause class for individual FDRA are displayed in Appendix A.3.

Cause	Count	Percent
Human	13,205	63%
Natural	5,516	26%
Missing	2,144	10%
Total	20,865	100%

Table 4. Cause class by count and percent for the EWA FDOP (2005-2024).

General Cause	Count	Percent
Natural	5,516	26%
Missing data/not specified/undetermined	5,097	24%
Debris and open burning	3,326	16%
Recreation and ceremony	1,929	9%
Equipment and vehicle use	1,222	6%
Arson/incendiarism	884	4%
Fireworks	821	4%
Power generation/transmission/distribution	792	4%
Other causes	476	2%
Misuse of fire by a minor	343	2%
Smoking	222	1%
Railroad operations and maintenance	120	<1%
Firearms and explosives use	117	<1%
Total	20,865	100%

Table 5. General cause class by count and percent for the EWA FDOP (2005-2024).

General Cause	Target Group	Degree of Control	Index	Management Tool
Natural	Agency	High	BI	Staffing Plan Initial Response Plan
Debris and open burning	Public	Low	ERC	Prevention Plan Restriction Plan
Recreation and ceremony	Public	Low	ERC	Prevention Plan Restriction Plan
Equipment and vehicle use	Public Industry	Low to Moderate	ERC IFPL	Prevention Plan Restriction Plan
Arson/incendiarism	Public	Low	BI	Prevention Plan Restriction Plan

Table 6. Top 5 general cause classes excluding missing data/not specified/undetermined class for the EWA FDOP (2005-2024).

Target Group		Ignition Cause		Degree of Control	Communication	Problem
General	Specific	General	General Cause	Relative	Method	Workload
Agency	Agency suppression resources and fire managers	Natural	Lightning	High	Dispatch centers and fire managers communicate fire weather (i.e., lightning forecast) and fire danger (staffing, response, and preparedness levels)	Fires which exceed the unit's capability to manage as new lightning ignitions cannot be staffed on discovery and/or escape initial attack on subsequent days
Public	Private landowners	Human	Debris and open burning	Low	Dispatch centers, public information officers, and posted on the dispatch website, radio, media broadcast, news release and internet	Escaped debris burns which become large fires or tie up agency resources
Public	Public use in recreation sites and agency lands for day or overnight use	Human	Recreation and ceremony	Low	Public information officers, radio, media broadcast, news release and internet. Fire danger (i.e., Smokey Bear) adjective signs, public use restrictions, and prevention patrols	Campfires and/or ceremonies in developed and undeveloped recreation areas that escape and become large fires and/or tie up agency resources
Public Industry	Public and industrial forest users operating on public lands	Human	Equipment and vehicle use	Low to Moderate	Dispatch centers, public information officers, and posted on websites, radio, and media broadcast. Fire danger (i.e., Smokey Bear) adjective signs, Industrial Fire Precaution Levels, and prevention patrols	Ignitions which become large fires resulting from public and/or industrial forest equipment and vehicle operations
Public	Public users engaging in acts of deliberate fire ignitions and/or use of incendiary devices and/or materials	Human	Arson/incendiarism	Low	Dispatch centers, public information officers, and posted on websites, radio, and media broadcast. Fire danger (i.e., Smokey Bear) adjective signs, public use restrictions, and prevention patrols	Fires which become large fires and/or tie up agency resources

Table 7. Top 5 general cause class fire problems identified and defined (excluding missing data/not specified/undetermined classes) for the EWA FDOP (2005-2024).

4 FIRE DANGER DECISION POINT ANALYSIS

The EWA FDOP will be used to support fire management decisions made at specific decision points. A decision point is a point along the range of possible output values where a decision shifts from one choice to another. When conditions, or a combination of events and conditions, signal that it is time to do something different, a decision point has been reached. Decision points are identified for selected indices and levels within each Fire Danger Rating Area.

4.1 Climatological Breakpoints

Climatological breakpoints are points on the cumulative distribution curve of a fire danger index. For example, the value at the 90th percentile ERC is the climatological breakpoint at which 10 percent of the ERC values are greater in value.

When using climatology, it is important to identify the period of record used to determine the percentile values. The percentile values for the calendar year will be different from the percentile values for the fire season. In lieu of national direction, to provide consistency across the Pacific Northwest, the EWA FDOP, related plans, products, and communications will use annual (full calendar year) percentile values.

Climatological breakpoint percentiles were originally developed for budgetary decisions by federal agencies, without regard to associated fire occurrence, and are predetermined by specific agency directives as exemplified below:

- Bureau of Land Management | 80th and 95th
- US Forest Service, US Fish and Wildlife Service, National Park Service | 90th and 97th

4.2 Fire Business Thresholds

Fire business thresholds, unlike decision points based on climatological percentiles, make a direct relationship between NFDRS outputs and historical fire business. Thresholds based on fire business are determined through analysis of historical weather and fire occurrence data and set such that each decision point represents a meaningful increase in fire activity.

The decision points identified in the EWA FDOP utilize fire business thresholds based upon the statistical correlation of historical fire occurrence and weather data and therefore do not use standard climatological percentiles for decision points.

4.3 Methods

4.3.1 Weather Station Selection

Individual Remote Automatic Weather Stations were combined into Special Interest Groups (SIGS) equally weighted (i.e., 1:1) to represent a range of conditions across broader Fire Danger Rating Areas (Table 8). Weather stations were chosen based on a combination of predictive power and ability to spread out decision points. Within each FDRA, every possible combination of stations, less than four, was tested against fire occurrence. Receiver Operating Characteristic (ROC) [10] and Precision Recall (PR) Area Under the Curve were summed within each class, and then the ROC + PR for each class was summed within the SIG. Within each FDRA a selection was made based on the SIG with the best spread (minimum interval) between target class ROC optimum values. Minimum interval was added to the selection criteria after discovering previous utility in selecting a fuel model and was incorporated here to maximize range between decision point thresholds values. Station correlation within FDRA was considered but was not a driving factor in station selections.

Dispatch	#	FDRA	Station	NWS (ID)	Fuel Model	Elevation (ft.)	Agency	Unit ID	Installed
CWC	1	Methow	First Butte	452006	Y	5,509	USFS	WAOWF	1991-07-29
	2	Methow	Douglas Ingram Ridge	452035	Y	3,566	USFS	WAOWF	1996-05-08
	3	Chelan	Stehekin-Airstrip	452121	Z	1,230	NPS	WANCP	2003-05-01
	4	Chelan	Dry Creek	452134	Z	3,661	USFS	WAOWF	1987-05-04
CWC YAC	5	Upper Yakima	Peoh Point	452206	Y	4,020	S&PF	WAWAS	1986-01-01
	6	Upper Yakima	Swauk	452219	Y	3,480	USFS	WAOWF	1997-06-15
	7	Upper Yakima	Sawmill Flats	452221	Y	3,000	USFS	WAOWF	1997-05-27
	8	Lower Yakima	Mill Creek	452304	Y	2,820	BIA	WAYAA	2001-09-25
	9	Lower Yakima	Signal Peak	452307	Y	5,052	BIA	WAYAA	2001-09-25
CWC CAC	10	Valley	Oroville	452039	Y	1,450	BLM	WASPD	1992-01-16
	11	Valley	Kramer	452040	Y	2,720	BIA	WACOA	1993-02-17
CWC	12	Upper Basin	Spring Canyon	453002	Z	1,340	NPS	WALRP	1994-03-31
	13	Upper Basin	Cheney	453506	Z	2,230	FWS	WATBR	2002-06-04
	14	Upper Basin	Escure	453601	Z	1,740	BLM	WASPD	2001-08-16
CWC YAC BMC	15	Lower Basin	Umatilla	351316	Y	270	FWS	ORUMR	2002-06-06
	17	Lower Basin	Saddle Mountain	452701	Y	634	FWS	WAHFR	2002-07-18
NEC CAC	18	Highlands	Nespelem	452009	Y	1,900	BIA	WACOA	1990-08-28
	19	Highlands	Lane Creek	452511	Y	4,430	USFS	WACOF	2002-07-02
NEC	20	Highlands	Iron Mountain	452512	Y	4,350	USFS	WACOF	2003-10-23
	21	Kaniksu	Tacoma Creek	453413	Y	3,240	USFS	WACOF	2002-06-30
	22	Kaniksu	Little Pend Oreille	453416	Y	2,045	FWS	WALPR	2002-06-04
	23	Foothills	Kettle Falls	452916	Y	1,310	NPS	WALRP	1995-07-19
	24	Foothills	Wellpinit	452918	Y	2,240	BIA	WASPA	2002-06-04

Table 8. Central Washington Interagency Communication Center (CWC), Northeast Washington Interagency Communication Center (NEC), Colville Agency Dispatch Center (CAC), Yakama Agency Dispatch Center (YAC), and Blue Mountains Interagency Dispatch Center (BMC) dispatch zone Remote Automatic Weather Stations combined into Special Interest Groups for use in Fire Danger Rating Area analysis for the EWA FDOP (2005-2024).

4.3.2 Fire Occurrence Selection

The full period of record for fire occurrence (2005-2024) was clipped within each FDRA (Appendix A.5-A.15) and then joined to the Fire Family Plus daily listings based on SIG identification and fire discovery date so that each final fire size was associated with initial discovery date and indices (i.e., ERC, BI) recorded at 1300. Fires within each representative FDRA were sorted and classified into integers one through four based on percentile fire size (i.e., 97th, 90th, 50th, <50th percentile) for each analysis area in which the 97th percentile fire size was defined as a large fire for each FDRA.

4.3.3 Indice Selection

Indice selection was primarily driven by the intended indices use as it relates to stability and sensitivity of the NFDRS outputs with the ability to react and communicate to the target group. Energy Release Component and Burning Index were selected as the two primary indices as they are the only two metrics referenced in the Incident Response Pocket Guide (IRPG) and are the most common metrics used in Supplemental Action Plans that represent two different fire behavior characteristics; although the use of Severe Fire Danger Index (SFDI) [9] as a product of both ERC and BI, its ability to represent two opposing fire characteristics, indication of extreme fire behavior potential, and as a metric that serves as a strong predictor related to responder risk (i.e., firefighter entrapment and fatalities) was explored as a valuable indice but not selected due to its current lack of familiarity, education, and full integration into the wildland fire community. Energy Release Component (i.e., heat per area released during the flaming front) due to the influence of large diameter, longer time-lag fuel classes, and fuel moisture content responds more slowly to environmental changes, is relatively stable, and displays a seasonal trend. These moderate to extended timeframe characteristics make ERC suitable to inform decision support in Supplemental Action Plans related to preparedness, prevention, and restrictions levels. Burning Index (i.e., correlated with flame length) due to influence inputs of spread component, fine dead fuels, and windspeed exhibits high frequency daily fluctuations and does not display a seasonal trend. These short-term timeframe characteristics warrant BI suitable to inform decision support in Supplemental Action Plans related to staffing and initial response levels.

4.3.3 Fuel Model Selection

The National Fire Danger Rating System (2016) has been standardized and consolidated into five primary fuel models consisting of models with live (i.e., V, W, X) and dead (i.e., Y, Z) fuels and model input parameters used to derive NFDRS calculations (Table 9).

The original intent was to explore all possible fuel models that best represent FDRA vegetation type, have the greatest statistical correlation, and/or are better than others at separating the target classes from one another across the entire analysis area. Broad FDRA vegetation type (i.e., grass, shrub, timber) is not the sole distinguisher in selecting a fuel model as other factors such as statistical model fit, predictive ability, stability, and target class separation along with indices reported in terms of percentiles may be a more decisive reason to select a particular fuel model over another.

The use of fuel models with live fuels (i.e., V, W, X), such as FDRA that may correspond with a particular vegetation type, have historically demonstrated increases in pre-green up fire danger and are also FDRA that have recorded large fire occurrence during the shoulder season period. In contrast, fuel models without a live fuel component (i.e., Y, Z) including its predictive ability across all analysis areas, stability, lack of effort to properly calibrate Growing Season Index (GSI), and use in previous iterations of interagency plans may pose reasons for selection.

NFDRS Model	Based on Scott and Burgan	Fuel Loading (tons/ac.$^{-1}$)							Surface Area Volume Ratio (ft.$^{-1}$)						Fuel Heat Content (BTU lb-1)	Moisture of Extinction (%)	Fuel Bed Depth (ft.)	Wind Adjustment Factor (DIM)	Maximus SC
		1-hr	10-hr	100-hr	1000-hr	Herbaceous	Woody	Drought	1-hr	10-hr	100-hr	1000-hr	Herbaceous	Woody					
V	GR2	0.1	0	0	0	1	0	0	2,000	109	30	8	2,000	1,500	8,000	15	1	0.6	108
W	GS2	0.5	0.5	0	0	0.6	1	1								15	1.5	0.4	62
X	SH9	4.5	2.45	0	0	1.55	7	2.5								25	4.4	0.4	104
Y	TL1	2.5	2.2	3.6	10.16	0	0	5								25	0.6	0.2	5
Z	SB2	4.5	4.25	4	4	0	0	7								25	1	0.4	19

Table 9. National Fire Danger Rating System (2016) fuel model parameters for V (grass), W (grass-shrub), X (shrub), Y (timber), and Z (slash).

However, current Fire Environment Mapping System station catalogue national defaults for Growing Season Index have been restricted and are inadequate to accurately calculate fuel models containing live fuels (i.e., V, W, X). GSI, a single indicator scaled from 0-1 (fully constrained to unconstrained, respectfully) as a function of minimum temperature, precipitation, vapor pressure deficit, and photoperiod serves as metric of plant physiological limits that appropriately initiates (i.e., green-up) and scales live herbaceous and woody fuels with increases and/or decreases in GSI. Due to current catalogue access restrictions, local field sampled data potentially used to calibrate and apply GSI is not available for those fuel models containing live herbaceous and/or woody fuels (i.e., V, W, X). Future FEMS GSI station catalogue access and calibration of GSI used in live fuel models may facilitate exploration and consideration of those fuel models and would require a re-analysis if selected. Therefore, only fuel models Y and Z were examined.

4.3.4 Time Selection

Daily 1300 local time has historically been the standard to calculate forecasted and observed indice outputs. Forecast outputs use some type of ingested forecast weather data (i.e. gridded, ensembles, etc.), whereas observed outputs from RAWS (i.e., point source) utilize local site-specific weather sensor inputs to produce outputs and are also important to inform and validate forecasted data. The Fire Environment Mapping System has the capability of leveraging available National Weather Service - National Digital Forecast Database (NDFD) gridded forecasts at 2.5 km grid spacing to ingest into FEMS to generate hourly 7-day forecast outputs representative of RAWS single point locations. FEMS can also generate daily maximums, the highest value (i.e., ERC or BI) recorded during the 24-hour period (midnight to midnight) for each station. Due to differences between forecasted (i.e., gridded) and RAWS (i.e., point source) outputs, outliers discovered using daily maximums, and as to not rely exclusively on forecasted weather, the regional guidance used in the EWA FDOP was to continue using daily 1300 local time for forecasted and observed calculated outputs.

4.3.5 Threshold Analysis

A machine learning approach using the Python programming language was used to develop four thresholds, or breakpoints, or decision points, which were then used to form the five (5) levels for each indice index (i.e. ERC and BI). The problem was solved as a five-class multiclass problem, using four fire target classes based on percentile fire size plus the no fire day, or miss. Indice floating point values (i.e., ERC and BI) from the fire initial discovery date occurring at 1300 were used as the features (0 - maximum) along with percentile fire size (i.e., 97^{th}, 90^{th}, 50^{th}, $<50^{th}$) class integer classifications (1-4) developed during the fire occurrence record selection as targets, and zero representing the no fire day for each FDRA.

Decision points for all FDRA were based on percentile fire size (97^{th}, 90^{th}, 50^{th}, $<50^{th}$) with exceptions for Highlands FDRA (99^{th}, 95^{th}, 50^{th}, $<50^{th}$) and Foothills FDRA which utilized the 97^{th} percentile fire size to define large fire days for use in Fire Family Plus. All fire size percentiles for each FDRA are provided in Appendix A.4.

The Python libraries pandas, geopandas, and sklearn were used for most of the analysis. For this purpose, daily listing files were generated from Fire Family Plus. Daily listing settings for elevation, latitude, longitude, precipitation, slope (slope class 1, 0-25%), and herb type (perennial) were set based on the Fire Environment Mapping System national catalogue defaults. All other settings were left at Fire Family Plus defaults.

A Receiver Operating Characteristic (ROC) [10] curve is a graphical plot that illustrates the performance of a binary classifier model (i.e., fire or no fire) at varying optimum indice values (i.e., 51.6) and their equivalent indice percentiles (i.e., 90.2%). The ROC curve is the plot of the true positive rate, predicted fire and fire, against the false positive rate, predicted fire and no fire, at each indice decision point. The best possible prediction method would yield a point in the upper left corner or coordinate (i.e., 0,1) of the ROC space, representing 100% sensitivity (i.e., no false negatives) and 100% specificity (i.e., no false positives). The (0,1) point is also called a perfect classification. The ROC generated decision points are the optimum indice values and corresponding indice percentiles on the ROC curve that is closest to being a perfect classification for the target (i.e., percentile fire size).

ROC curves and optimum value indice decision points using percentile fire size were generated for each FDRA using possible station combinations as well as ERC and BI indice inputs. Weather stations and fire occurrence were limited to the FDRA, and station combinations limited to three or fewer. FDRA fire size percentiles were used for decision points, thus each decision point represents conditions at which fires of a certain size can be expected based on historical data. Final station and decision point selections were determined based on target class separation between decision points (i.e., decision space) as well as the ROC Area Under the Curve (AUC) generating values ranging from 0.5-1 with 1 indicating perfect discrimination to assess model performance and statistical fit.

All FDRA in the EWA FDOP were assessed and characterized using the ROC method with exception of the Foothills FDRA as optimum values were not acceptable despite fire occurrence outlier removal. Fire Family Plus was used to assess the Foothills FDRA by means of the fire analysis function using large fire days defined by the 97^{th} percentile fire size (100 acres) and the same fire occurrence period of record as in the ROC method as well as applicable summary statistics (Chi^2, p-value, R^2). Decision points were further identified based on the sorting of increases in large fire days and multi-fire days (5 fires) into increasing decision point levels and assessing decision space and target class separation.

4.4 Results

Model inputs (Table 10), decision point summary table with endorsed indice selections for use in Supplemental Action Plans (Table 11), and final decisions points for the EWA FDOP (Table 12). Spatial fire occurrence, fire occurrence summaries, and fire decision point analysis figures for FDRA are presented in Appendix A.5-A.15.

FDRA	Slope Class	Herb Type	Fuel Model	Model	Description
Methow	1	P	Y	16Y1P	Timber
Chelan	1	P	Z	16Z1P	Slash
Upper Yakima	1	P	Y	16Y1P	Timber
Lower Yakima	1	P	Y	16Y1P	Timber
Valley	1	P	Y	16Y1P	Timber
Upper Basin	1	P	Z	16Z1P	Slash
Lower Basin	1	P	Y	16Y1P	Timber
Highlands	1	P	Y	16Y1P	Timber
Kaniksu	1	P	Y	16Y1P	Timber
Foothills	1	P	Y	16Y1P	Timber

Table 10. Fire Danger Rating Area fuel model selections for the EWA FDOP (2005-2024).

Target Group	Decision Points	Indice	Supplemental Action Plan
Agency	5	Burning Index	Staffing Plan ▪ Daily staffing ▪ Exended daily staffing
Agency	3	Burning Index	Initial Response Plan ▪ Strategic response zones ▪ Run cards
Agency	5	Energy Release Component	Preparedness Plan ▪ Extended resource availability ▪ Severity requests
Public	5	Energy Release Component	Prevention Plan ▪ Fire danger adjective levels ▪ Education and enforcement
Public Industry	5 4	Energy Release Component	Restriction Plan ▪ Public use restrictions ▪ Industrial fire precaution levels

Table 11. Fire business decision point summary table for the EWA FDOP. Signatory agencies and/or units may further develop and maintain separate Supplemental Action Plans based on interagency decision points.

FDRA	Fire Size (percentile)	Fire Size (acres)	Burning Index (level and value)		Energy Release Component (level and value)	
Methow	0	0	1	0	1	0
	< 50th	< 0.10	2	14.1	2	25.7
	50th	0.10	3	17.8	3	32.7
	90th	5.1	4	22.2	4	43.5
	97th	>726.6	5	24.9	5	51.6
Chelan	0	0	1	0	1	0
	< 50th	< 0.10	2	30.9	2	43.3
	50th	0.10	3	37.1	3	53.8
	90th	13.5	4	44.7	4	68.0
	97th	>1123.2	5	54.3	5	80.2
Upper Yakima	0	0	1	0	1	0
	< 50th	< 0.10	2	13.9	2	20.5
	50th	0.10	3	15.9	3	24.0
	90th	2.0	4	18.5	4	30.3
	97th	>43.2	5	21.6	5	35.8
Lower Yakima	0	0	1	0	1	0
	< 50th	< 0.10	2	14.7	2	20.8
	50th	0.10	3	17.9	3	25.6
	90th	4.7	4	21.9	4	33.1
	97th	>42.3	5	25.4	5	45.1
Valley	0	0	1	0	1	0
	< 50th	< 0.20	2	17.5	2	27.6
	50th	0.20	3	20.4	3	31.3
	90th	39.4	4	23.8	4	39.5
	97th	>729.5	5	30.2	5	53.0
Upper Basin	0	0	1	0	1	0
	< 50th	< 0.20	2	44.8	2	56.7
	50th	0.20	3	51.6	3	69.7
	90th	14.0	4	62.3	4	86.9
	97th	>393.7	5	74.0	5	96.6
Lower Basin	0	0	1	0	1	0
	< 50th	< 1.0	2	19.7	2	29.6
	50th	1.0	3	21.8	3	32.5
	90th	163.1	4	24.8	4	38.7
	97th	>2000	5	28.4	5	42.7

FDRA	Fire Size (percentile)	Fire Size (acres)	Burning Index (level and value)		Energy Release Component (level and value)	
Highlands	0	0	1	0	1	0
	< 50th	< 0.20	2	14.7	2	22.0
	50th	0.20	3	17.6	3	28.7
	95th	35.0	4	21.2	4	37.4
	99th	>1299.2	5	27.8	5	52.2
Kaniksu	0	0	1	0	1	0
	< 50th	< 0.10	2	14.0	2	21.9
	50th	0.10	3	16.8	3	25.6
	90th	2.0	4	18.4	4	28.8
	97th	>32.6	5	22.1	5	37.2
Foothills	0	0	1	0	1	0
	< 50th	.	2	14.0	2	20.0
	50th	.	3	18.0	3	27.0
	90th	.	4	21.0	4	36.0
	97th	>100	5	25.0	5	43.0

Table 12. Fire Danger Rating Area fire size percentile, fire size, and decision point input level and corresponding indice value for the EWA FDOP (2005-2024).

5 COMMUNICATION OF FIRE DANGER

5.1 Percentiles

Fire danger will be communicated using percentiles (not the same as using percentiles based on climatology to set decision points). Percentiles are preferable for communication of fire danger because they put disparate fuel model and index values on the same scale.

5.2 Fire Danger Level Calculation

Fire danger is calculated using the weather stations, fuel models, and the Fire Danger Rating Areas and the resulting decision points form the basis for the following fire danger level calculations identified in Section 4 – Fire Danger Decision Point Analysis.

The NFDRS (Appendix A.16) utilizes FEMS to manipulate weather and forecast data to produce fire danger ratings for corresponding individual RAWS which then can be used to aggregate multiple RAWS into Special Interests Groups to represent Fire Danger Rating Areas in external applications. The NFDRS outputs will be used to determine various levels of fire danger rating to address the fire problems identified in the EWA FDOP. The system is designed to model worst-case fire danger scenarios. Outputs from FEMS, along with other decision support tools (i.e., secondary inputs, etc.), will be applied to produce levels (i.e., thresholds) of fire business to address local fire problems by targeting public, industrial, and/or agency groups.

The NFDRS will be utilized to produce outputs to assist fire managers with decision support:

- **Staffing Level** will be used for appropriate day-to-day suppression resource staffing.
- **Response Level** will be used as a decision tool for dispatchers to assign initial attack resources to a fire reported in a specific FDRA or strategic response zone.
- **Preparedness Level** will assist fire managers with more long-term (or seasonal) decisions with respect to fire danger.
- **Adjective Fire Danger Level** will be used to communicate fire danger to the public.
- **Industrial Fire Precaution Level** will be used to curtail preventable industrial ignitions.
- **Public Use Restriction Level** will be used to mitigate public ignitions.

5.2.1 Fire Danger Level Decision Matrix

Primary inputs (i.e., input levels) are the raw forecasted or observed levels (1-5) for BI and ERC based on fire business indice decision points defined in Section 4 – Fire Danger Decision Point Analysis. Secondary inputs incorporate a decision matrix (i.e., plinko chart) that combines other related events to determine final BI and ERC output levels (1-5). The secondary input events display similar related components occurring during similar timeframes for specific indices. For example, BI is heavily influenced by windspeed, fine dead fuels, and exhibits short-term variations as does National Weather Service fire weather warnings (i.e., red flag) and watches [11] which were selected as secondary inputs into BI. ERC, is influenced by large diameter, longer time-lag fuel moisture classes, and exhibits seasonal trends as does the US Drought Monitor

(USDM) [12] at D3 (extreme) and D4 (exceptional) categories which were selected as a secondary input into ERC. If the secondary inputs in the decision matrix are non-existent or do not reach defined thresholds (i.e., percent of an FDRA) they will not be applied and an automatic downgrade of -1 (i.e., 5 to 4) from the input level to the output level will be applied. The application of secondary inputs to input levels in order to determine final output levels are employed for several reasons:

- Alignment of related indices and weather events suggest potential increase in overall fire danger.
- Validation and concurrence of model outputs from independent frameworks and/or field-based conditions.
- NFDRS model outputs represent worst-case fire danger scenarios, and at times, can result in overprediction of input levels.
- When related indices and weather events are not aligned the automatic downgrade avoids remaining in the upper decision point levels for an extenuated timeframe.
- Upper decision point levels (i.e., 5) should represent, and be commensurate, with the ability take, sustain, and communicate actions being applied.

The input level will always be greater than or equal to the output level. Daily or extended final output levels serve to define specific actions within Supplemental Actions Plans.

5.2.2 Staffing Level

Staffing level based on burning index decision points forms the foundation for daily decisions regarding the degree of readiness and support resources. Staffing levels are expressed as numeric values (1-5) where 1 represents the low end of the fire danger continuum and 5 the high end. Staffing level is intended to provide fire managers with day-to-day decision support regarding staffing of suppression resources including extended staffing associated with working beyond normal schedules. Because burning index and other related weather events used to generate staffing levels are of shorter duration, daily staffing levels are best suited for decision support. Decision output levels from the EWA FDOP form the basis that influences daily staffing levels (Table 13). Signatory agencies and/or units may further develop and maintain separate Staffing Plans based on interagency decision points.

Staffing Input Level	**1**	**2**		**3**		**4**		**5**	
Fire Weather Warning and/or Fire Weather Watch (>0% of FDRA)	-	No	Yes	No	Yes	No	Yes	No	Yes
Staffing Output Level	**1**	**2**		**3**		**4**		**5**	

Table 13. Staffing level decision matrix displaying final staffing output levels.

5.2.3 Response Level

Response level (or dispatch level) based on burning index decision points expressed as adjectives (low, moderate, high), are pre-planned actions which identify the number and type of resources (engines, crews, aircraft, etc.) initially dispatched to a reported wildland fire based upon fire danger criteria. Response levels are established to assist fire managers with daily decisions regarding the most appropriate response to an initial fire report. Because burning index and other related weather events used to generate response levels are of shorter duration, daily response levels are best suited for decision support. Decision output levels from the EWA FDOP form the basis that influences daily response levels in which response level is a direct function of staffing output level (Table 14).

A coordinated interagency Initial Response Plan (i.e., run card) will be utilized by all agencies within respective dispatch boundary units using response levels generated for individual FDRA and potentially further delineated by strategic response zones based on additional considerations (i.e., values at risk, etc.). The response levels indicate expected differences in fire business. As response levels change, the type and number of suppression resources responding to unplanned ignitions is commensurate with response level. The specific type and number of resources dispatched upon initial fire discovery are reflected in respective Initial Response Plans. Signatory agencies and/or units may further develop and maintain separate Initial Response Plans based on interagency decision points.

Deviation from Initial Response Plans is at the discretion of the duty officer (DO), Incident Commander (IC), or other exclusively authorized personnel. Other considerations that may warrant deviations include abundant lightning or other extenuating events.

Staffing Output Level	**1**	**2**	**3**	**4**	**5**
Response Level	**Low**		**Moderate**	**High**	

Table 14. Response level decision matrix as a function of staffing output level, displaying final response levels.

5.2.4 Preparedness Level

Preparedness level is based on energy release component decision points expressed as numerical values (1-5) where 1 represents the low end of the fire danger continuum and 5 the high end (Table 15). Preparedness levels are established to assist fire managers with longer-term (i.e., weekly, monthly, seasonal) planning decisions such as extended suppression resource availability and severity requests. Because energy release component and other related weather events and considerations of local fire activity and resource availability used to generate preparedness levels are of moderate to longer-term duration, an average or weighted average of extended forecasts for specific FDRA or a combined average of FDRA

preparedness levels pertinent to the unit may be best suited for decision support. For example, a unit may elect to use the 7-day forecasted average for multiple FDRA's that corresponds with the majority of the unit's response area of concern along with other long-term considerations. Signatory agencies and/or units may further develop and maintain separate Preparedness Plans based on interagency decision points.

Preparedness Input Level	**1**	**2**		**3**		**4**		**5**	
US Drought Monitor D3-D4 (>= 15% of FDRA)	-	No	Yes	No	Yes	No	Yes	No	Yes
Preparedness Output Level	**1**		**2**		**3**		**4**		**5**

Table 15. Preparedness level decision matrix displaying final preparedness output levels.

5.2.5 Adjective Fire Danger Level

In 1974 the US Forest Service, Bureau of Land Management, and state forestry organizations established five standard adjective fire danger rating level descriptions (Appendix A.16) for public information and signing, although some other states and agencies have elected to use a four-class system. Fire danger is expressed using the national adjective descriptions and color codes.

Adjective levels are based on energy release component decision points expressed as adjectives (low to extreme) where low represents the low end of the fire danger continuum and extreme the high end. Adjective levels are established to assist fire managers and cooperators generally with longer-term (i.e., weekly, monthly, seasonal) prevention efforts and communication to the public of fire danger. Adjective levels are a direct function of FDRA preparedness level outputs, expressed as an adjective as opposed to a numerical value, respectively (Table 16).

Coordinated interagency discussions with cooperators typically occur weekly during fire season. Because prevention efforts characteristically consider foreseeable longer-term durations and reflect preparedness levels (based on ERC), an average of extended forecast (i.e., 7-days) or trends for FDRA may be best suited for decision support and also take into account other considerations such as local factors, weather, wildfire activity, adjective levels tied to restrictions, public messaging, etc. Official adjective levels are reflected on the Washington Department of Natural Resources (WADNR) [13] website. Each agency will define the posting signs within their respective Prevention Plans. Signatory agencies and/or units may further develop and maintain separate Prevention Plans based on interagency decision points.

Preparedness Output Level	1	2	3	4	5
Adjective Fire Danger Level	Low	Moderate	High	Very High	Extreme

Table 16. Adjective level matrix as a function of preparedness output level displaying final adjective fire danger levels.

5.2.6 Industrial Fire Precaution Level

Industrial Fire Precaution Level (IFPL) is a four-level regulation system used by the Department of Natural Resources, U.S. Forest Service, Bureau of Land management, and Bureau of Indian Affairs in Washington. IFPL are stages that apply to permitted work activities including timber sales, service contracts, and personal use firewood cutting on agency lands to reduce the risk of wildfire ignitions (Table 17).

Prior to the adoption of NFDRS 2016 and updated fuel models, a precaution value (PV) corresponding to IFPL I-IV levels within IFPL zones was calculated based on indices (i.e., ERC-Y * IC-Y * 0.10) from the 1978 fuel models determined using an analysis of equipment-caused fire occurrence and fire weather over broad geographic areas to determine breakpoints. Discussions are ongoing regarding how precaution values will be calculated using NFDRS 2016 as the previous calculations are no longer applicable.

Coordinated interagency discussions with cooperators typically occur weekly during fire season to determine IFPL. Official IFPL levels are reflected on the Washington Department of Natural Resources (WADNR) [14] website.

Industrial Fire Precaution Level	Description
I	Closed Fire Season - fire equipment and fire watch service is required.
II	Partial Hootowl - limits certain activities to between the hours of 8 p.m. and 1 p.m.
III	Partial Shutdown - prohibits some activities altogether and limits other activities between the hours of 8 p.m. and 1 p.m.
IV	General Shutdown – all operations prohibited.

Table 17. Industrial Fire Precaution Level descriptions (WADNR) [14].

5.2.7 Public Use Restriction Level

Public use restriction levels are determined by individual agencies or units participating in the EWA FDOP. Currently there is not a coordinated interagency set of restrictions levels or actions. Examples of public use restrictions may include but are not limited to campfires, outdoor burning, smoking, fireworks, target shooting, off-road equipment use, etc. and are

generally enforced on a longer-term (i.e., weekly, monthly, seasonal) timeframe as a preventative measure to mitigate ignition sources.

Due to corresponding timeframes of enforcement and related indice metrics, ideally units will set public use restrictions based on or informed by measures of current and forecasted adjective fire danger levels, unit calculated preparedness levels, or a matrix of the former along with other inputs based on risk tolerance. Signatory agencies and/or units may further develop and maintain separate Restriction Plans based on interagency decision points.

6 FIRE DANGER OPERATING PROCEDURES

6.1 Roles and Responsibilities

The following describes roles and responsibilities related to fire danger operating procedures.

6.1.1 Agency Administrators

Agency Administrators (AA) and decision support personnel will use the EWA FDOP to coordinate with fire management staff for fire business-related decisions.

6.1.2 Fire Program Managers

Fire program managers will use the EWA FDOP and NFDRS outputs as a tool to coordinate and make informed fire business decisions. Fire program managers are ultimately responsible for ensuring this plan is maintained, utilized, and communicated. Fire program managers will ensure that their stations are maintained to NFDRS standards.

6.1.3 Fire Danger Technical Group

Each participating agency will be responsible for providing an NFDRS technical specialist to participate in the maintenance, review, and update of this plan. The following are specific individuals which have participated in plan development or review to date.

- Joshua James – Fire Planner
  US Forest Service | Okanogan-Wenatchee National Forest
- Shane Robson – Deputy Fire Staff Officer Fuels
  US Forest Service | Colville National Forest
- Vaughn Cork – Fire Regulation Program Manager
  Washington State Department of Natural Resources
- Miles Pollack – Fire Section Manager
  Washington State Department of Natural Resources | Southeast Region
- Lonnie Newton – Fire Management Officer
  US Wildland Fire Service | Bureau of Land Management | Spokane District
- Bruce Jackson – Fire Management Officer
  US Wildland Fire Service | US Fish and Wildlife Service | Mid-Columbia River National Wildlife Refuge Complex
- Josh Tellessen – Fire Management Officer

Members of the Fire Danger Technical Group will monitor NFDRS to ensure validity, coordinate/communicate any problems identified, review plan implementation, coordinate plan revisions, present the plan, and be available for NFDRS technical consultation. The technical group will coordinate with fire managers from their unit for updates and additions to the plan. The technical group will coordinate annually to review plan implementation, decide if revisions are necessary, and accomplish revisions.

6.1.4 Fire Weather Station Owners and Managers

The station owners will ensure appropriate editing of the RAWS catalogues to match this plan and maintain current primary and secondary contacts for stations. Station owners will maintain stations in accordance with NWCG PMS 426-3 [2] and ensure a timely response when notified of an unexpected need for repair.

6.1.5 Communication Centers

Communication centers will ensure that daily NFDRS indices are retrieved, and that daily indices, staffing, response, and preparedness levels are calculated, communicated, and made available during fire season beginning June 1 through September, or season-end, or as requested by participants in this plan due to extenuating factors. The communication center will monitor daily outputs for unusual readings that may suggest an issue which needs attention and contact the station owners to arrange resolutions and notify agency fire program managers.

Efforts will be made to continue providing NFDRS EWA FDOP-based web products such as the Region 6 Fire Danger Rating Area [15] interface and other local products to assist dispatchers and managers in obtaining the needed information to calculate and communicate fire danger levels. This information has previously been hosted externally, and communication centers should be prepared to obtain and calculate outputs from FEMS in the absence of NFDRS products using the tables and worksheets in this plan.

Measures of fire danger will be broadcast twice per day during the morning and afternoon for each FDRA. Morning broadcasts will use 1300 daily forecast indices and decision levels effective until the afternoon broadcast. Afternoon broadcasts will use the days observed 1300 indices and decision levels effective until the next morning broadcast.

Morning and afternoon broadcasts should include at minimum BI percentile (%), staffing level (1-5), response level (low, moderate, high), ERC percentile (%), and preparedness level (1-5). BI and ERC percentiles are preferable vs. values for communication as they put disparate fuel models and indice values on the same scale. Additional measures of fire danger or readiness at the discretion of the communication center may be broadcast including severe fire danger index, adjective fire danger levels, public use restrictions, extended daily staffing, unit preparedness level, and/or other pertinent information.

6.1.6 Duty Officers

Duty officers from each agency will be identified to the communication centers throughout the fire season. The duty officers are responsible for implementing this plan and ensuring decisions are made consistent with the intent of the EWA FDOP. It is the duty officer’s role to

interpret and modify daily staffing, response, and preparedness levels if warranted by extenuating factors not addressed by this plan to make fire business decisions.

6.1.7 National Weather Service

Weather forecasts and products for the area are provided by the National Weather Service, Spokane and Pendleton forecast offices. The annual Northwest Fire Weather Operating Plan contains contact information and product listing (including NFDRS point and trend forecast products) and can be found on the Northwest Interagency Coordination Center (NWCC) [16] website.

6.2 Critical Fire Danger

Critical fire danger events such as abundant lightning, post-thermal trough, marine push, dry cold frontal passes, and high winds will be typically captured by National Weather Service meteorologists in red flag warnings, fire weather watches, or other advisories. For more information see the publication Critical Weather Patterns of the United States which can be found on the NWCC [16] website.

Other critical fire danger elements contributing to explosive fire growth aside from wind, high daytime temperatures, and low relative humidity, include abnormally low seasonal snowpack, streamflow, drought, and periods of poor overnight humidity recoveries. Sustained overnight humidity recoveries below approximately 40-45% combined with ERC generally above the 90th percentile should be considered a watch out in timber fuel types, especially when combined with any of the above frontal patterns. Effects of prolonged periods of poor humidity recovery on heavy fuels can last several days after frontal passage and humidity recovery.

6.3 Season Ending Event

Several resources exist to view and/or conduct season ending (i.e., season slowing) events including the Region 6 Fire Danger Rating Area [15] interface via FDRA, NWCC [16] via Predictive Service Areas (PSA), Risk Management Assistance Dashboard (RMA) [17] via fire perimeter, and using Fire Family Plus [18] term file generation.

Experience has shown that local season-ending events conducted in the traditional manner (i.e., ERC percentile) generally align and often occur within a week or so when compared across the various analysis methods above.

6.4 Fire Danger Pocket Cards

Fire danger pocket cards are a tool which can aid fire personnel to interpret NFDRS outputs and understand local fire danger thresholds. Pocket cards for the EWA FDOP utilize the FDRA, RAWS, fire occurrence, percentile fire size, fuel models, indices, and decision points for the period of record in the analysis and relates current NFDRS outputs with historical average and worst-case values in a specific geographic or FDRA location. Visiting resources can use the pocket card to familiarize with local fire danger conditions. Pocket cards meet NWCG guidelines and are posted on the Wildland Fire Application Information Portal (WFAIP) [19].

7 APPENDIX A

A.1 Fire Danger Rating Area Administrative Units

FDRA	Ownership	Acres	Percent
Methow	US Forest Service	1,424,802	85%
Methow	State	188,680	11%
Methow	Private	58,428	3%
Methow	Bureau of Land Management	6,772	< 1%
Methow	US Fish and Wildlife Service	1,040	< 1%
Methow	National Park Service	219	< 1%
Chelan	US Forest Service	1,243,127	83%
Chelan	National Park Service	133,886	9%
Chelan	Private	101,100	7%
Chelan	State	12,055	< 1%
Chelan	US Fish and Wildlife Service	1,456	< 1%
Chelan	County	342	< 1%
Chelan	Bureau of Land Management	43	< 1%
Upper Yakima	US Forest Service	975,556	62%
Upper Yakima	State	339,072	22%
Upper Yakima	Private	234,626	15%
Upper Yakima	Tribal	15,094	< 1%
Upper Yakima	Bureau of Land Management	709	< 1%
Upper Yakima	Bureau of Reclamation	96	< 1%
Upper Yakima	National Park Service	94	< 1%
Upper Yakima	County	54	< 1%
Lower Yakima	Tribal	792,174	67%
Lower Yakima	Private	251,595	21%
Lower Yakima	State	109,422	9%
Lower Yakima	US Forest Service	11,732	1%
Lower Yakima	US Fish and Wildlife Service	7,081	< 1%
Lower Yakima	Bureau of Land Management	2,234	< 1%
Lower Yakima	County	424	< 1%
Valley	Private	785,579	53%
Valley	Tribal	221,718	15%
Valley	State	217,493	15%
Valley	US Forest Service	164,560	11%
Valley	Bureau of Land Management	73,949	5%
Valley	County	8,152	< 1%
Valley	US Fish and Wildlife Service	5,135	< 1%
Valley	Bureau of Reclamation	652	< 1%
Upper Basin	Private	5,949,760	91%

Upper Basin	State	351,255	6%
Upper Basin	Bureau of Land Management	146,295	2%
Upper Basin	US Fish and Wildlife Service	21,667	< 1%
Upper Basin	National Park Service	21,318	< 1%
Upper Basin	Bureau of Reclamation	19,722	< 1%
Upper Basin	County	12,010	< 1%
Upper Basin	Department of Defense	4,330	< 1%
Upper Basin	US Forest Service	18	< 1%
Lower Basin	Private	7,409,985	76%
Lower Basin	State	685,958	7%
Lower Basin	Tribal	625,972	6%
Lower Basin	Department of Defense	394,227	4%
Lower Basin	US Fish and Wildlife Service	249,761	3%
Lower Basin	Department of Energy	210,465	2%
Lower Basin	Bureau of Land Management	143,601	1%
Lower Basin	Bureau of Reclamation	16,086	< 1%
Lower Basin	County	7,363	< 1%
Lower Basin	US Forest Service	3,224	< 1%
Lower Basin	National Park Service	170	< 1%
Highlands	Tribal	1,132,211	41%
Highlands	US Forest Service	761,509	28%
Highlands	Private	697,249	25%
Highlands	State	133,712	5%
Highlands	National Park Service	51,382	1%
Highlands	Bureau of Land Management	17,297	< 1%
Highlands	US Fish and Wildlife Service	566	< 1%
Kaniksu	US Forest Service	650,527	67%
Kaniksu	Private	218,094	23%
Kaniksu	State	57,656	6%
Kaniksu	US Fish and Wildlife Service	36,771	3%
Kaniksu	Bureau of Land Management	3,719	< 1%
Foothills	Private	1,150,441	76%
Foothills	Tribal	150,988	10%
Foothills	State	116,890	8%
Foothills	National Park Service	30,168	3%
Foothills	US Forest Service	40,301	3%
Foothills	Bureau of Land Management	14,735	2%
Foothills	US Fish and Wildlife Service	4,405	< 1%
Foothills	County	2,379	< 1%

Table A.1.1. FDRA administrative ownership count and percent for the EWA FDOP.

A.2 Fire Danger Rating Area Delineations

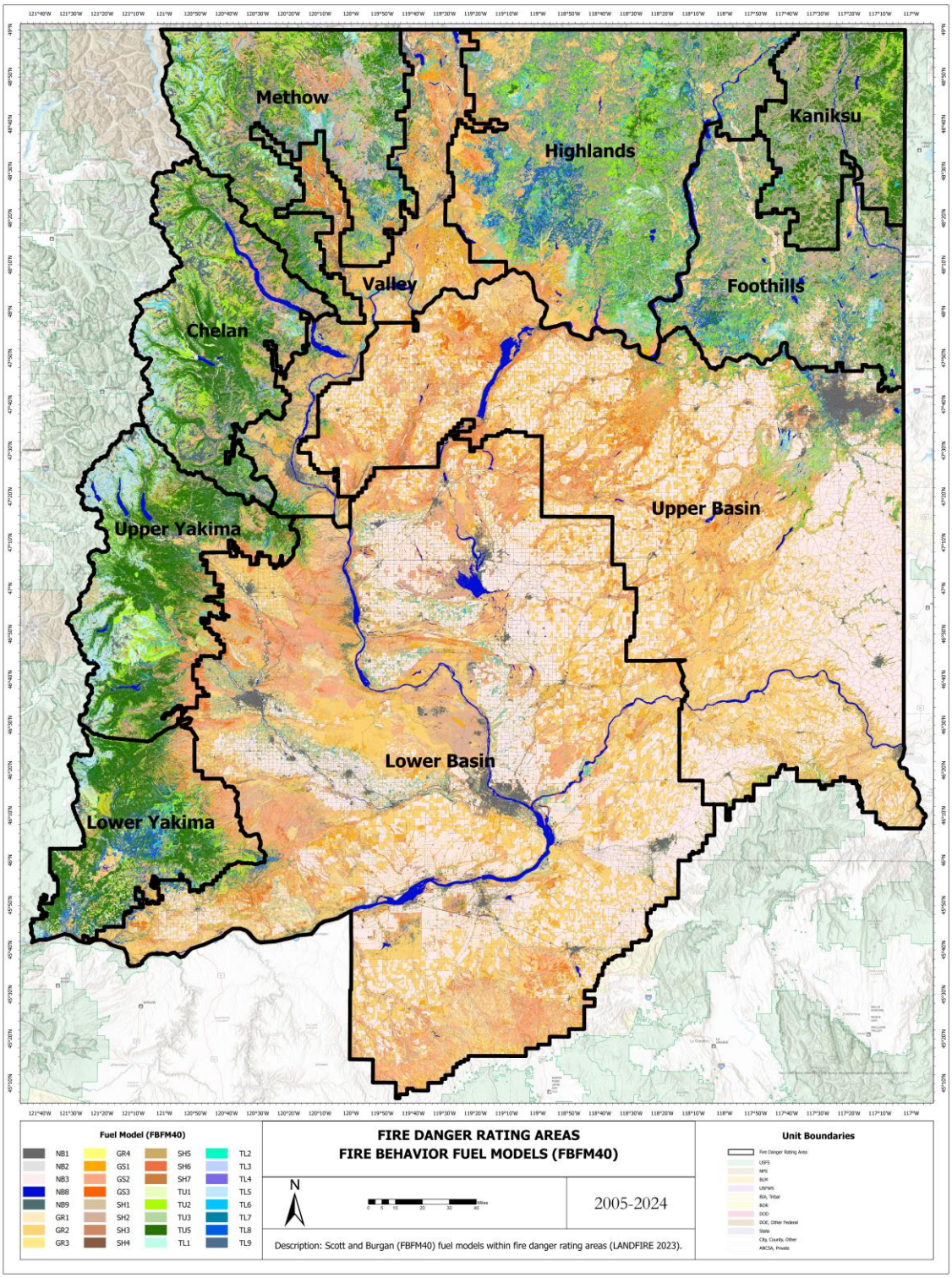


Figure A.2.1. FDRA Scott and Burgan fire behavior fuel models (FBFM40) for the EWA FDOP.

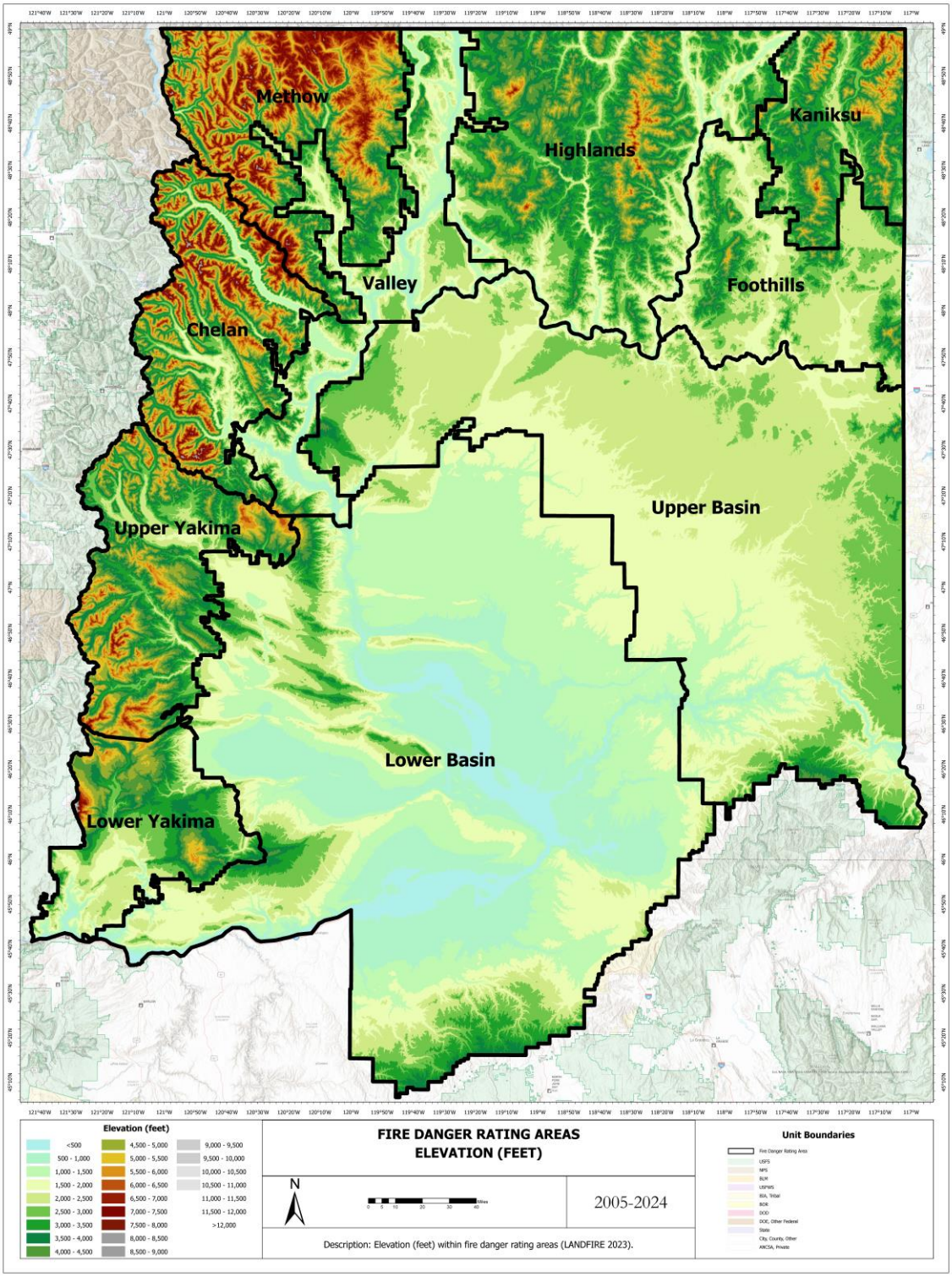


Figure A.2.2. FDRA elevations for the EWA FDOP.

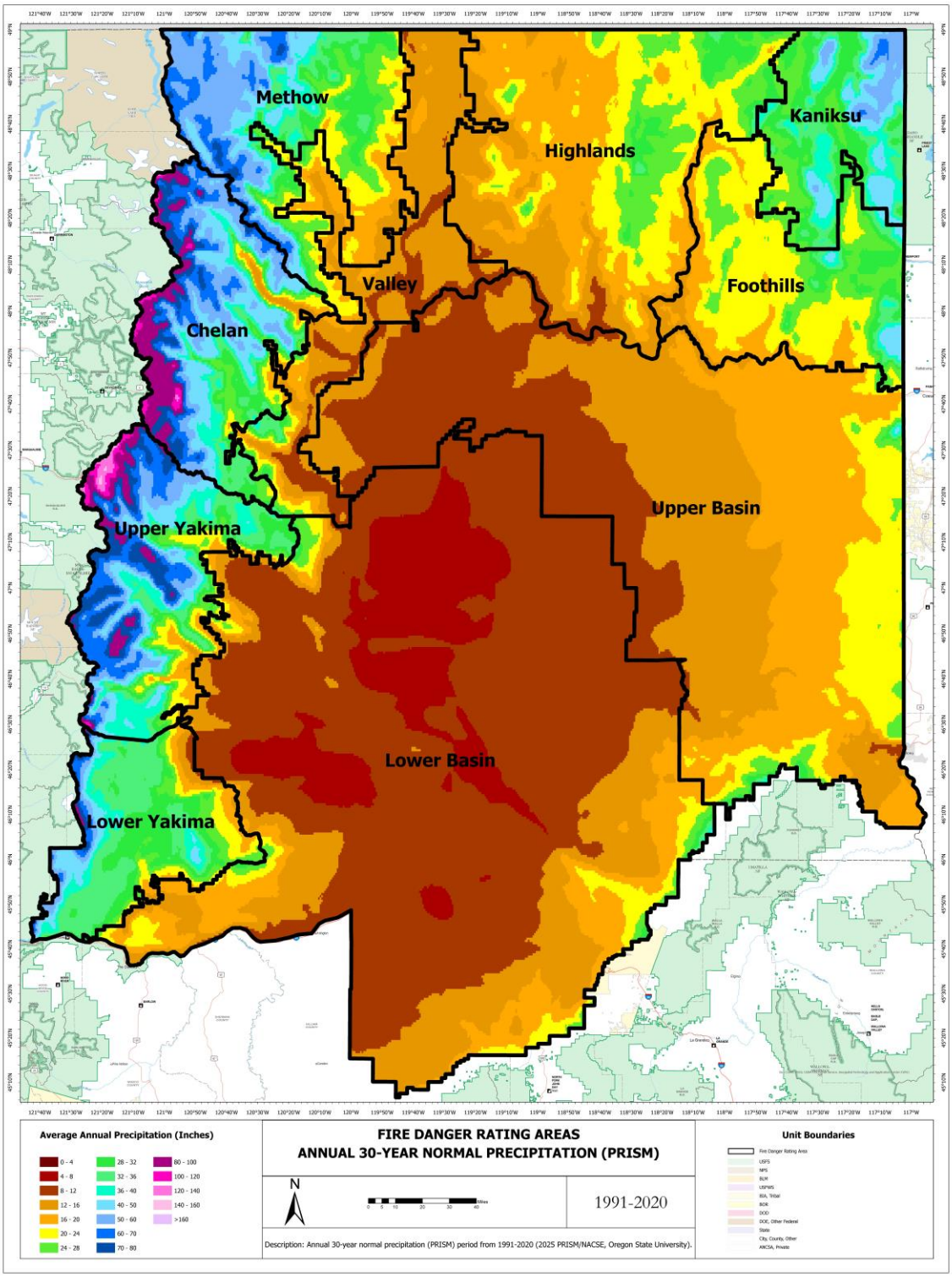


Figure A.2.3. FDRA annual 30-year normal precipitation for the EWA FDOP.

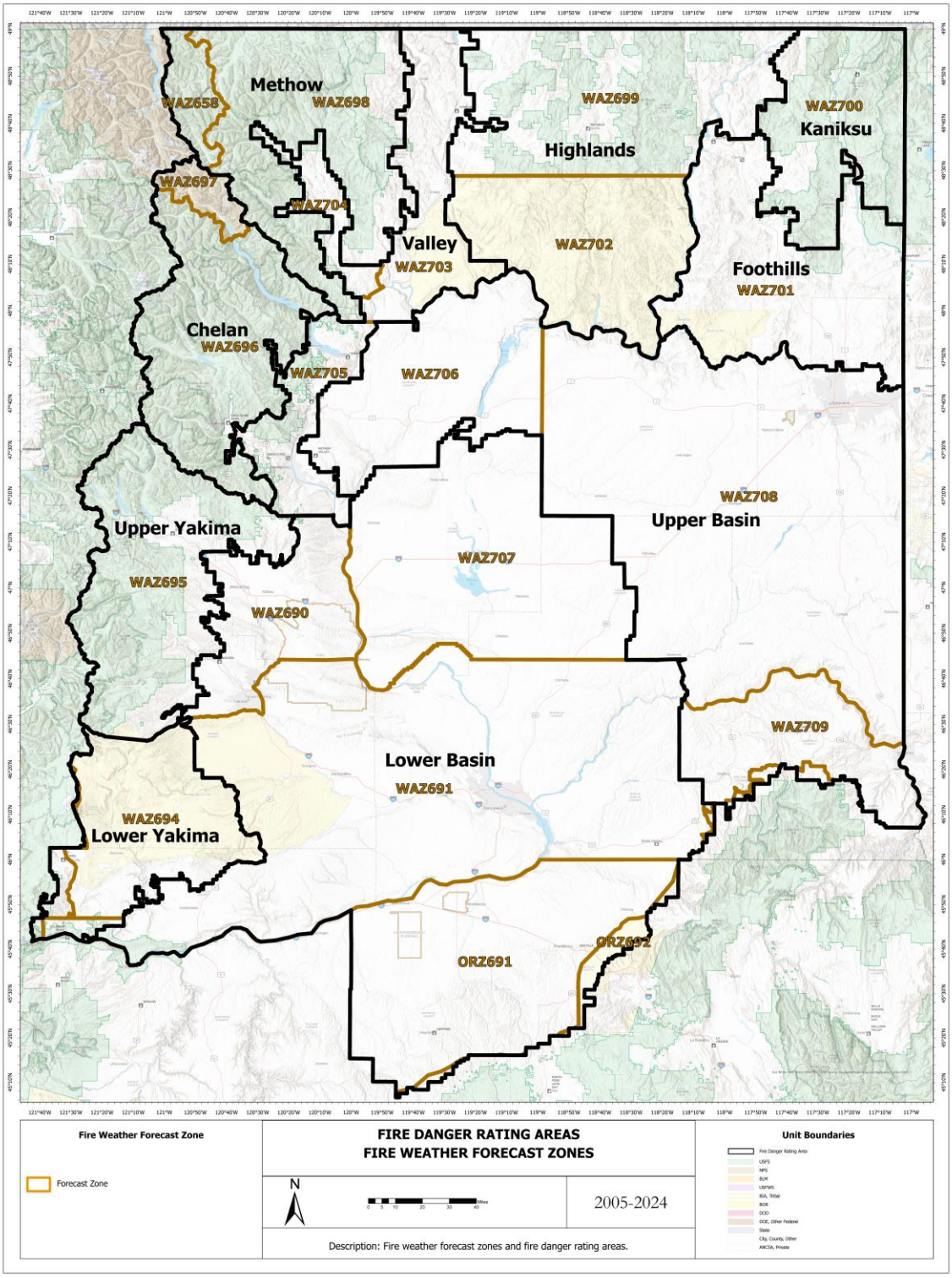


Figure A.2.4. FDRA fire weather forecast zones for the EWA FDOP.

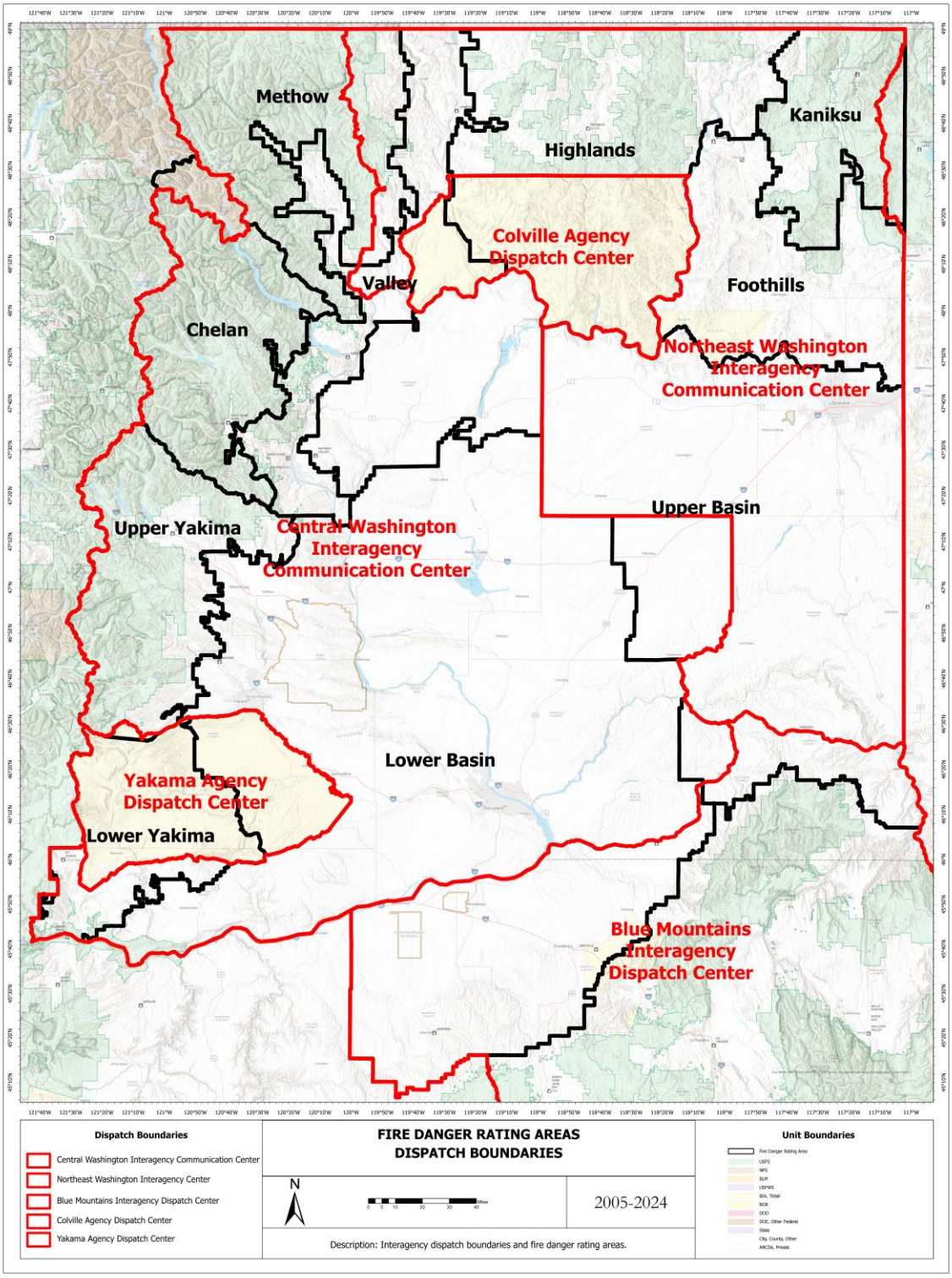


Figure A.2.5. FDRA dispatch boundaries for the EWA FDOP.

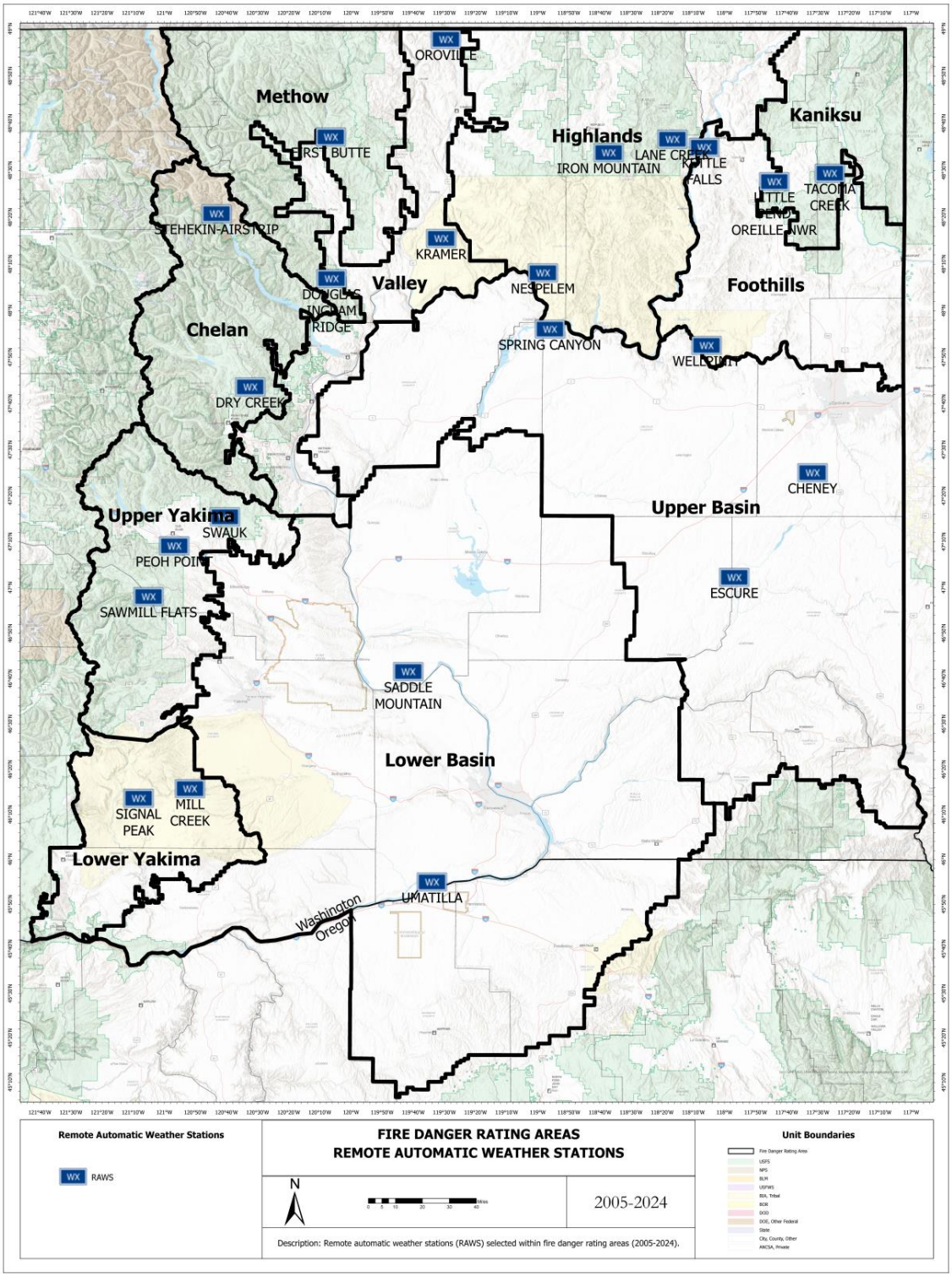


Figure A.2.6. FDRA Remote Automatic Weather Stations for the EWA FDOP.

A.3 Fire Danger Rating Area Fire Causes

FDRA	General Cause	Count	Percent
Methow	Natural	557	82%
Methow	Recreation and ceremony	71	10%
Methow	Debris and open burning	22	3%
Methow	Equipment and vehicle use	22	3%
Methow	Smoking	9	1%
Chelan	Natural	469	67%
Chelan	Recreation and ceremony	145	21%
Chelan	Debris and open burning	54	8%
Chelan	Equipment and vehicle use	23	3%
Chelan	Arson/incendiarism	13	2%
Upper Yakima	Recreation and ceremony	535	46%
Upper Yakima	Natural	435	37%
Upper Yakima	Debris and open burning	89	8%
Upper Yakima	Equipment and vehicle use	68	6%
Upper Yakima	Arson/incendiarism	37	3%
Lower Yakima	Natural	247	45%
Lower Yakima	Debris and open burning	144	26%
Lower Yakima	Recreation and ceremony	95	17%
Lower Yakima	Equipment and vehicle use	41	7%
Lower Yakima	Arson/incendiarism	25	5%
Valley	Natural	560	48%
Valley	Debris and open burning	301	26%
Valley	Recreation and ceremony	131	11%
Valley	Equipment and vehicle use	89	8%
Valley	Power generation/transmission/distribution	82	7%
Upper Basin	Debris and open burning	363	28%
Upper Basin	Natural	360	28%
Upper Basin	Recreation and ceremony	288	22%
Upper Basin	Equipment and vehicle use	152	12%
Upper Basin	Arson/incendiarism	140	11%
Lower Basin	Debris and open burning	646	33%
Lower Basin	Fireworks	419	21%
Lower Basin	Equipment and vehicle use	370	19%
Lower Basin	Arson/incendiarism	269	14%
Lower Basin	Natural	262	13%
Highlands	Natural	1,537	57%
Highlands	Debris and open burning	616	23%
Highlands	Recreation and ceremony	190	7%
Highlands	Power generation/transmission/distribution	185	7%

Highlands	Equipment and vehicle use	180	7%
Kaniksu	Natural	485	69%
Kaniksu	Recreation and ceremony	69	10%
Kaniksu	Debris and open burning	58	8%
Kaniksu	Equipment and vehicle use	45	6%
Kaniksu	Power generation/transmission/distribution	44	6%
Foothills	Debris and open burning	1,033	44%
Foothills	Natural	604	26%
Foothills	Recreation and ceremony	239	10%
Foothills	Arson/incendiarism	233	10%
Foothills	Equipment and vehicle use	232	10%

Table A.3.1. FDRA general fire cause count and percent for the EWA FDOP (2005-2024).

A.4 Fire Danger Rating Area Fire Size Percentiles and Seasonal Trends

FDRA	25th	50th	75th	85th	90th	95th	97th	99th
Methow	0.1	0.1	0.5	1.8	5.1	72.8	726.6	8,759.6
Chelan	0.1	0.1	0.5	2.0	13.5	186.2	1,123.2	9,919.7
Upper Yakima	0.1	0.1	0.3	1.0	2.0	9.7	43.2	748.9
Lower Yakima	0.1	0.1	0.6	2.0	4.7	20.0	42.3	298.0
Valley	0.1	0.2	3.0	11.0	39.4	182.3	729.5	5,534.4
Upper Basin	0.1	0.2	1.5	5.5	14.0	100.9	393.7	3,000.0
Lower Basin	0.1	1.0	10.0	55.8	163.1	787.7	2,000.0	8,472.2
Highlands	0.1	0.2	1.0	3.2	7.7	35.0	105.6	1,299.2
Kaniksu	0.1	0.1	0.4	1.0	2.0	7.1	32.6	443.4
Foothills	0.1	0.2	0.9	1.8	3.2	9.9	22.0	100.0

Table A.4.1. FDRA fire size percentiles for the EWA FDOP (2005-2024).

A.5 Eastern Washington | Fire Danger Rating Areas

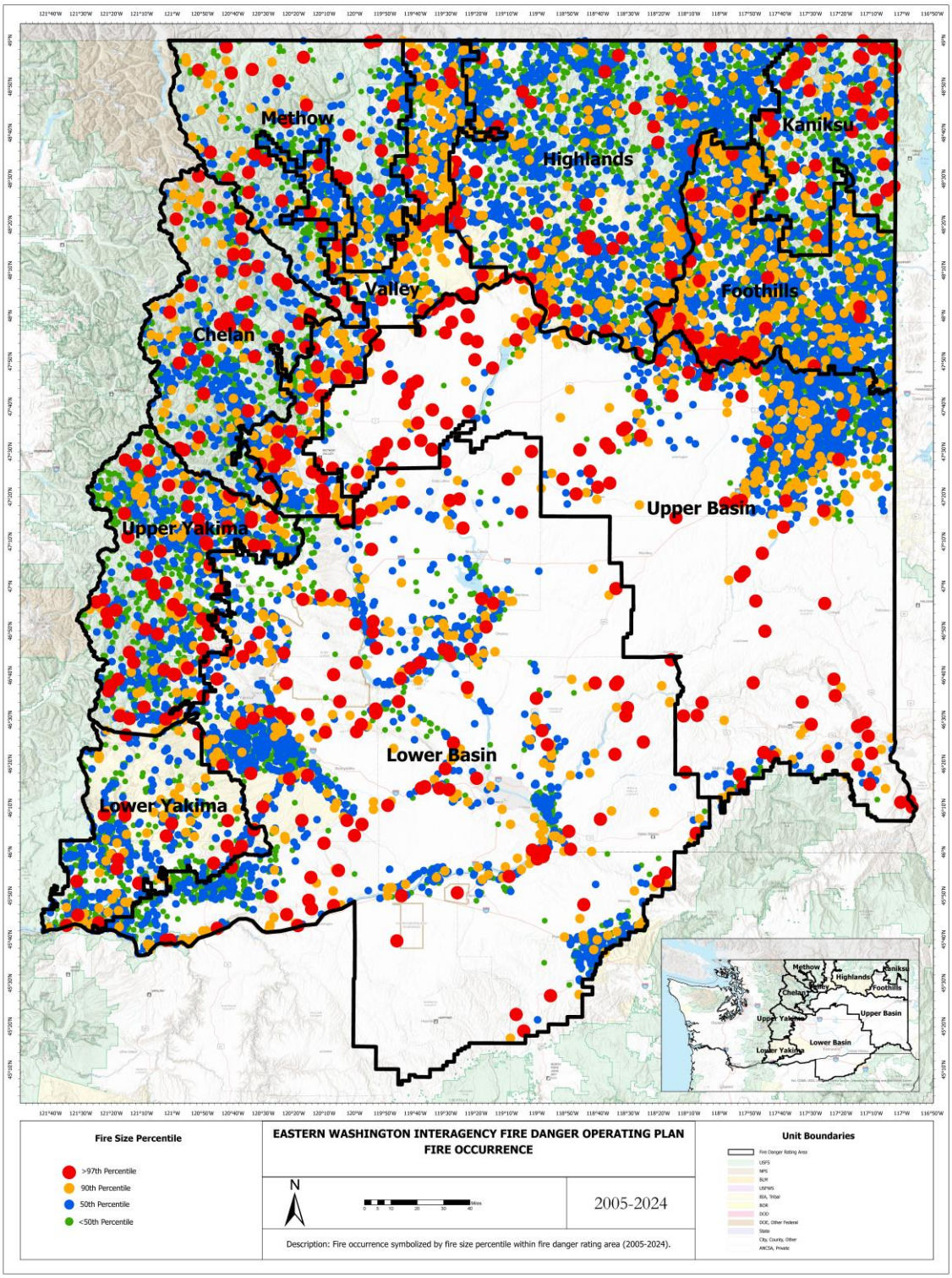


Figure A.5.1. Eastern Washington spatial fire occurrences for the EWA FDOP (2005-2024).

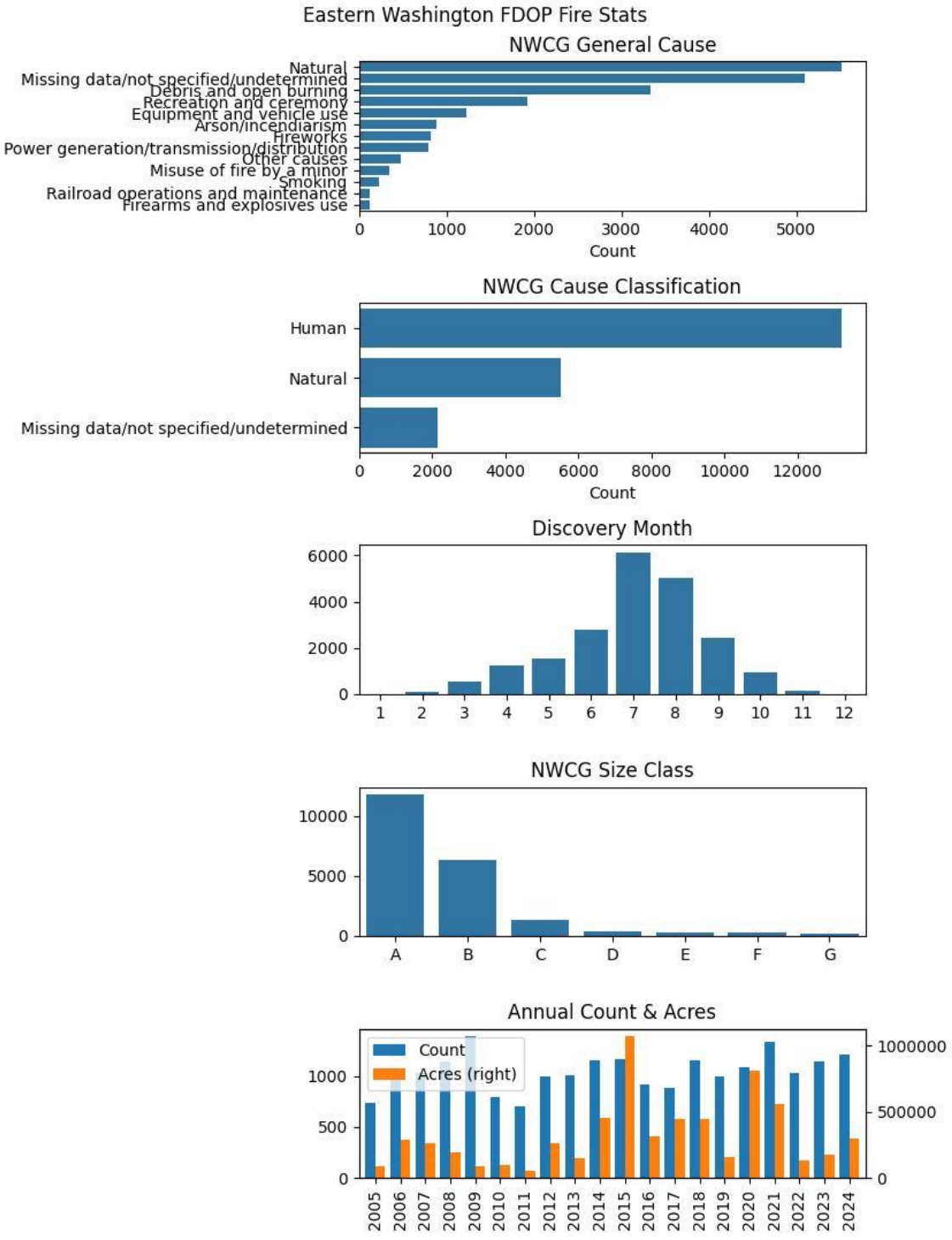


Figure A.5.2. Eastern Washington fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

A.6 Methow | Fire Danger Rating Area

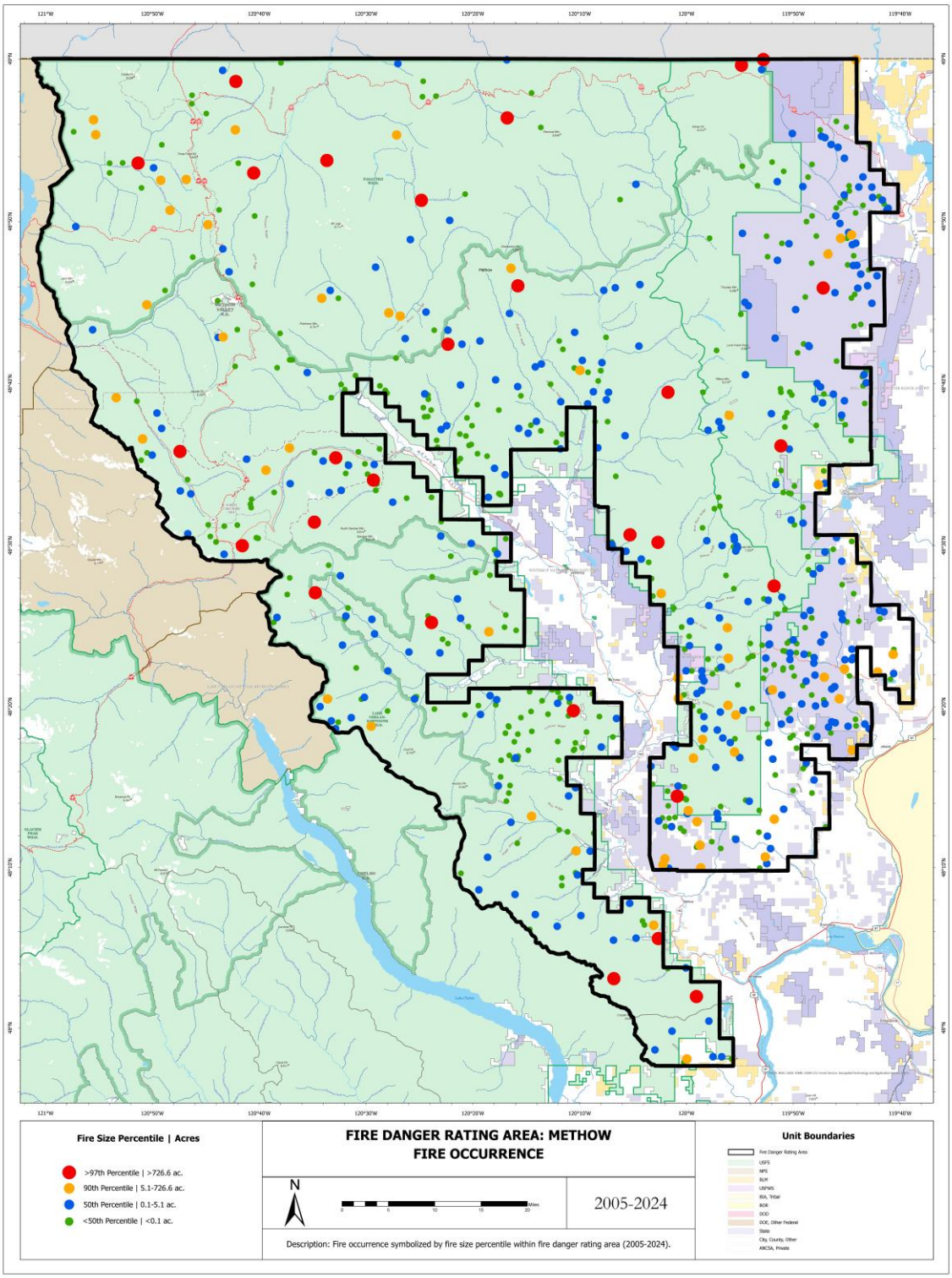


Figure A.6.1. Methow FDRA spatial fire occurrences for the EWA FDOP (2005-2024).

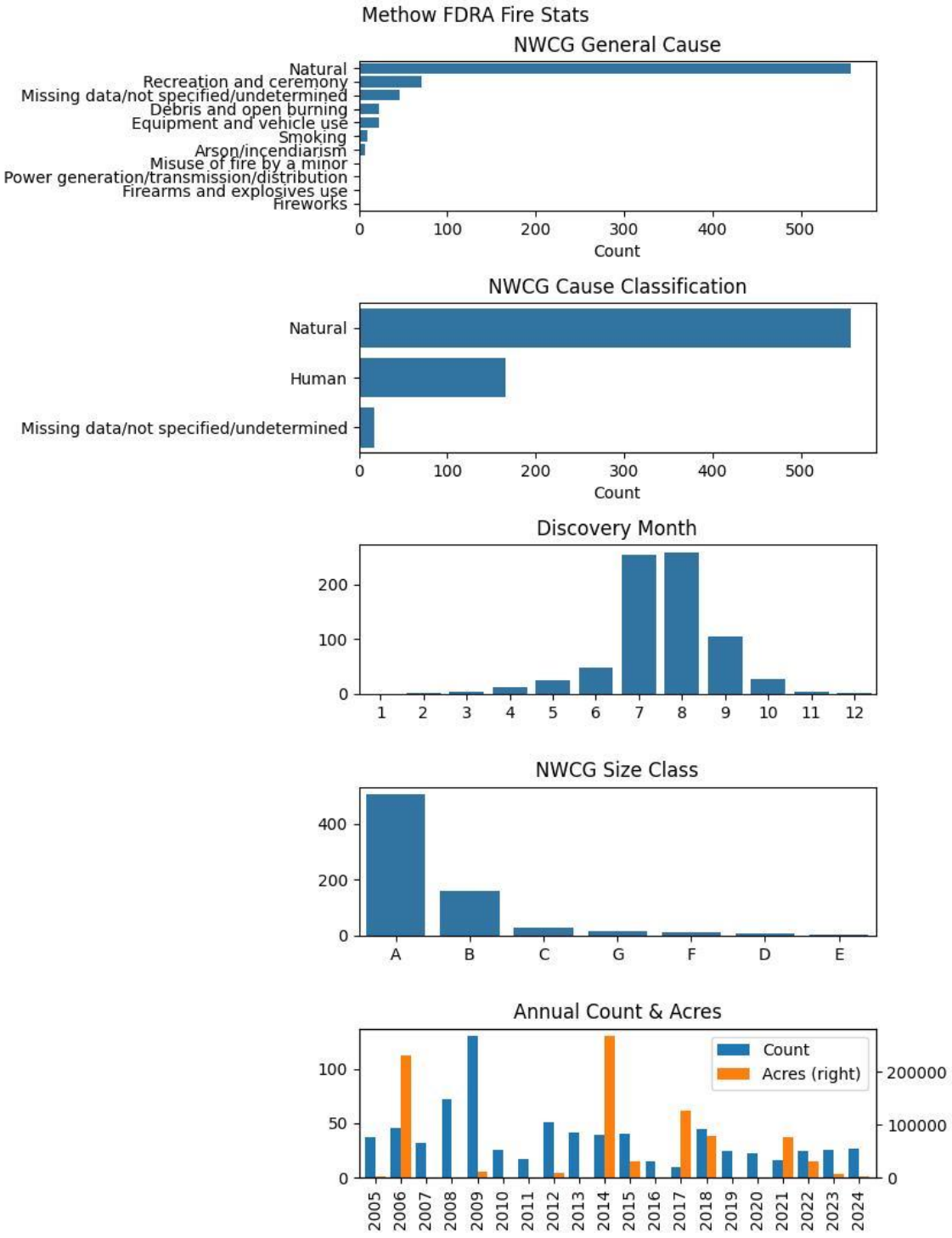


Figure A.6.2. Methow FDRA fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

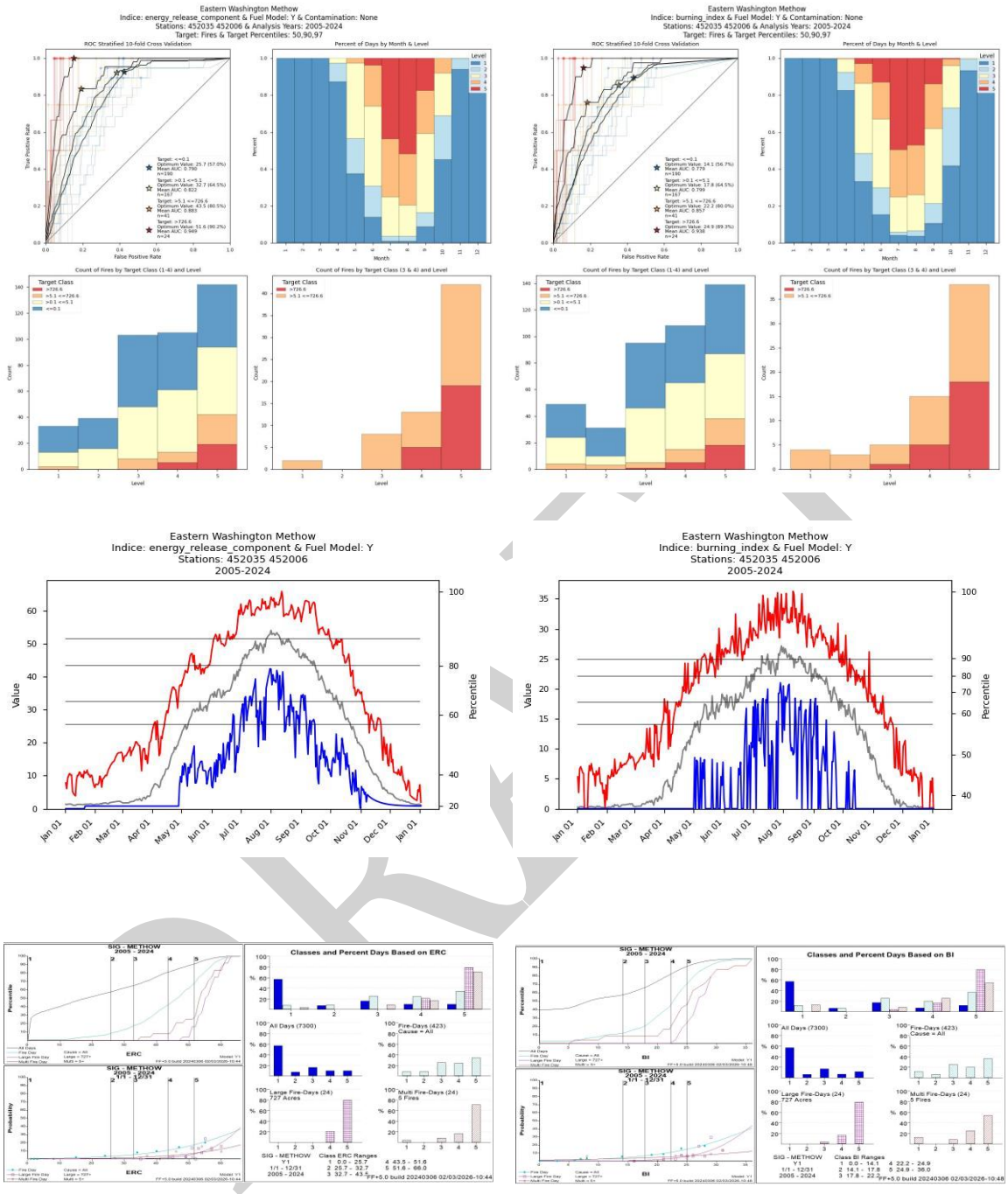


Figure A.6.3. Methow FDRA fire decision point analysis results including from top to bottom (left ERC, right, BI) ROC decision points and target class level outputs, decision point climatology graphs, and corresponding Fire Family Plus fire distributions for the EWA FDOP (2005-2024).

A.7 Chelan | Fire Danger Rating Area

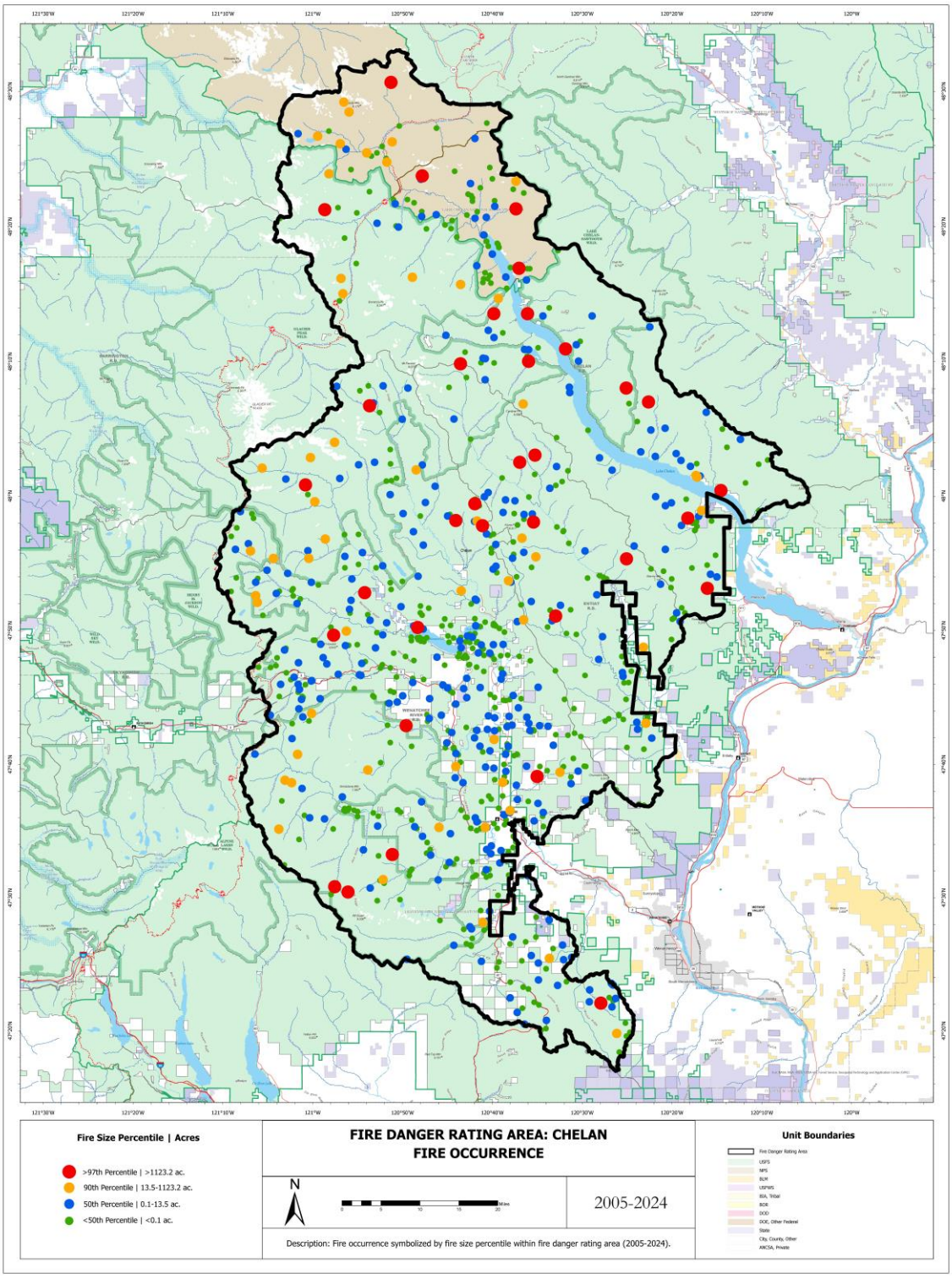


Figure A.7.1. Chelan FDRA spatial fire occurrences for the EWA FDOP (2005-2024).

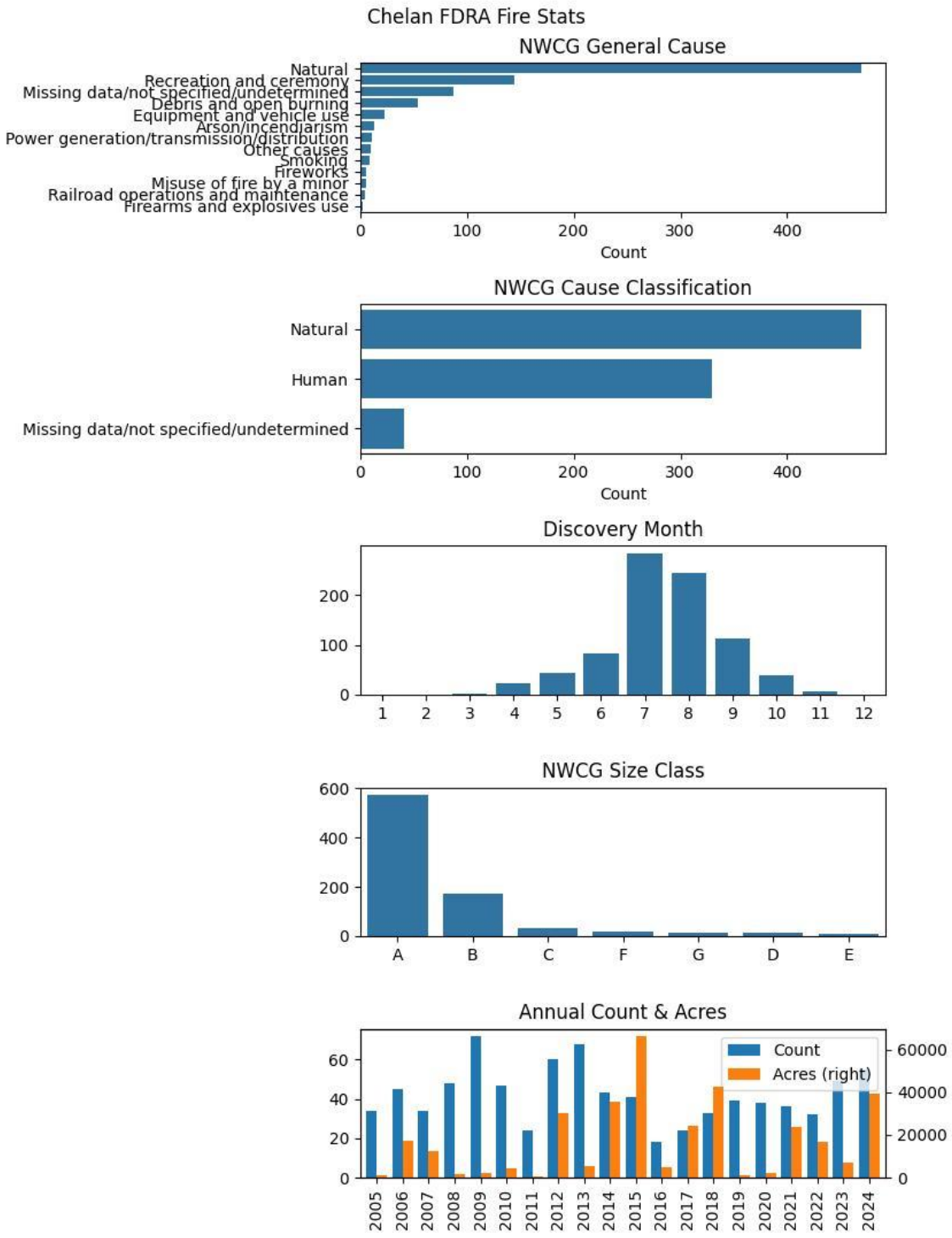


Figure A.7.2. Chelan FDRA fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

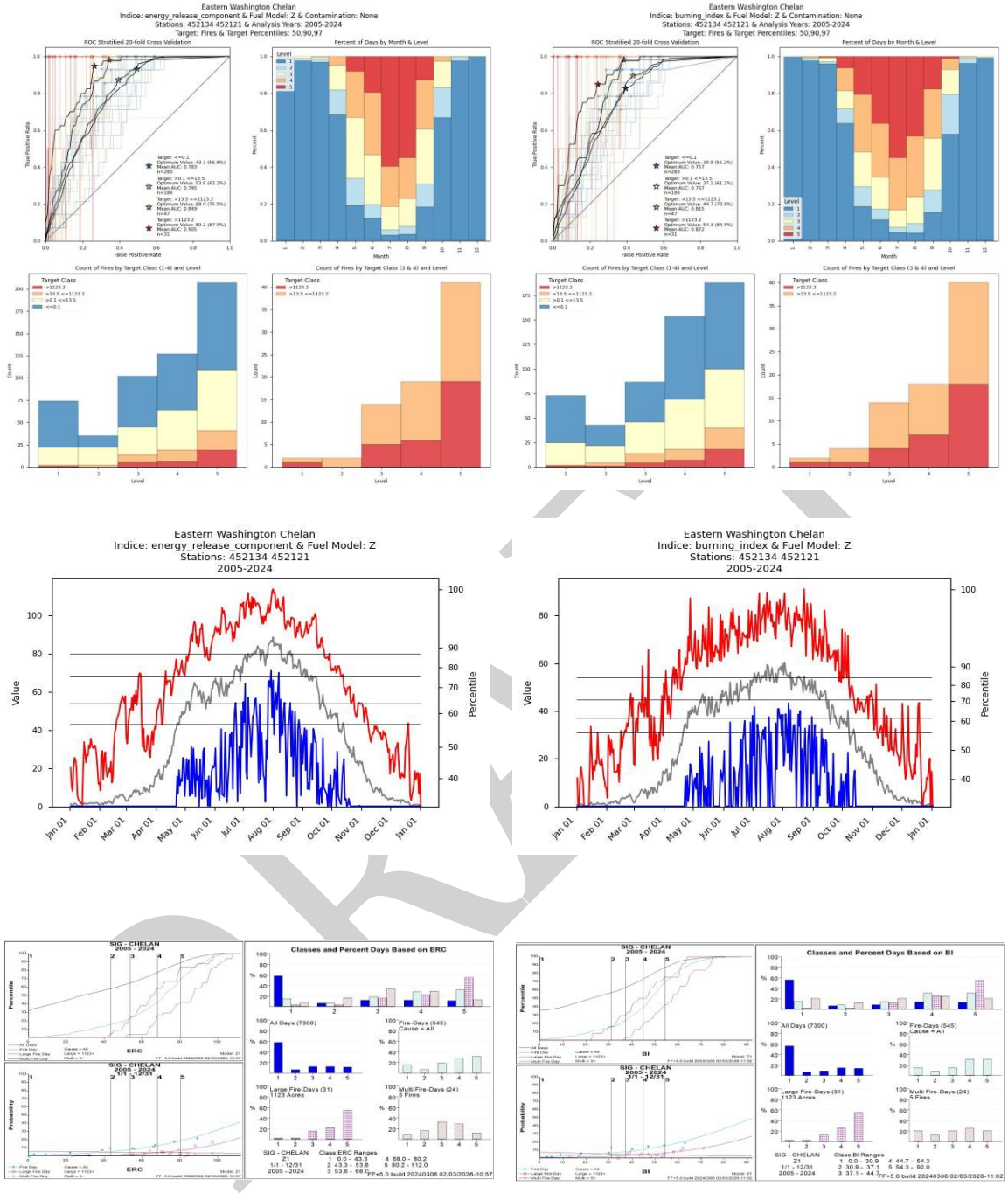


Figure A.7.3. Chelan FDRA fire decision point analysis results including from top to bottom (left ERC, right, BI) ROC decision points and target class level outputs, decision point climatology graphs, and corresponding Fire Family Plus fire distributions for the EWA FDOP (2005-2024).

A.8 Upper Yakima | Fire Danger Rating Area

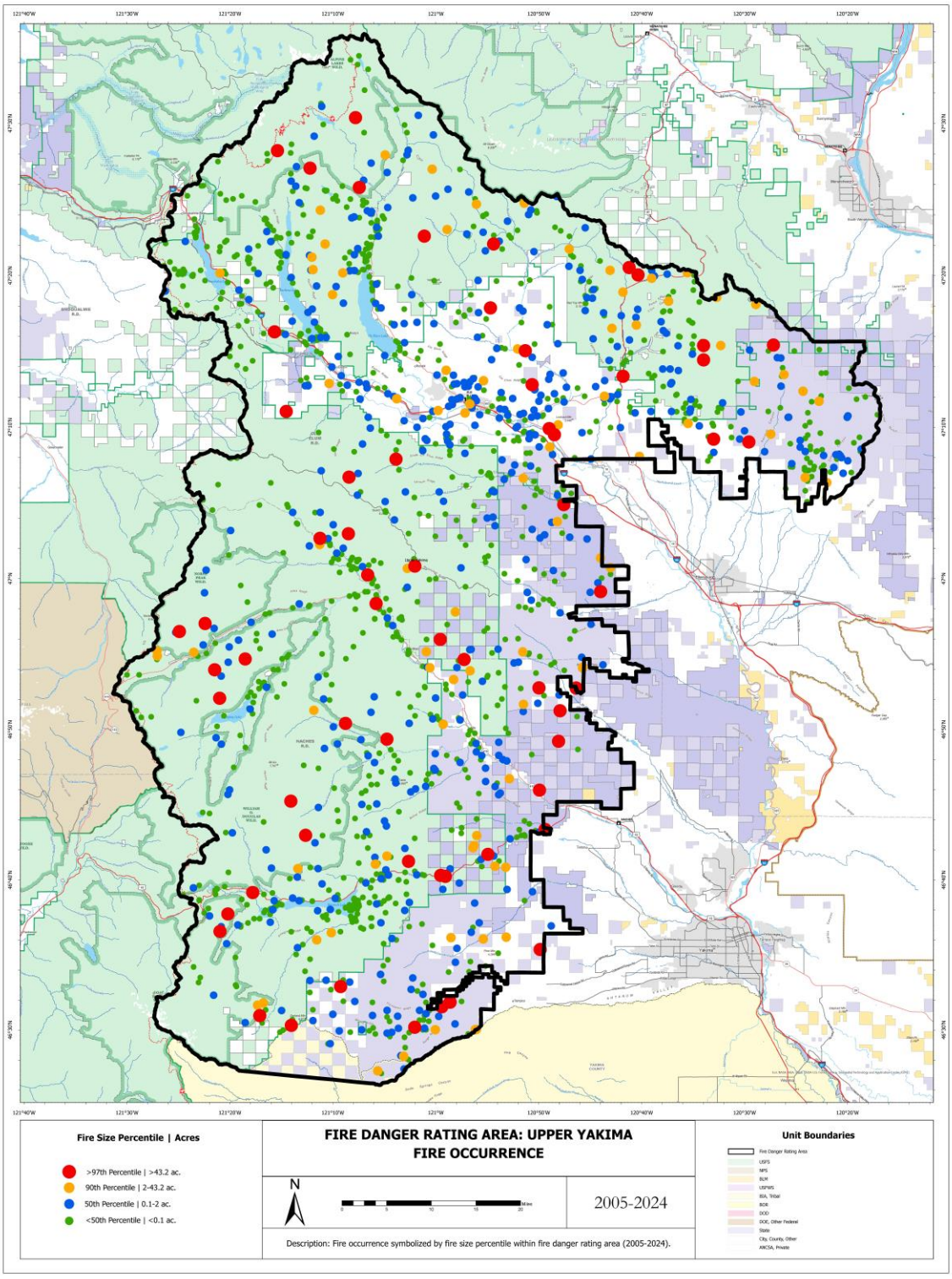


Figure A.8.1. Upper Yakima FDRA spatial fire occurrences for the EWA FDOP (2005-2024).

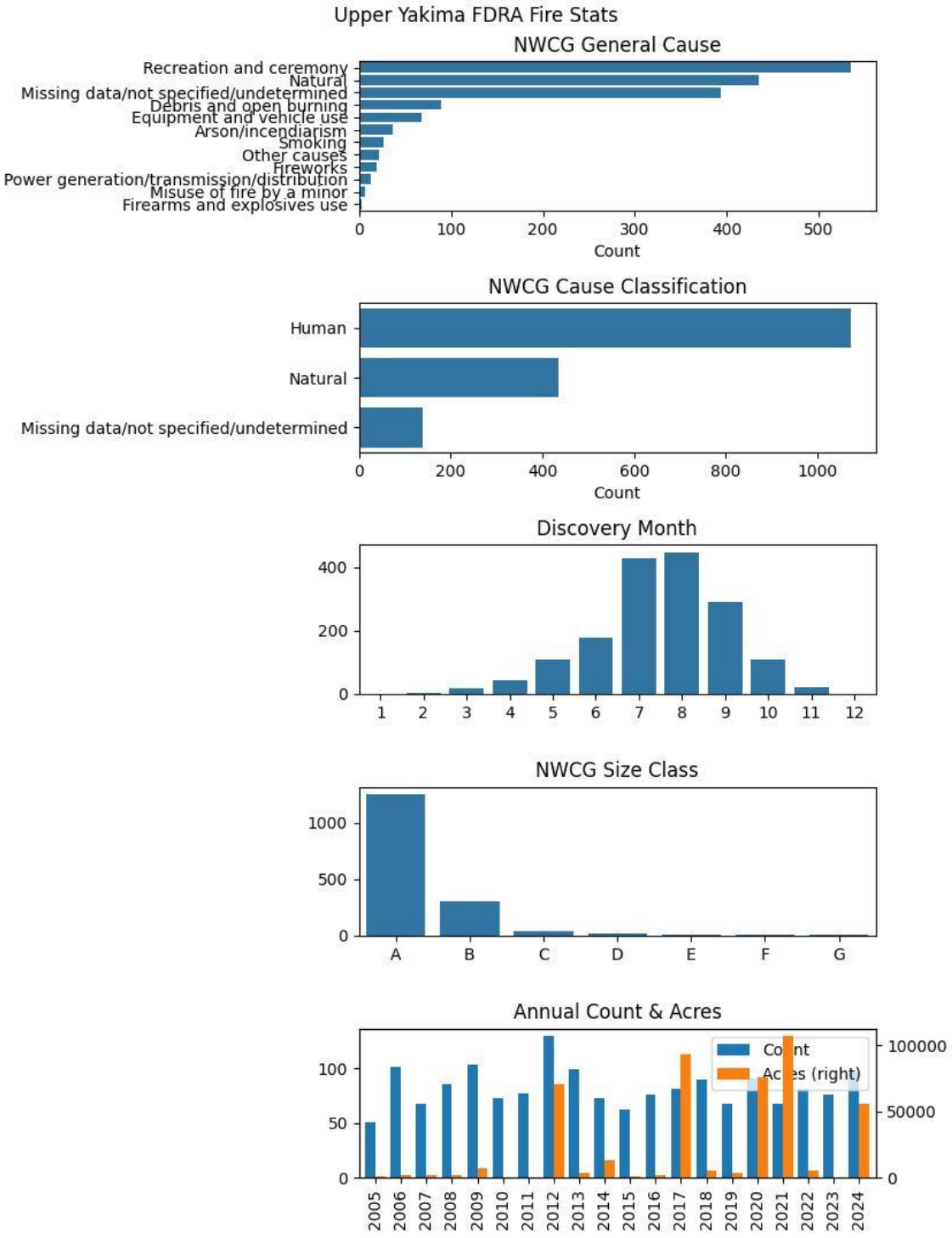


Figure A.8.2. Upper Yakima FDRA fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

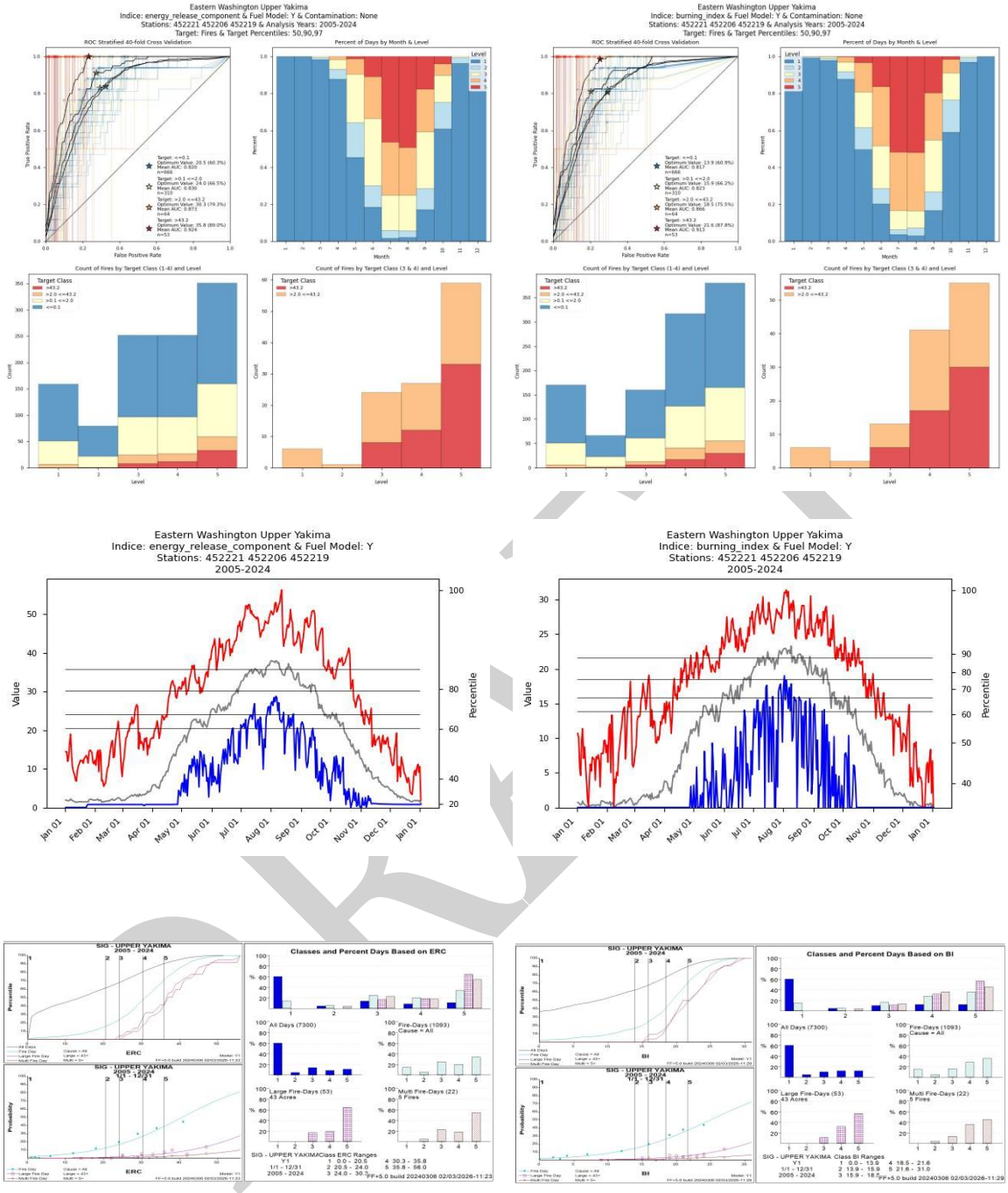


Figure A.8.3. Upper Yakima FDRA fire decision point analysis results including from top to bottom (left ERC, right, BI) ROC decision points and target class level outputs, decision point climatology graphs, and corresponding Fire Family Plus fire distributions for the EWA FDOP (2005-2024).

A.9 Lower Yakima | Fire Danger Rating Area

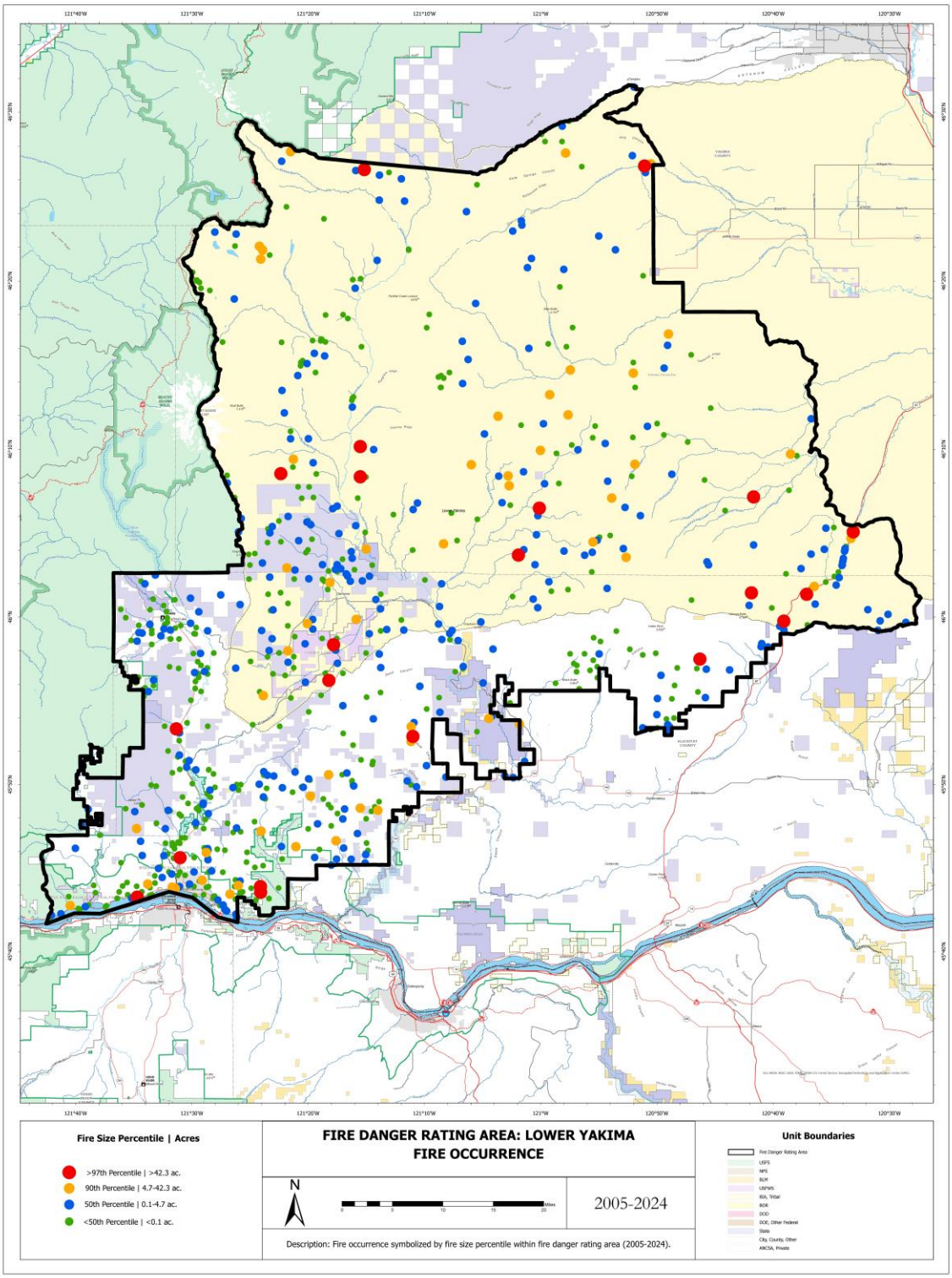


Figure A.9.1. Lower Yakima FDRA spatial fire occurrences for the EWA FDOP (2005-2024).

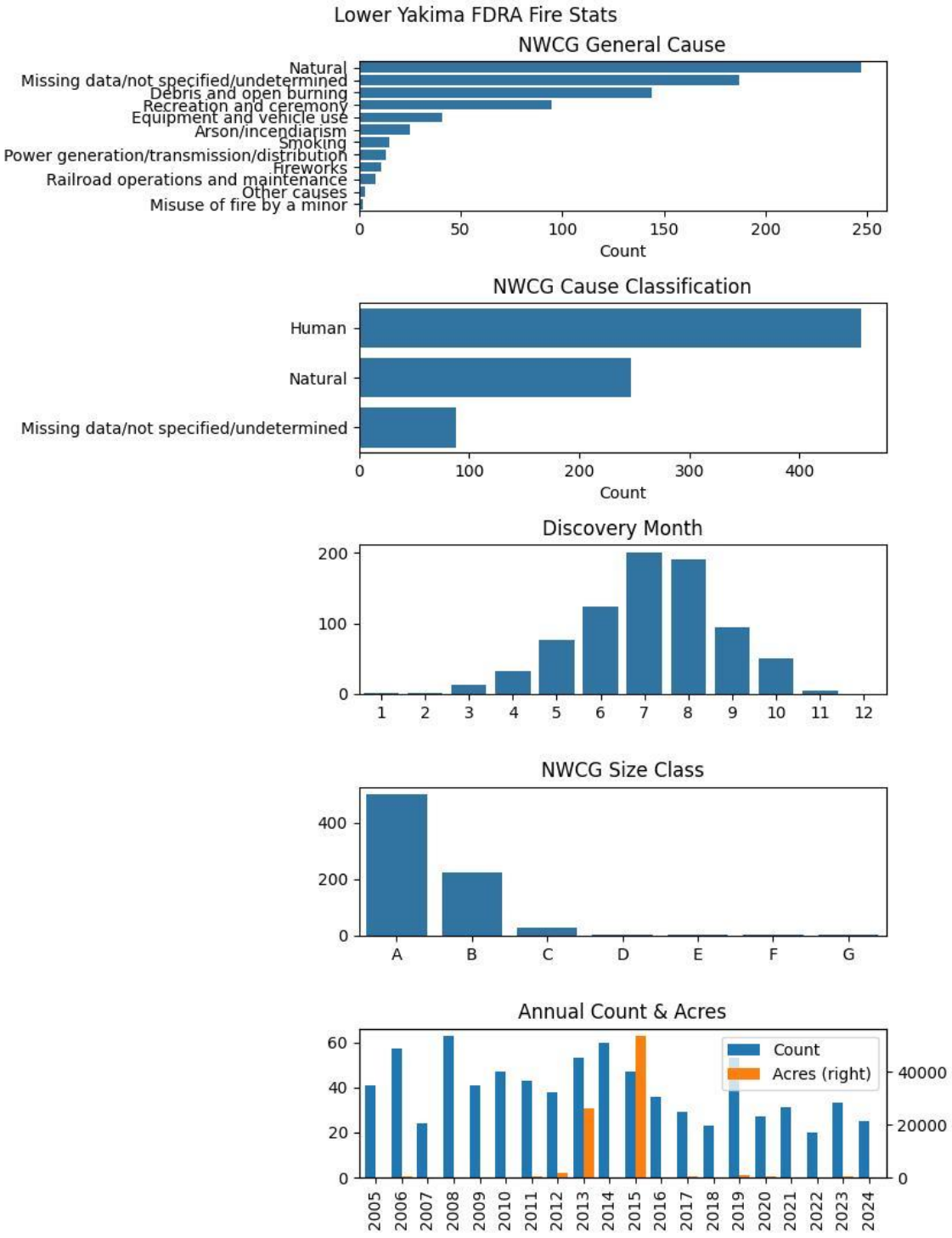


Figure A.9.2. Lower Yakima FDRA fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

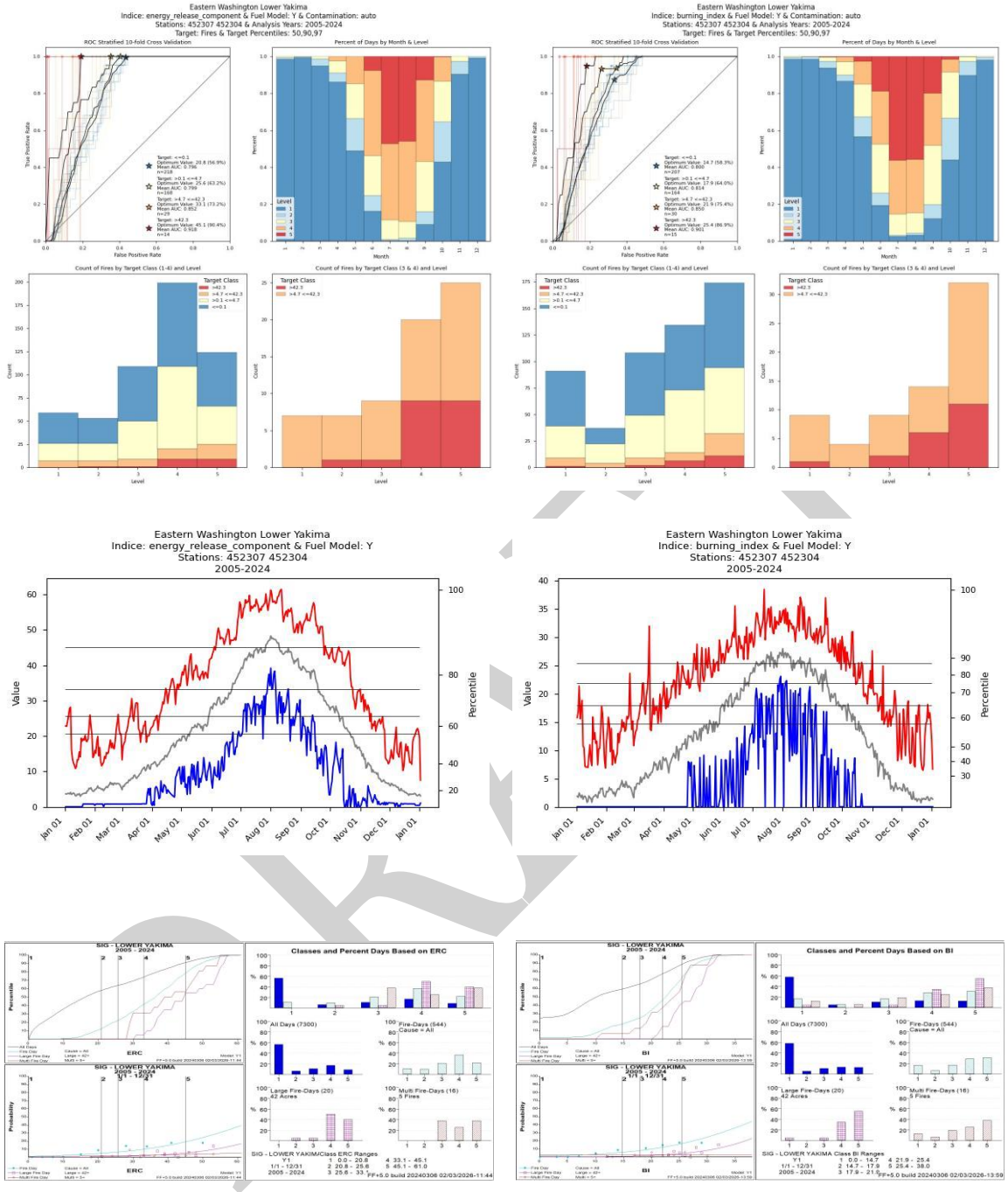


Figure A.9.3. Lower Yakima FDRA fire decision point analysis results including from top to bottom (left ERC, right, BI) ROC decision points and target class level outputs, decision point climatology graphs, and corresponding Fire Family Plus fire distributions for the EWA FDOP (2005-2024).

A.10 Valley | Fire Danger Rating Area

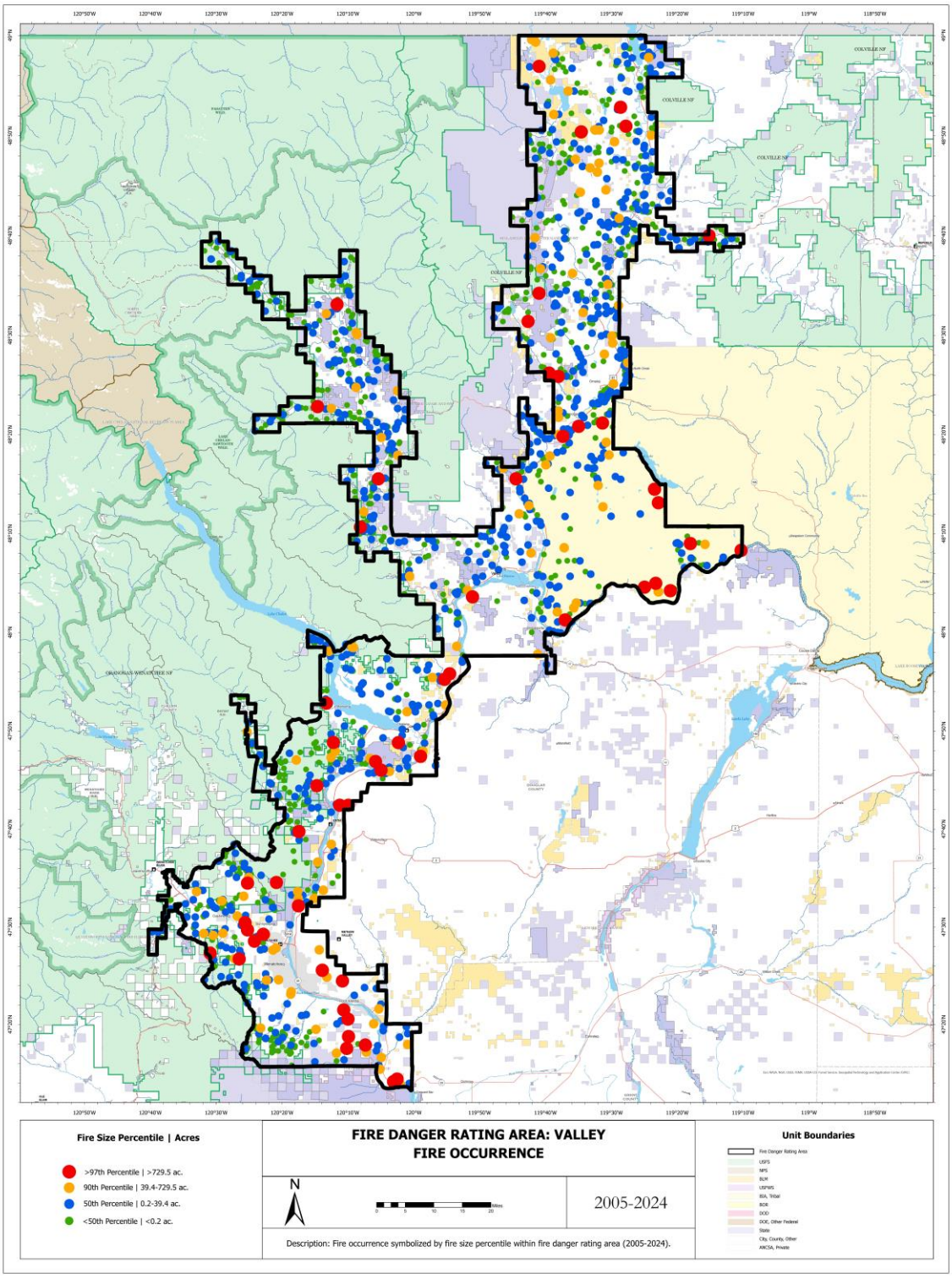


Figure A.10.1. Valley FDRA spatial fire occurrences for the EWA FDOP (2005-2024).

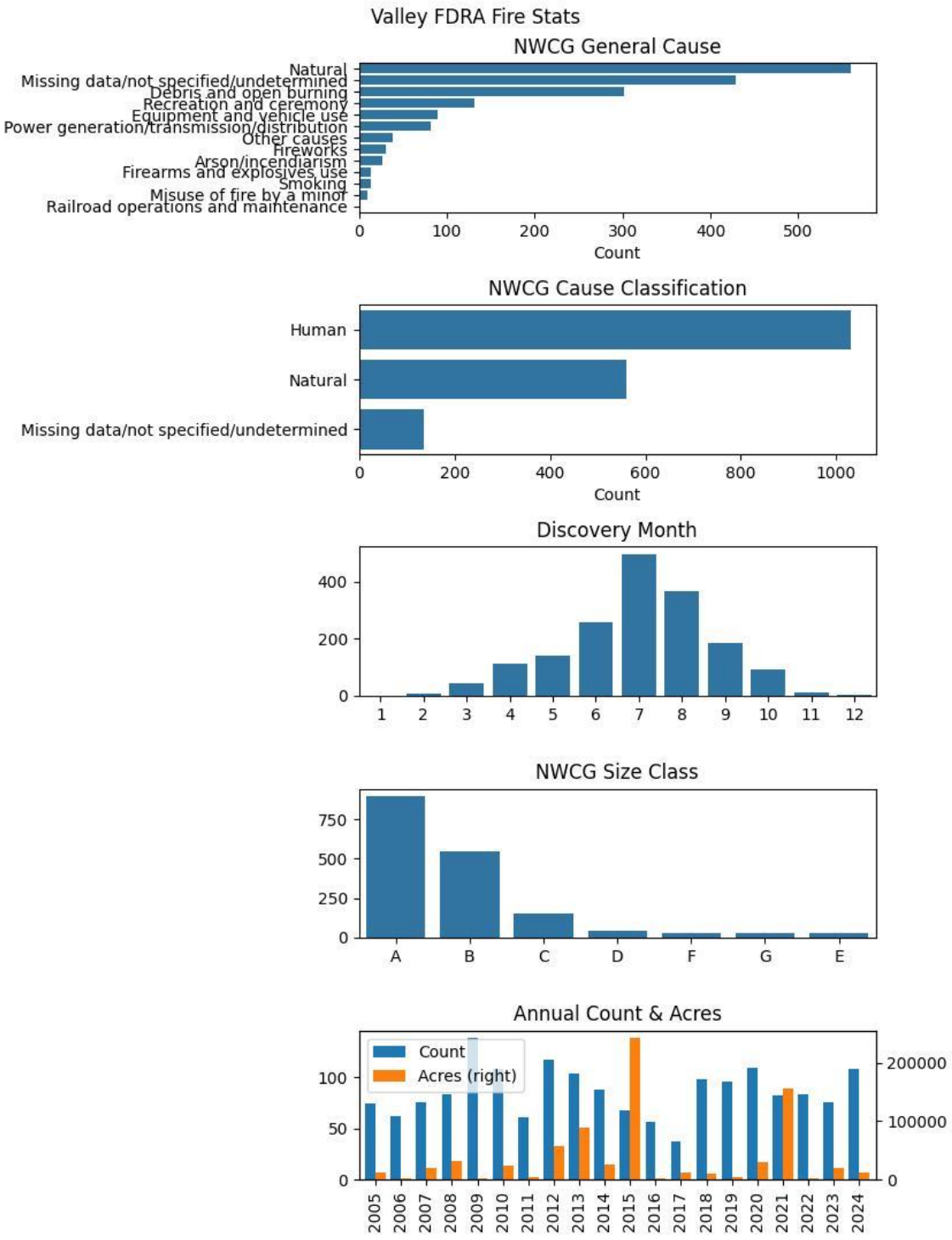


Figure A.10.2. Valley FDRA fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

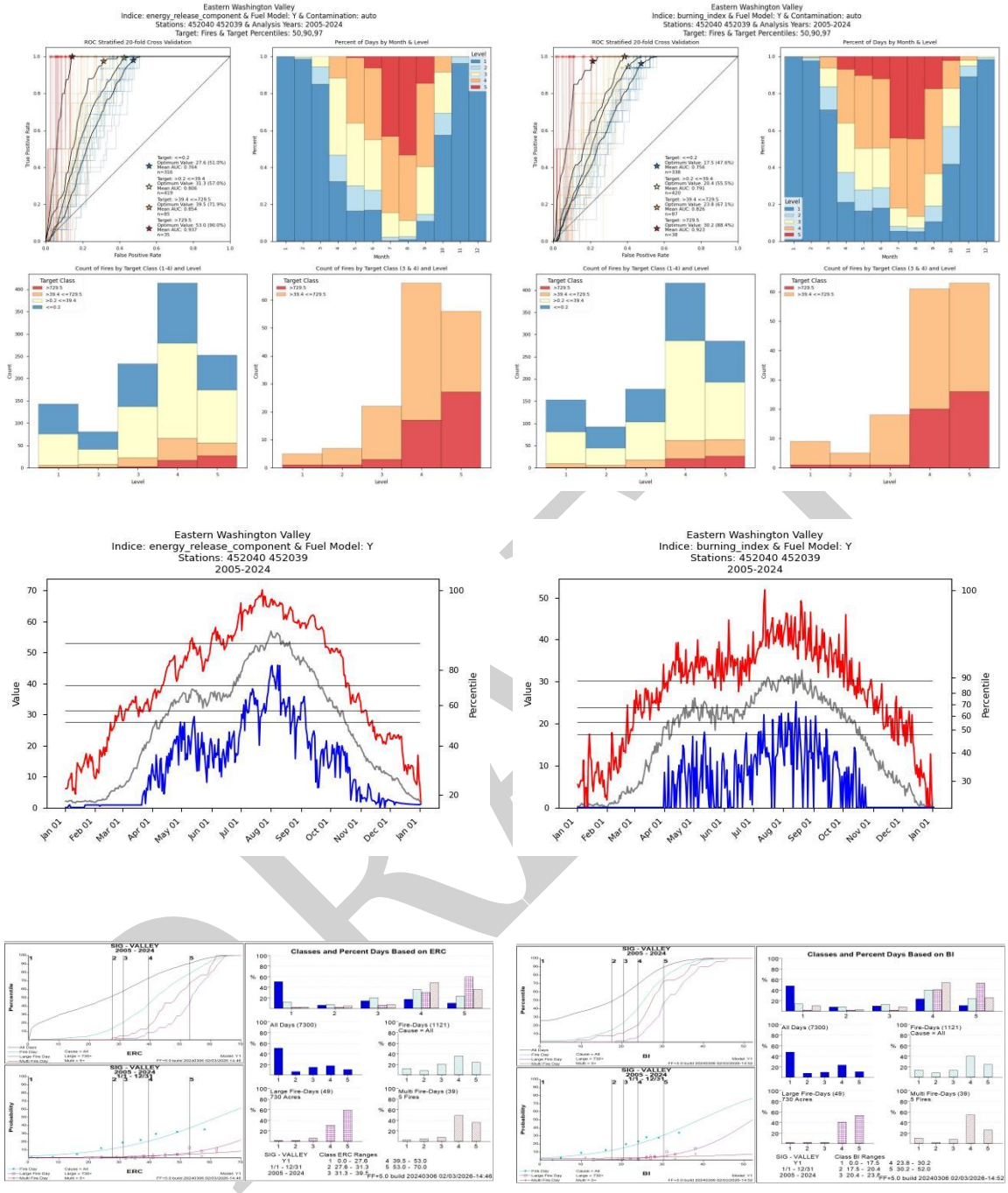


Figure A.10.3. Valley FDRA fire decision point analysis results including from top to bottom (left ERC, right, BI) ROC decision points and target class level outputs, decision point climatology graphs, and corresponding Fire Family Plus fire distributions for the EWA FDOP (2005-2024).

A.11 Upper Basin | Fire Danger Rating Area

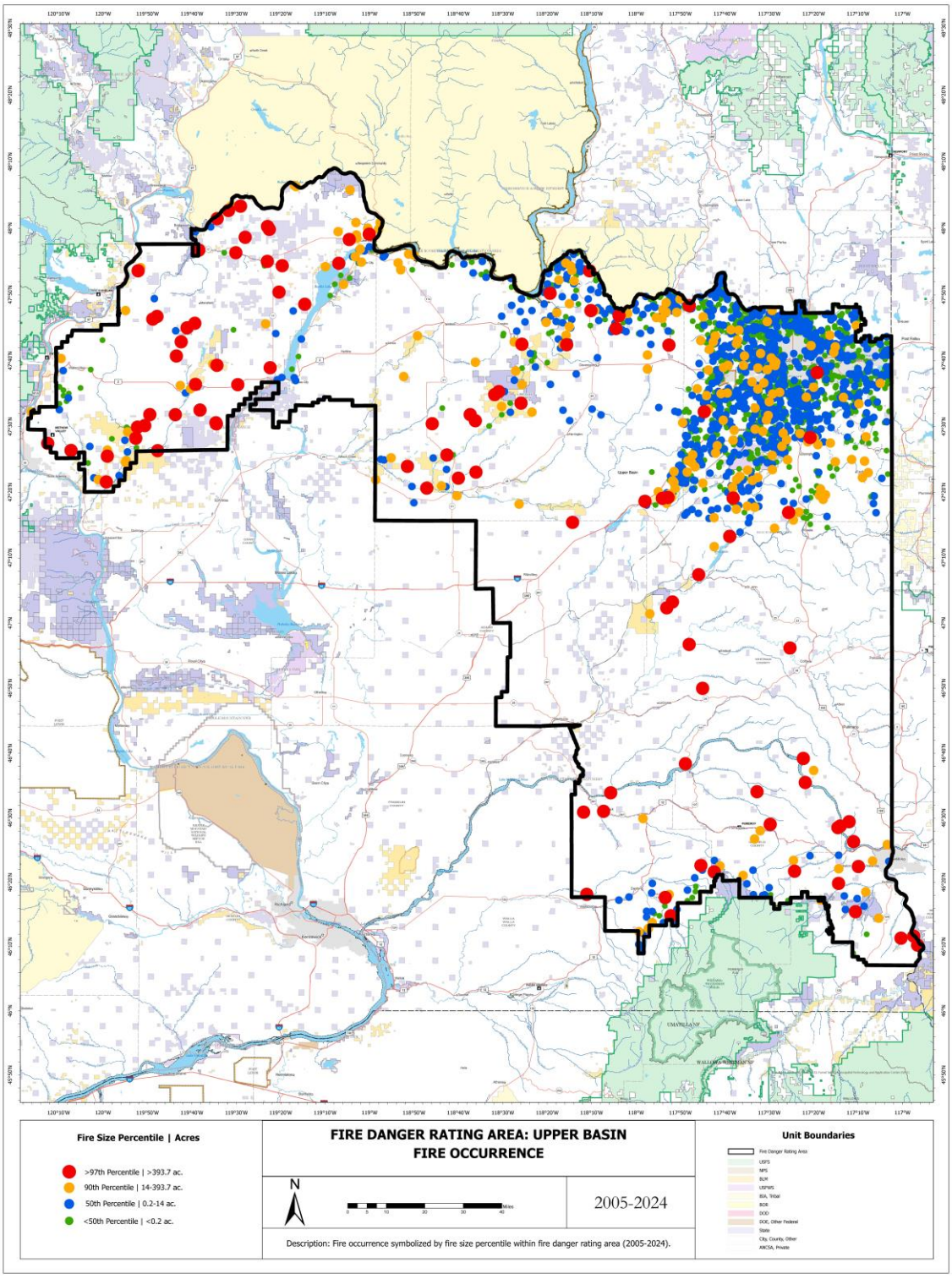


Figure A.11.1. Upper Basin FDRA spatial fire occurrences for the EWA FDOP (2005-2024).

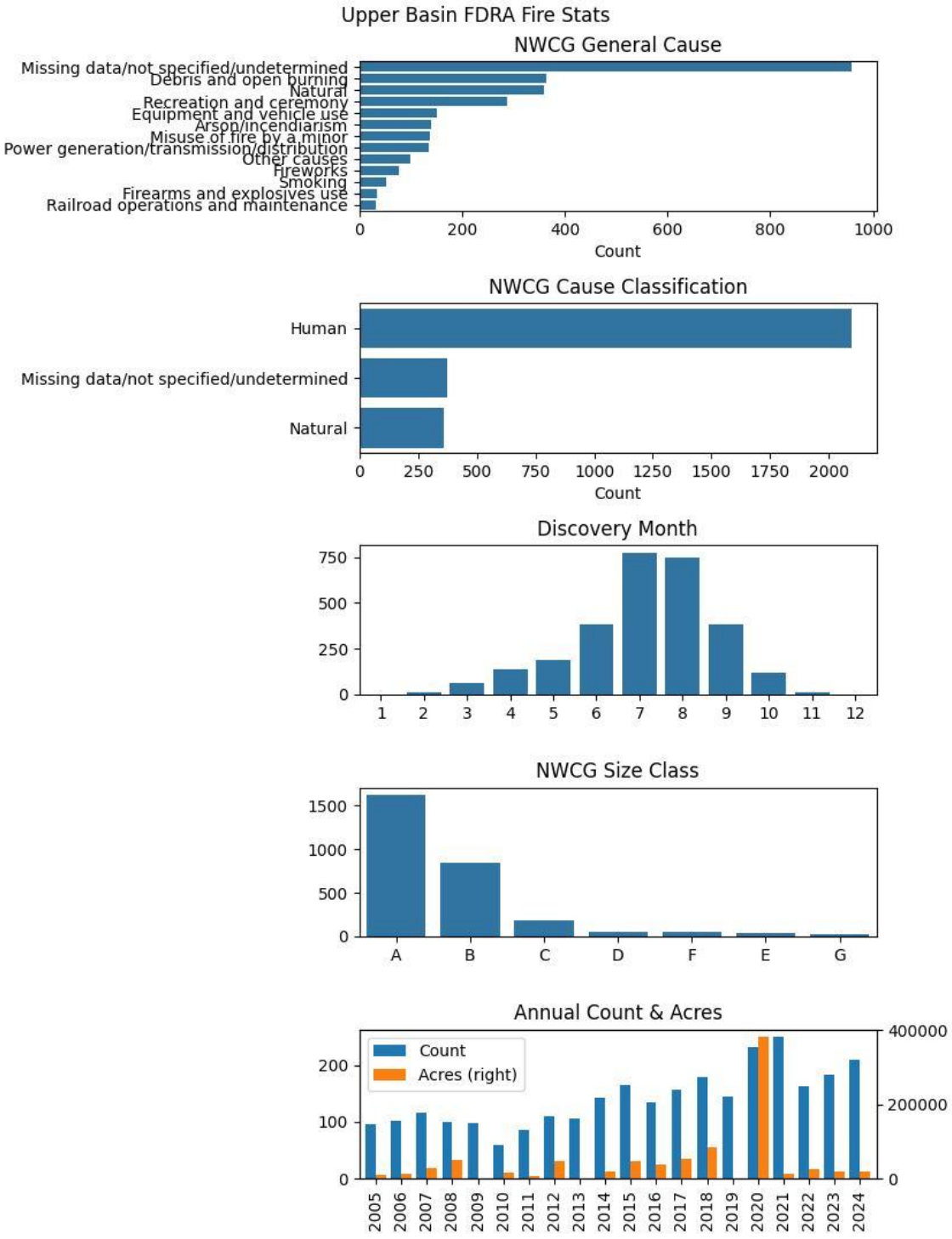


Figure A.11.2. Upper Basin FDRA fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

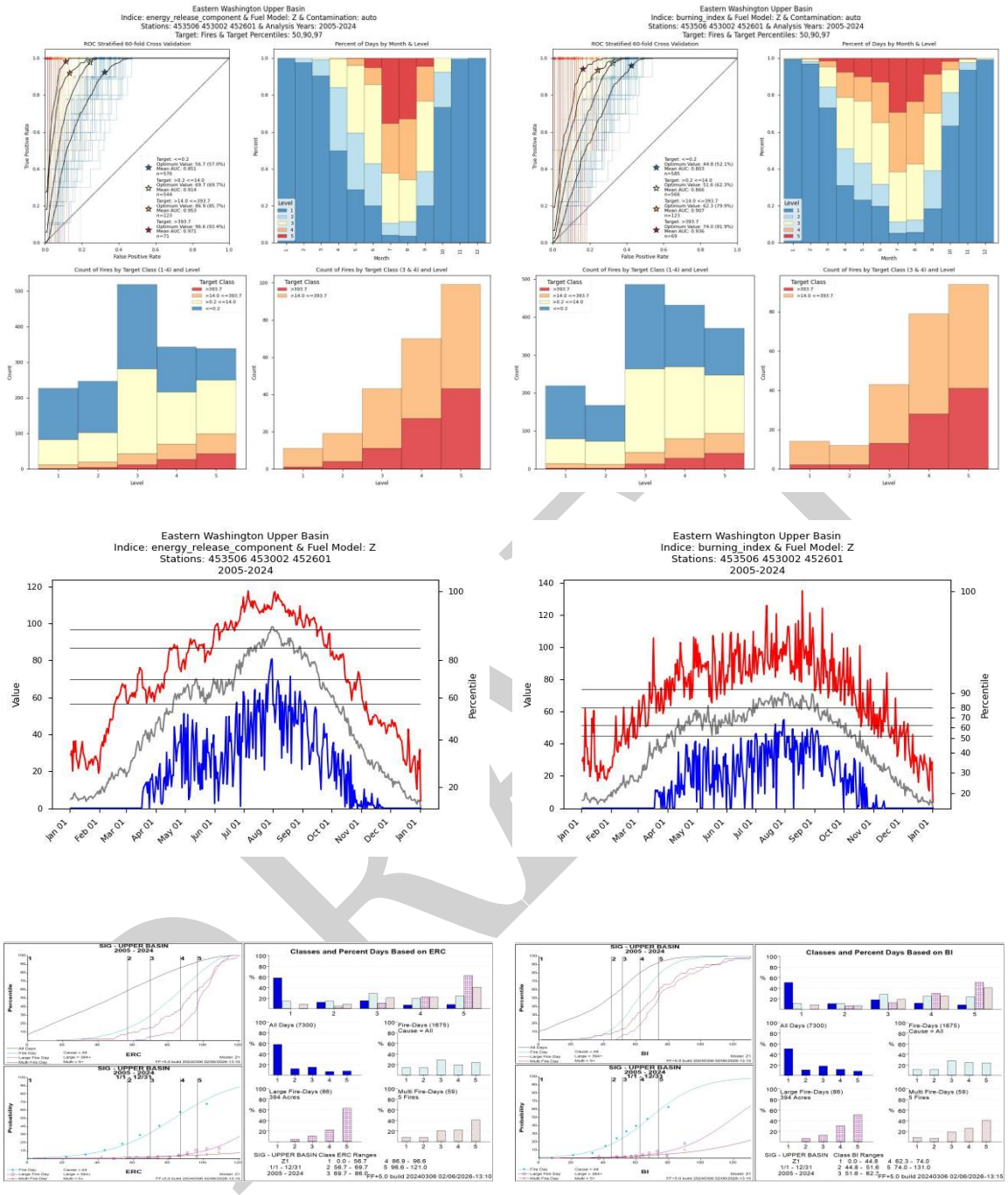


Figure A.11.3. Upper Basin FDRA fire decision point analysis results including from top to bottom (left ERC, right, BI) ROC decision points and target class level outputs, decision point climatology graphs, and corresponding Fire Family Plus fire distributions for the EWA FDOP (2005-2024).

A.12 Lower Basin | Fire Danger Rating Area

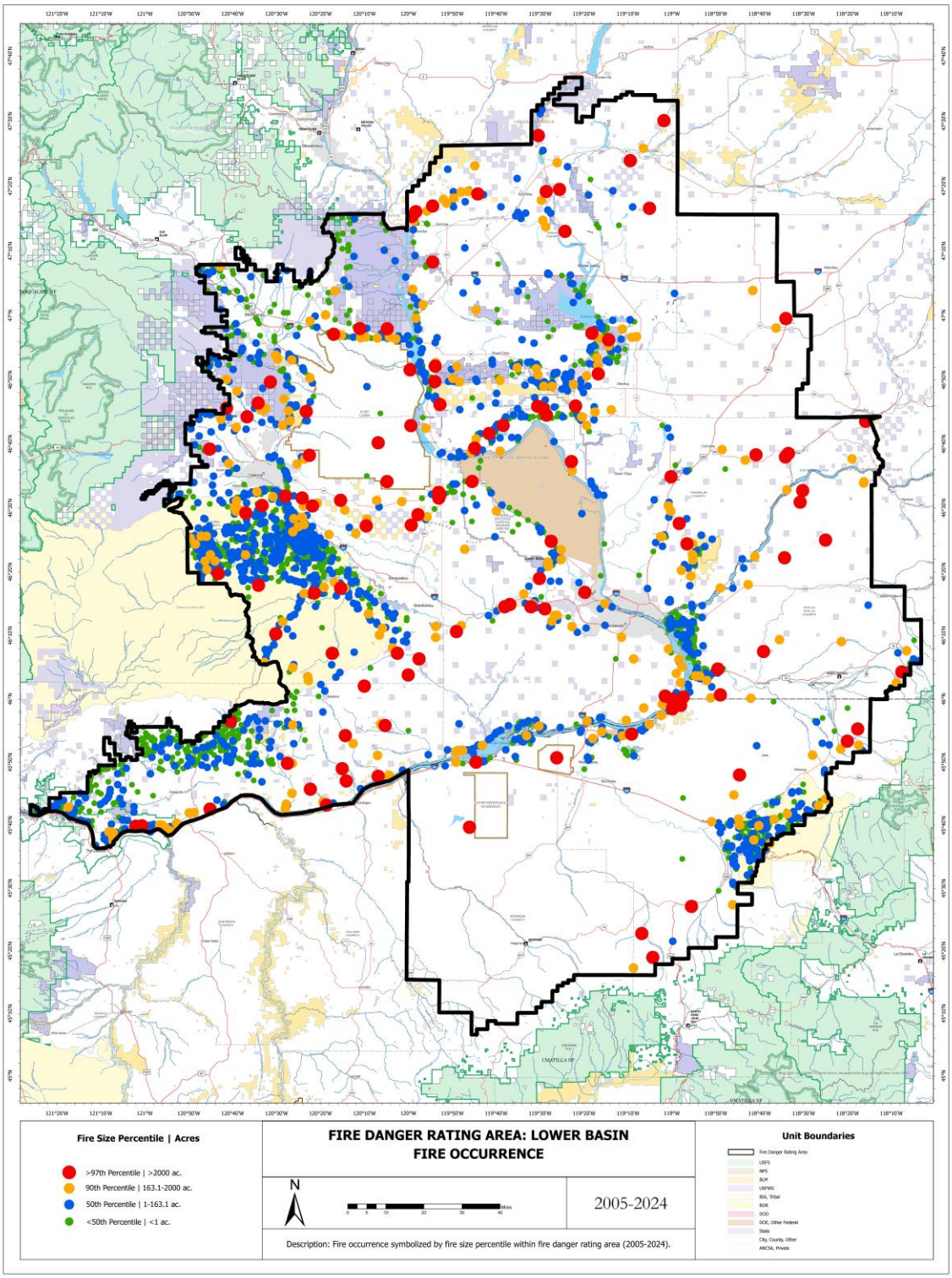


Figure A.12.1. Lower Basin FDRA spatial fire occurrences for the EWA FDOP (2005-2024).

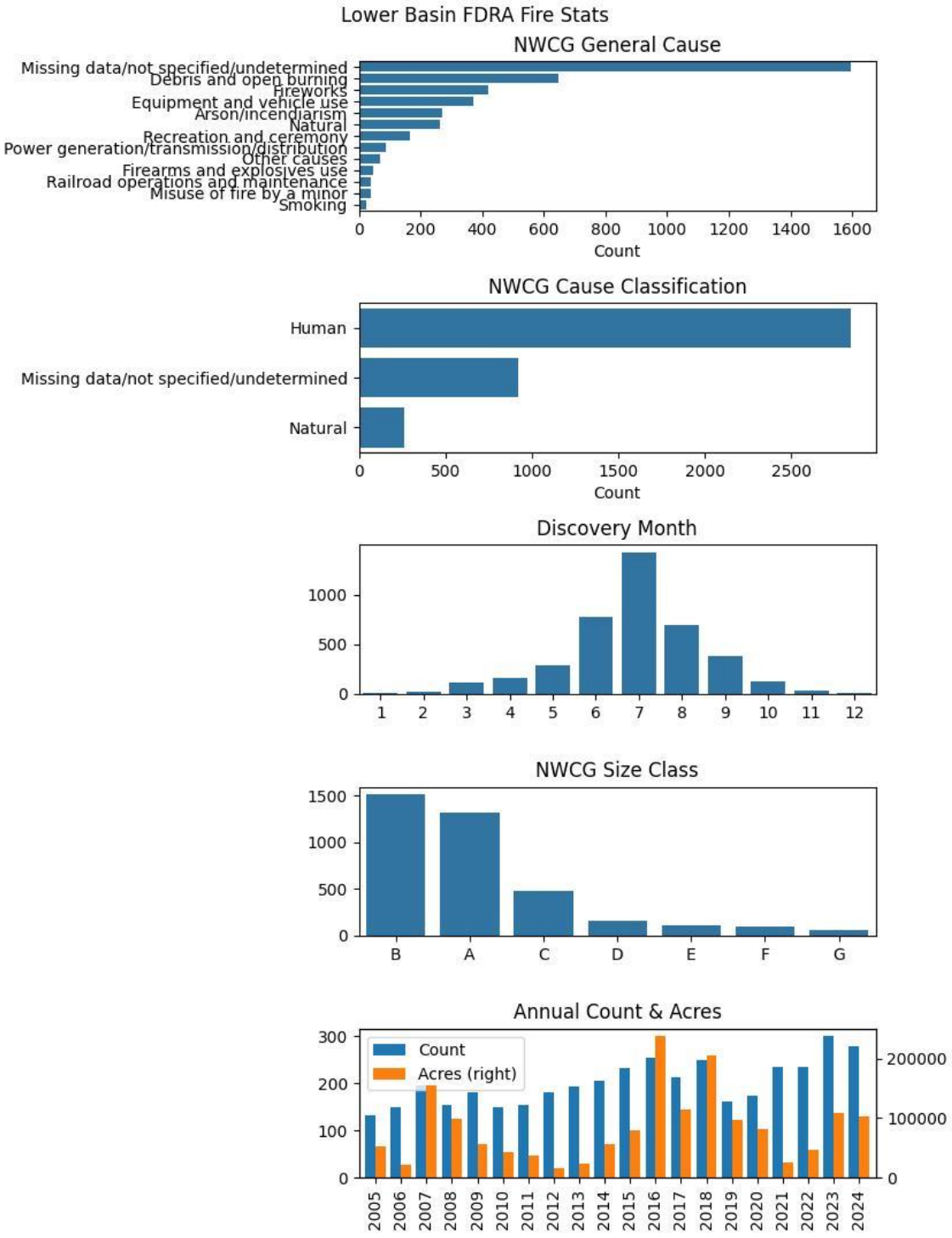


Figure A.12.2. Lower Basin FDRA fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

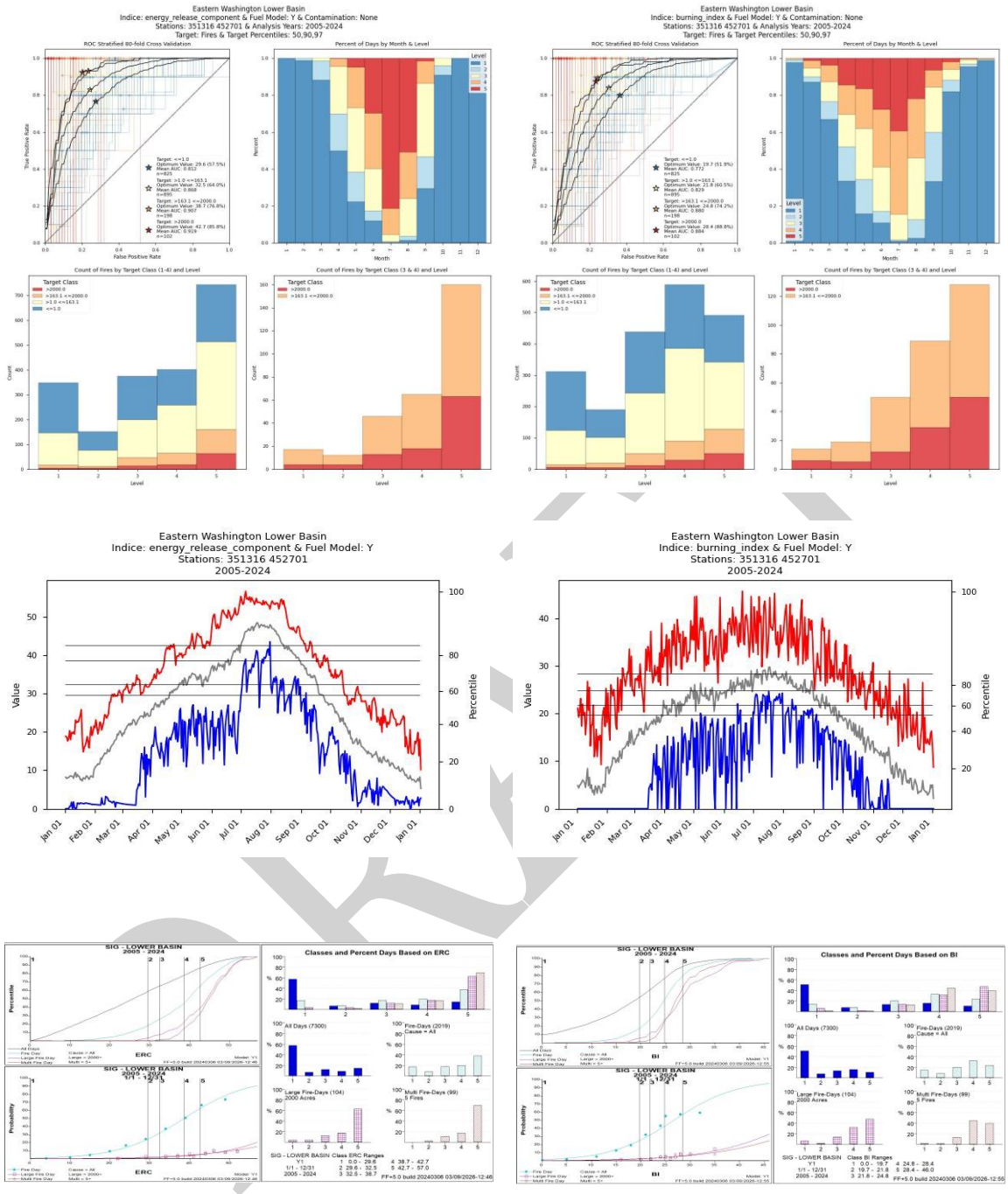


Figure A.12.3. Lower Basin FDRA fire decision point analysis results including from top to bottom (left ERC, right, BI) ROC decision points and target class level outputs, decision point climatology graphs, and corresponding Fire Family Plus fire distributions for the EWA FDOP (2005-2024).

A.13 Highlands | Fire Danger Rating Area

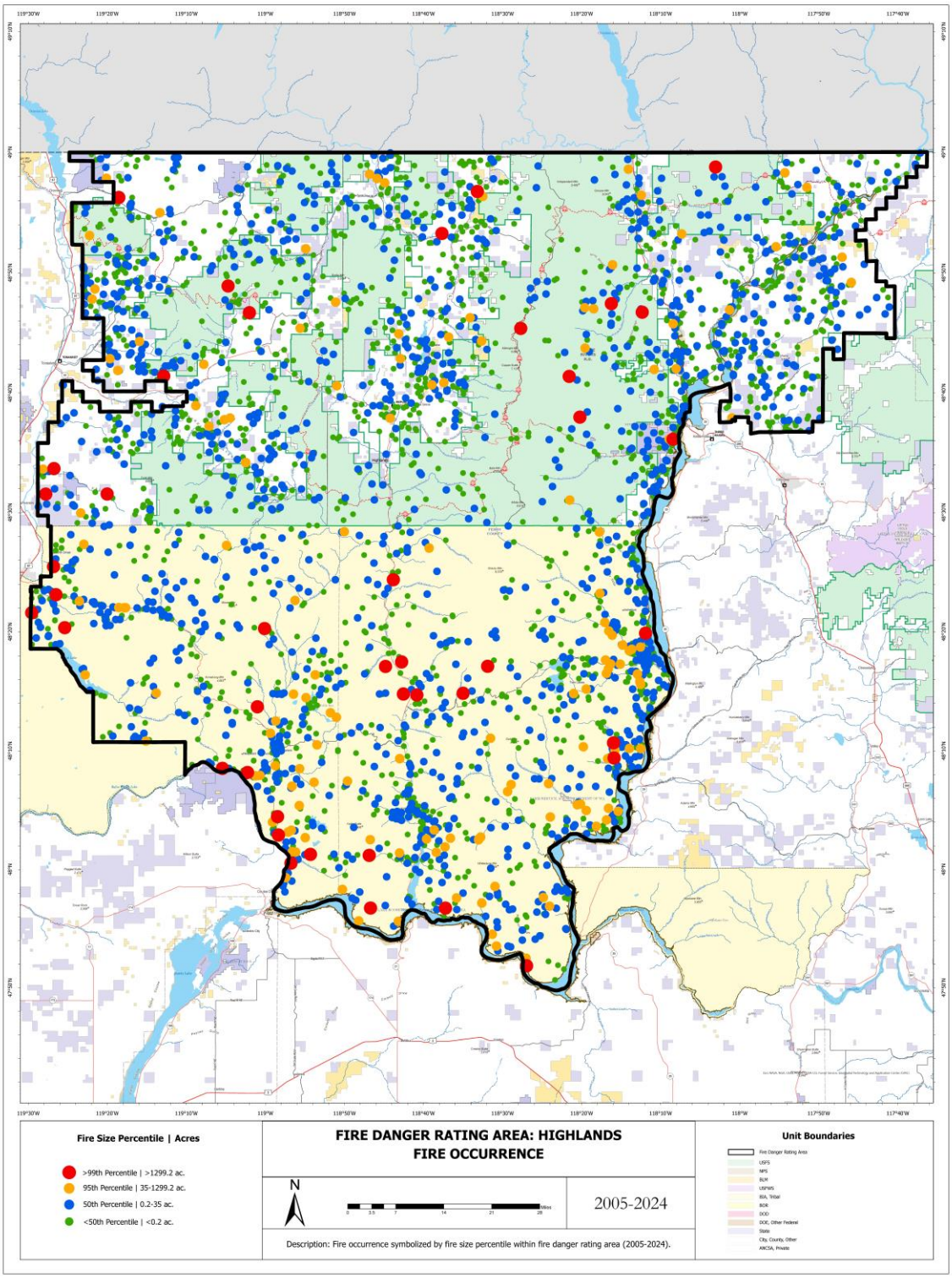


Figure A.13.1. Highlands FDRA spatial fire occurrences for the EWA FDOP (2005-2024).

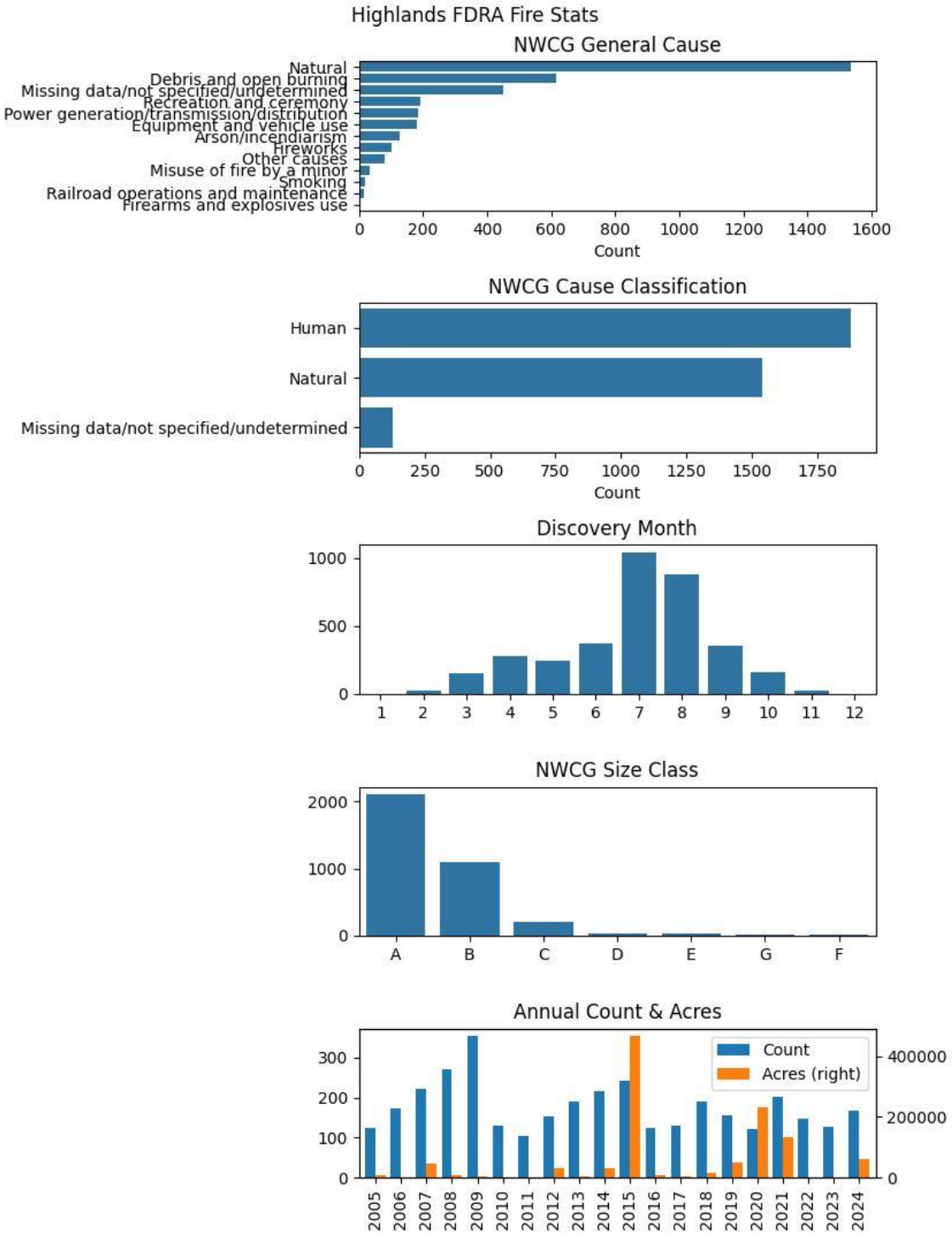


Figure A.13.2. Highlands FDRA fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

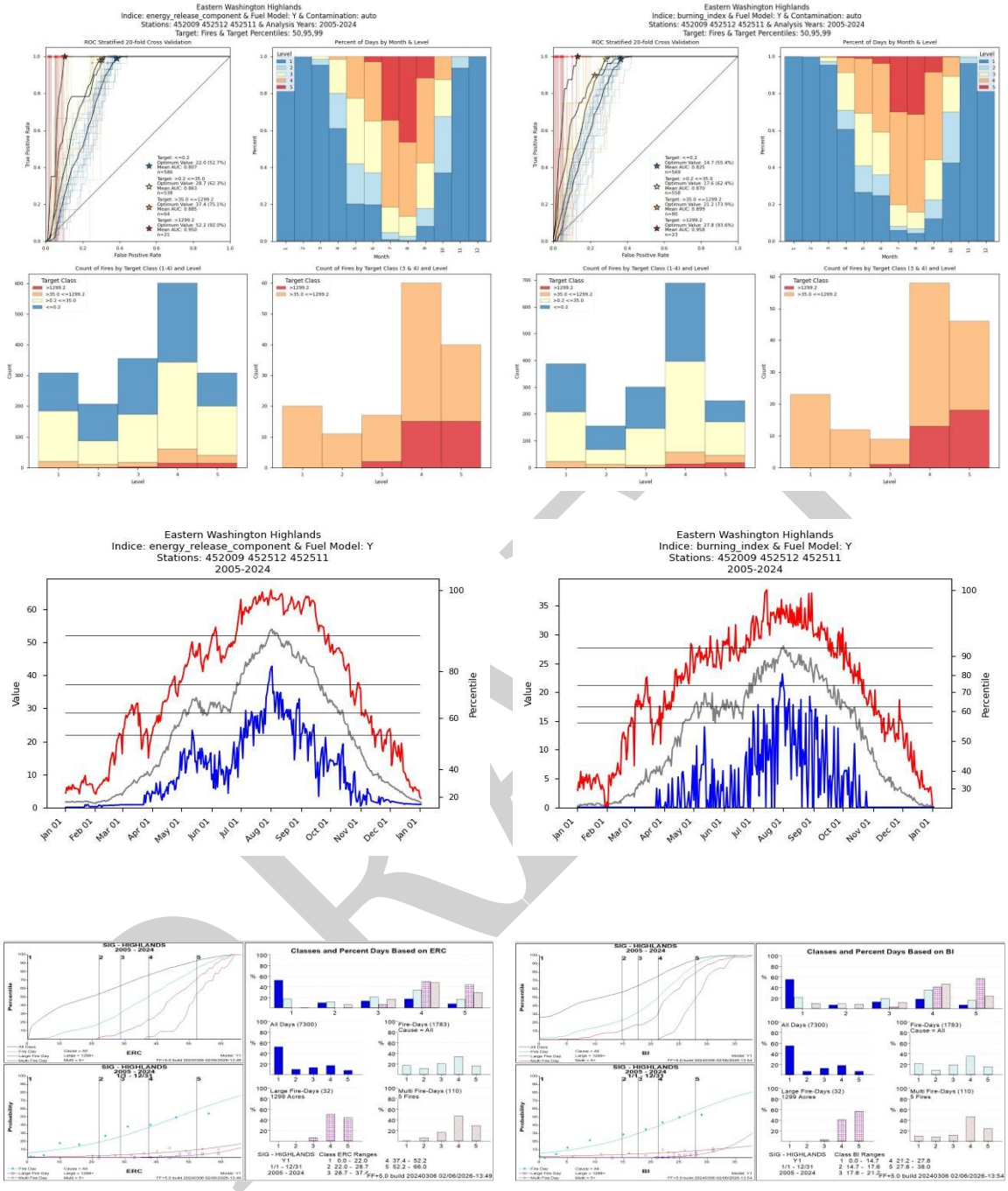


Figure A.13.3. Highlands FDRA fire decision point analysis results including from top to bottom (left ERC, right, BI) ROC decision points and target class level outputs, decision point climatology graphs, and corresponding Fire Family Plus fire distributions for the EWA FDOP (2005-2024).

A.14 Kaniksu | Fire Danger Rating Area

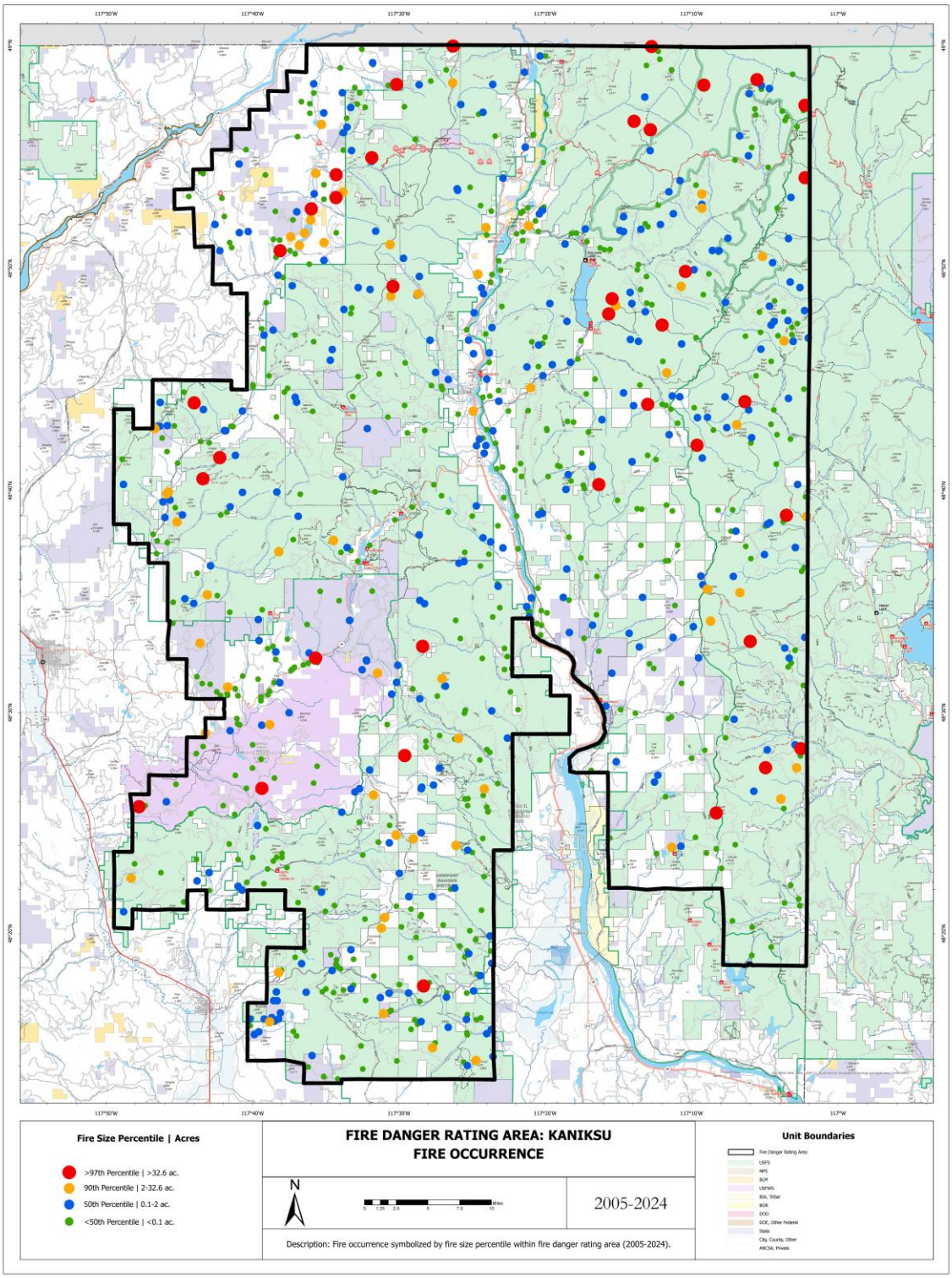


Figure A.14.1. Kaniksu FDRA spatial fire occurrences for the EWA FDOP (2005-2024).

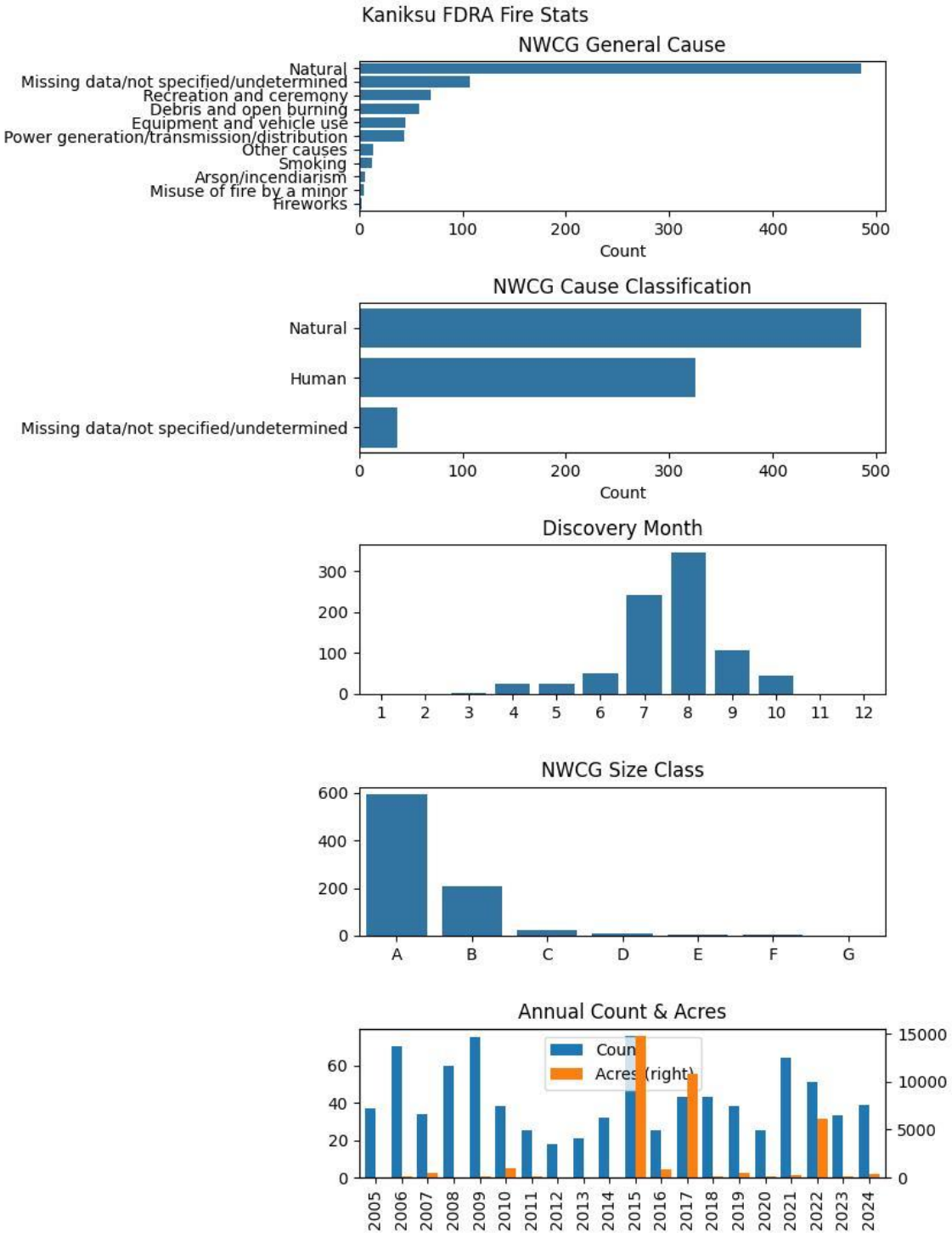


Figure A.14.2. Kaniksu FDRA fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

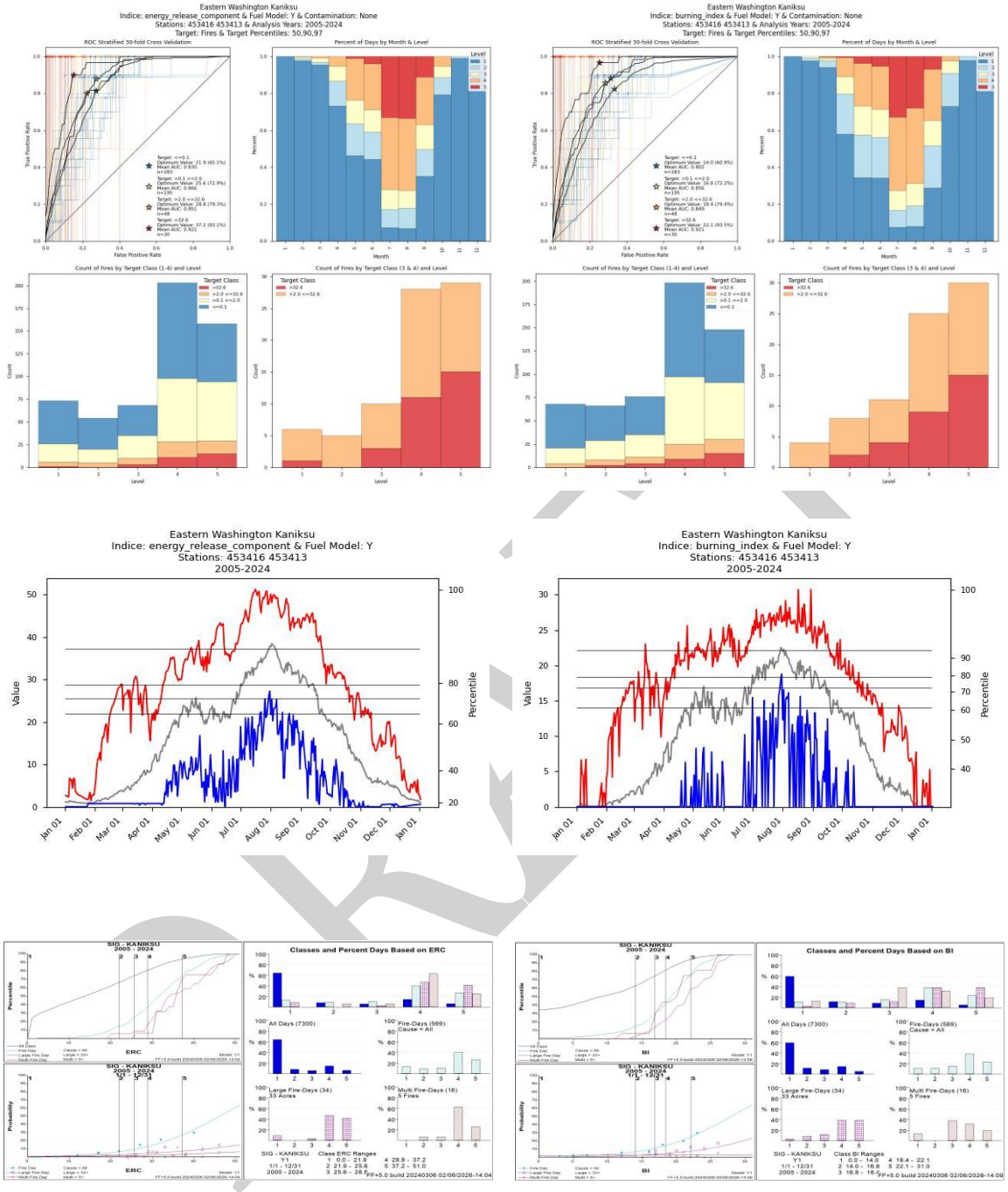


Figure A.14.3. Kaniksu FDRA fire decision point analysis results including from top to bottom (left ERC, right, BI) ROC decision points and target class level outputs, decision point climatology graphs, and corresponding Fire Family Plus fire distributions for the EWA FDOP (2005-2024).

A.15 Foothills | Fire Danger Rating Area

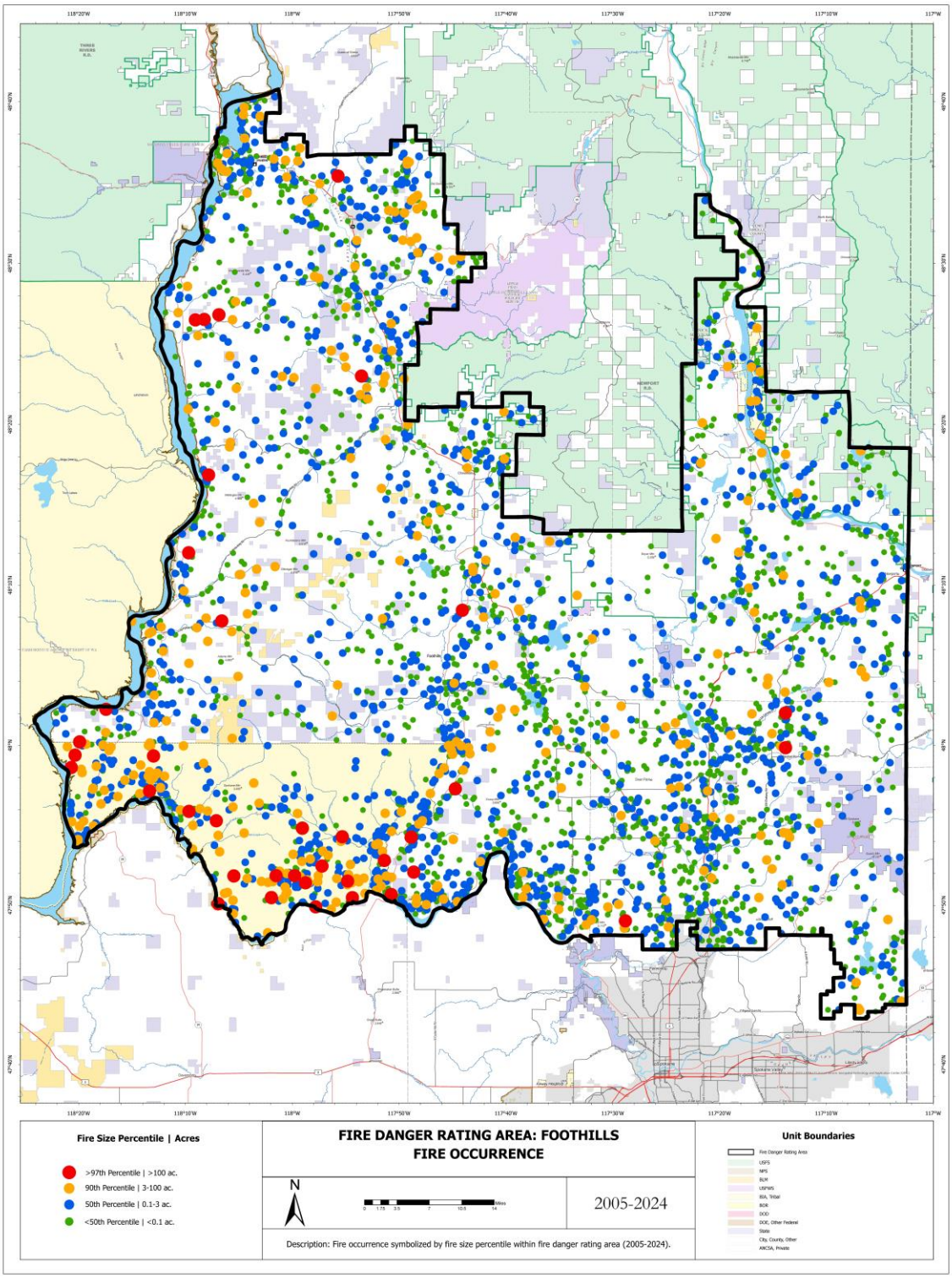


Figure A.15.1. Foothills FDRA spatial fire occurrences for the EWA FDOP (2005-2024).

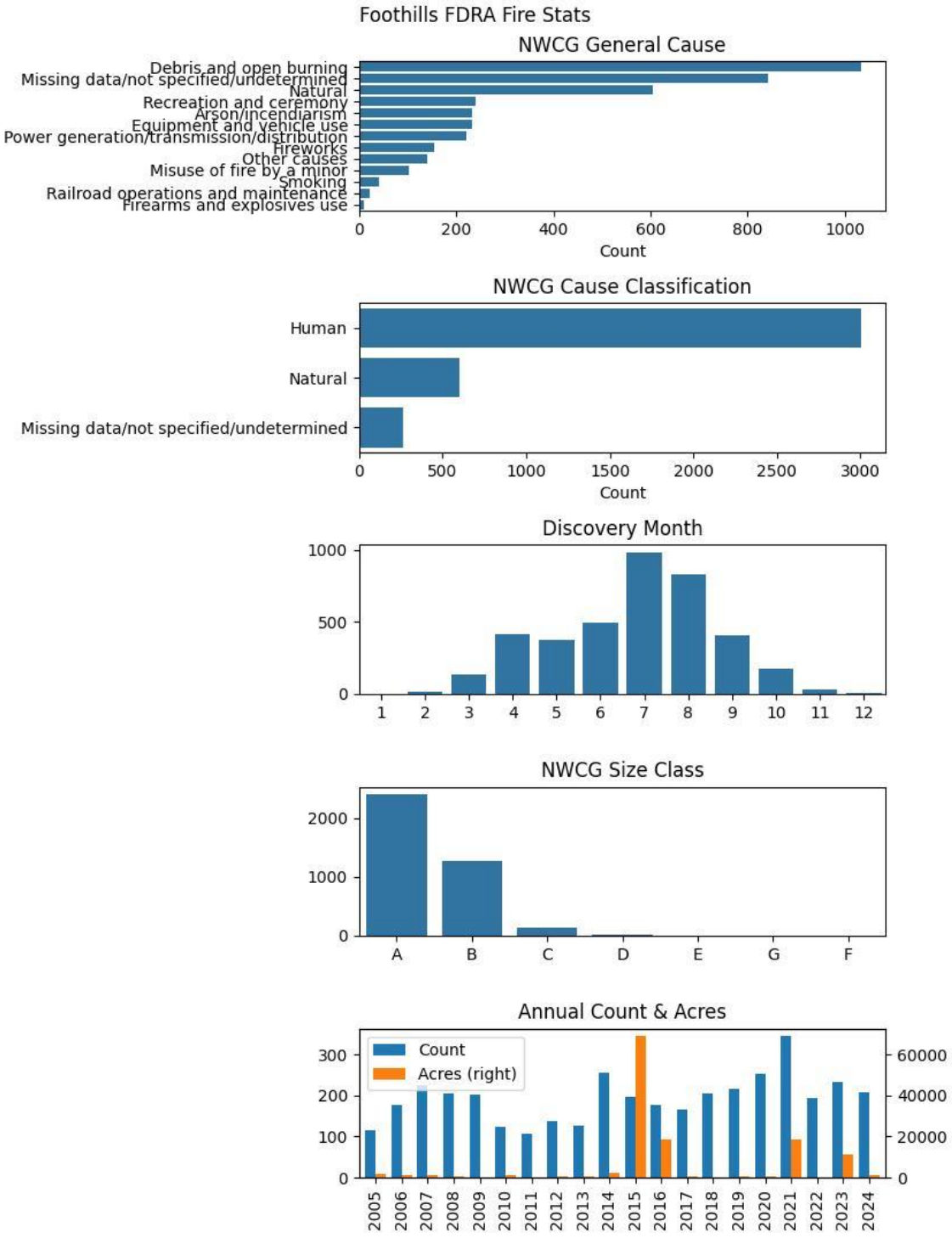


Figure A.15.2. Foothills FDRA fire occurrence summaries including from top to bottom general cause, cause, discovery month, size class, count, and acres for the EWA FDOP (2005-2024).

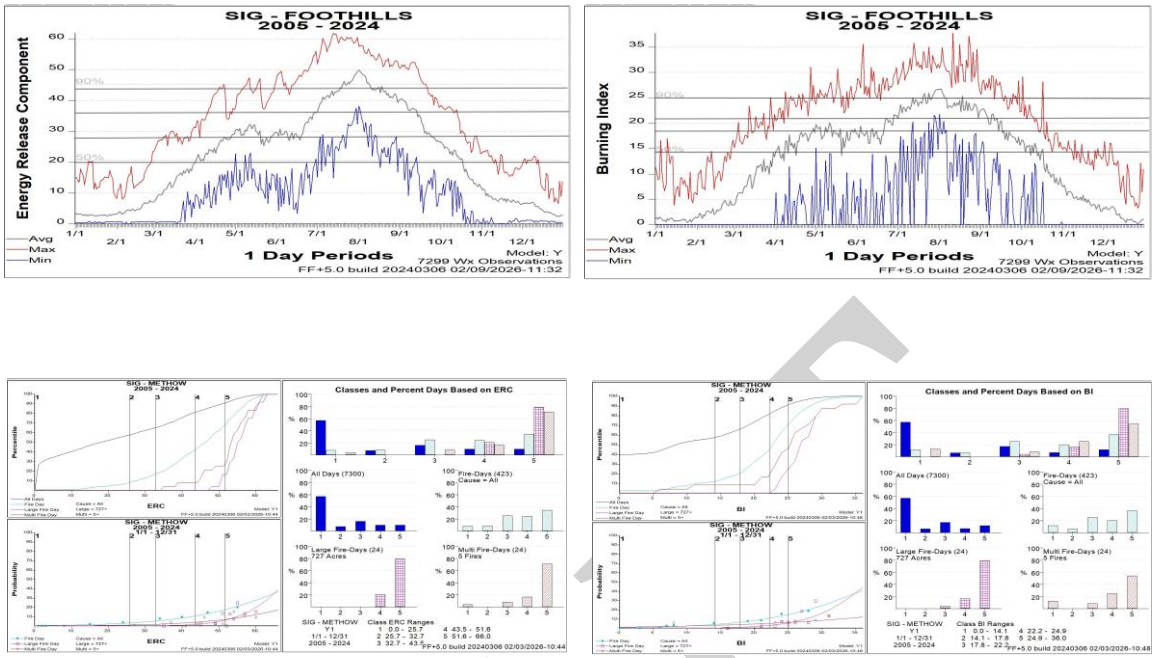


Figure A.15.3. Foothills FDRA fire decision point analysis results including from top to bottom (left ERC, right, BI) Fire Family Plus decision point climatology graphs and fire distributions for the EWA FDOP (2005-2024).

A.16 National Fire Danger Rating System Chart and Adjective Fire Danger Ratings

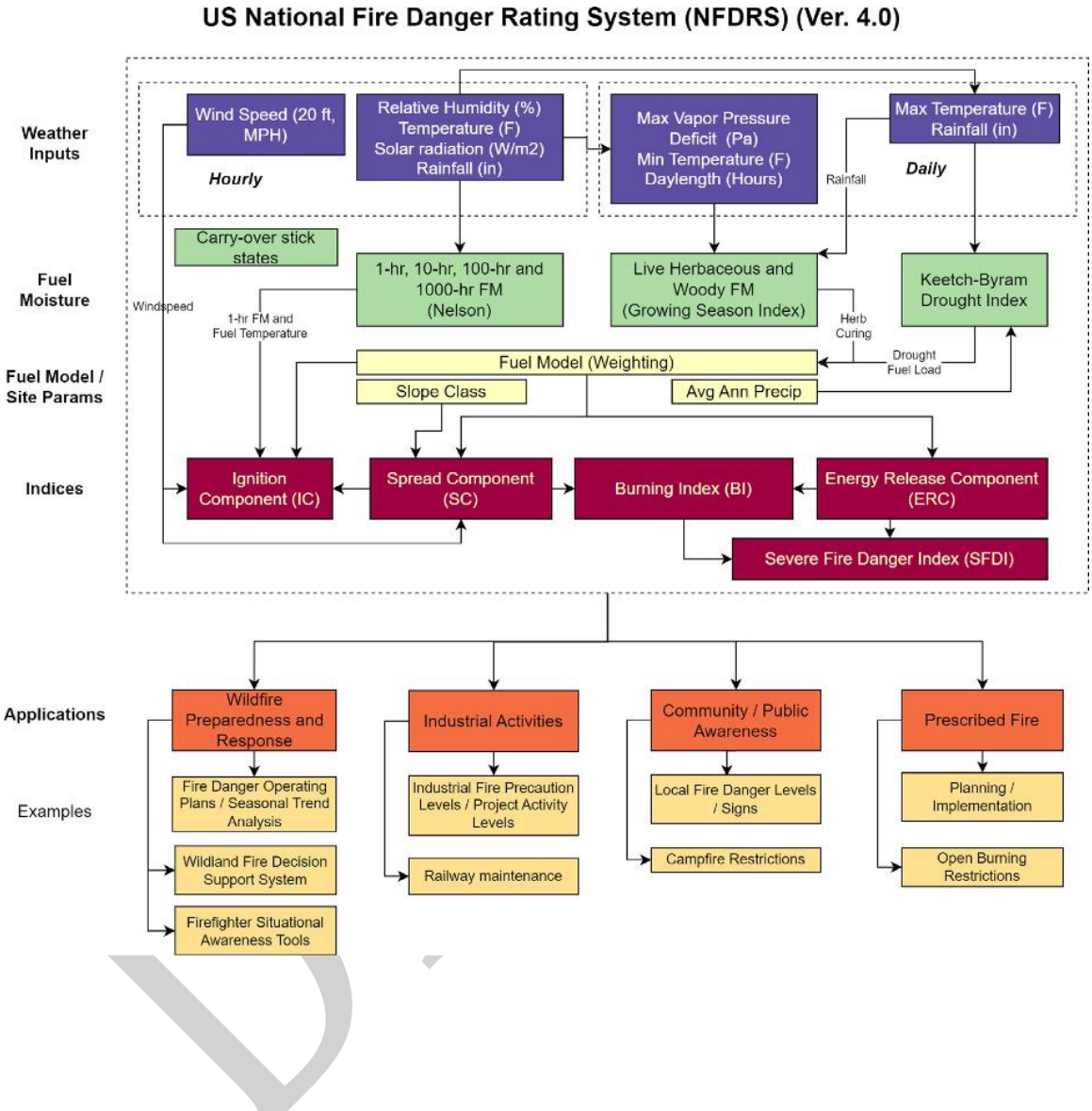


Figure A.16.1. The National Fire Danger Rating System Version 4.0 (2016) structure chart displaying inputs used in the generation of fire danger indices and application use.

Adjective Fire Danger Ratings

In 1974, the Forest Service, Bureau of Land Management and state forestry organizations established a standard adjective description for five levels of fire danger for use in public information releases and fire prevention signing. For this purpose only, fire danger is expressed using the adjective levels and color codes described below. In 2000, the NWCG Fire Danger Working Team reviewed and slightly revised these terms and definitions for adjective fire danger.

Fire Danger Rating and Color Code	Description
Low (L) (Green)	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.
Moderate (M) (Blue)	Fires can start from most accidental causes but, with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
High (H) (Yellow)	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High (VH) (Orange)	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme (E) (Red)	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

Table A.16.2. 1974 standard adjective descriptions for the five levels of fire danger.

8 REFERENCES

[1] "Interagency Standards for Fire and Fire Aviation Operations." National Interagency Fire Center (NIFC). 2025. Web. https://www.nifc.gov/standards/guides/red-book.

[2] "NWCG Standards for Fire Weather Stations." National Wildfire Coordinating Group (NWCG). PMS 426-3. March 2019. Web. https://fs-prod-nwcg.s3.us-gov-west-1.amazonaws.com/s3fs-public/publication/pms426-3.pdf?VersionId=Pw0T41e9JyWIcn64UrWzxirZS6Dq7LD.

[3] "Fire Environment Mapping System (FEMS)." 2026. Web. https://fems.fs2c.usda.gov/ui?Weather/hourly/temperature/3/topo/0/12120/false/false

[4] "Snow Data Assimilation System (SNODAS)." National Snow and Ice Data Center. 2026. Web. https://nsidc.org/home.

[5] "Climate of Washington." Western Regional Climate Center (WRCC). 2026. Web. https://wrcc.dri.edu/Climate/narrative_wa.php.

[6] "Fire for Information Resource Management System (FIRMS)." National Aeronautics and Space Administration. 2026. Web. https://firms.modaps.eosdis.nasa.gov/.

[7] Short, Karen C. 2022. "Spatial Wildfire Occurrence Data for the United States, 1992-2020 [FPA FOD]. 6th Edition." Fort Collins, CO. Forest Service Research Data Archive. Web. https://www.fs.usda.gov/rds/archive/catalog/RDS-2013-0009.6.

[8] "InFORM." 2026. Web. https://inform.firenet.gov/inspector/incidents#.

[9] Jolly, Matt W. 2019. "Severe Fire Danger Index: A Forecastable Metric to Inform Firefighter and Community Wildfire Risk Management." Missoula, MT. Rocky Mountain Research Station, USDA, Forest Service. Web. https://www.fs.usda.gov/rm/pubs_journals/2019/rmrs_2019_jolly_m001.pdf.

[10] "Receiver Operating Characteristic (ROC)." Wikipedia. 2026. Web. https://en.wikipedia.org/wiki/Receiver_operating_characteristic.

[11] "Fire Weather – Hazards/Overview Map." National Weather Service. 2016. Web. https://www.weather.gov/fire/.

[12] "U.S. Drought Monitor (USDM)." National Drought Mitigation Center. 2016. Web. https://droughtmonitor.unl.edu/CurrentMap.aspx.

[13] "Fire Danger and Outdoor Burning." Washington Department of Natural Resources. 2026. Web. https://fortress.wa.gov/dnr/protection/firedanger/.

[14] “Industrial Fire Precaution Levels (IFPL).”. Washington Department of Natural Resources. 2026. Web. https://dnr.wa.gov/wildfire-resources/industrial-fire-precaution-levels-ifpl.

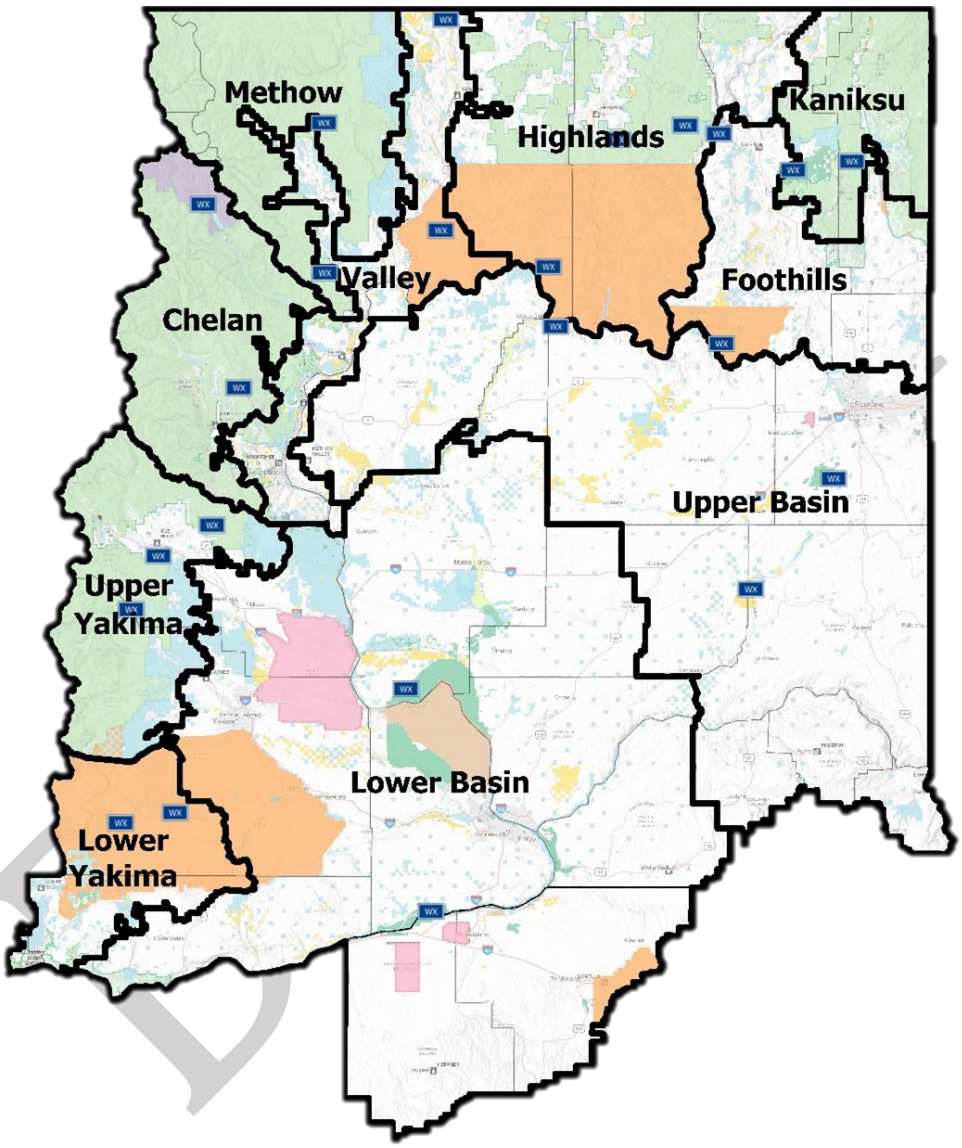
[15] “Region 6 Fire Danger Rating Areas (FDRA).” 2026. Web. http://pnwwildfireplanning.pythonanywhere.com/nfdrs/r6map/.

[16] “Northwest Interagency Coordination Center (NWCC).” 2026. Web. https://gacc.nifc.gov/nwcc/index.aspx.

[17] “Risk Management Assistance Dashboard (RMA).” U.S. Forest Service Strategic Analytics Branch. 2026. Web. https://experience.arcgis.com/experience/f9d7f7f920494c3db43a23a8dffe4664.

[18] “Fire Family Plus (FFPlus).” 2026. Web. https://research.fs.usda.gov/firelab/products/dataandtools/firefamilyplus.

[19] “Wildland Fire Application Information Portal (WFAIP).” 2026. Web. https://www.wildfire.gov/application/pocket-cards.


Methow
Highlands
Kaniksu
Valley
Foothills
Chelan
Upper Basin
Upper Yakima
Lower Basin
Lower Yakima