2023 Marin County Unit Strategic Fire Plan & Community Wildfire Protection Plan (CWPP)

MCFD Unit Strategic Fire Plan

Scott Alber
5/1/23

Plan Amendments

Table 1. Plan Amendments.

Date	Section Updated	Page Numbers Updated	Description of Update	Updated By
4/27/23	Appendix A		Minor update to project list	JReeser
4/27/23	Appendix A & C	72 & 78	Updates to projects andaccomplishment	JReeser
4/27/23	Appendix B	76	Updates to unit goals & objectives	JReeser
4/27/23	Section 1	9	Updates to population and housing elements	SAlber
5/4/21	Section 2	26	Added “Climate Variability” Sub-Section	SAlber/STI
5/4/21	Section 3	30	Added Sub-Section for “MWPA”	SAlber
5/4/21	Section 4	34-49	Updated Risk Assessment Methodology	STI
5/4/21	Section 5	50-63	Updated Parcel-Level Fire Hazard Assessment Methodology	STI
4/27/23	Section 6.4	71-78	Updated/clarified code references	SAlber
5/4/21	Section 6.6	82-86	Updated from previous version	STI
5/4/21	Appendix A	91	Updated project list	JReeser
5/4/21	Appendix B	95	Updated Unit goals and Objectives	SAlber
5/4/21	Appendix C	100	Updated Unit Report on Accomplishments	SAlber
5/4/21	Appendix D	103	Updated Unit Reporting Requirements	SAlber
5/4/21	Appendix E	104	Updated Ignition Data	SAlber

Contents

Signatures

This Plan:

- Was collaboratively developed as Community Wildfire Protection Plan and modified to meet the requirements of CAL FIRE Unit Fire Plan. Interested parties,Federal, State, City, and County agencies within the County have been consulted and are listed in the plan.
- Identifies and prioritizes pre-fire and post fire management strategies and tactics meant to reduce the loss of assets at risk within Marin County.

/s/ Jason Weber

_____ May1, 2023

Jason Weber, Chief **Date**

Scott D. Alber

_____ May 1, 2023

Scott D. Alber, Battalion Chief/Fire Marshal **Date**

Executive Summary

The Marin County Unit Strategic Fire Plan is a living document. It has been combined with the Marin County Community Wildfire Protection Plan (CWPP) and is intended to be reviewed annually with Addendums.

The goal of Marin County Fire Department is to reduce the loss of life, property, watershed and natural resource impacts and other assets at risk from wildfire using an integrated approach that includes a combination of the following elements: (1) Compliance with California Public Resources Code (PRC) 4291 Defensible Space regulations, as well as 2022 California Fire Code Section 4907.2 as amended in Marin County Ordinance 3775, (2) ridge top and strategically located fuel treatments, (3) fire-prone species thinning, limbing and clearing, (4) increased access to improvements, (5) wildfire awareness campaign, (6) enforcement of the 2006 International Urban-Wildland Interface Code (with extensive Marin County amendments) (7) wide area defensible space projects around communities and infrastructure, (8) fuel reduction and neighborhood defensible space projects in partnership with land management agencies, homeowner's groups, cities, towns and special districts, and (9) Countywide strategic prioritization of vegetation/fire hazard reduction projects.

Where opportunities and partnerships with land management agencies exist, efforts will support the combination of hazardous fuel reduction that prevents and or minimizes the spread of invasive species. Where necessary, overgrown roadside vegetation will be trimmed, and turnouts will be improved along primary access roads in interface communities. Our wildfire awareness campaign encourages individual and community responsibility for creating defensible space and reducing structure ignitability.

The International Urban-Wildland Interface Code, applicable to all new and substantially remodeled structures located in the WUI, is being enforced; this code combines building standards, fire apparatus access, and fire-fighting water supply requirements with landscape and defensible space planning to reduce potential losses caused by wildfire. Furthermore, where alterations and remodels are taking place in the WUI, those elements, modified, altered, or replaced are required to comply with Chapter 7A of the 2022 California Building Code (Materials, and Construction Methods for Exterior Wildfire Exposure). Finally, this plan incorporates the major landowner's (MMWD, NPS, MCOSD) respective vegetation management plan's fuel reduction and defensible space projects.

Even though the Marin County Fire Department has been successful in controlling a large portion of all wildland fires within its jurisdiction, one only needs to examine our fire history to understand the risk our communities face. This fire plan will allow the Marin County Fire Department to create a more efficient fire-protection system focused on meaningful solutions to better protect the communities in Marin. Being able to identify areas where cost-effective, pre-fire management investments can be made will help minimize citizen losses and reduce costs from catastrophic wildfire incidents.

Jason Weber, FIRE CHIEF

1. Unit Overview

Marin County is in the North San Francisco Bay Area in California (Figure 1). The county has a land area of approximately 526 square miles (336,573 acres) with a population of approximately 261,0001 and is largely rural. The county is a peninsula bordered by Sonoma County to the northeast, the San Pablo Bay and San Francisco Bay to the East and South respectively, and the Pacific Ocean to the West. Most of the county's population resides in the eastern, urban-developed region of the county along the Highway 101 corridor.

The west region of the county—in and around Pt. Reyes—is a popular local tourist region covered by parklands and recreation areas including Point Reyes National Seashore (with over 2.4 million visitors annually), and the northwest is sparsely populated, agricultural rangeland.

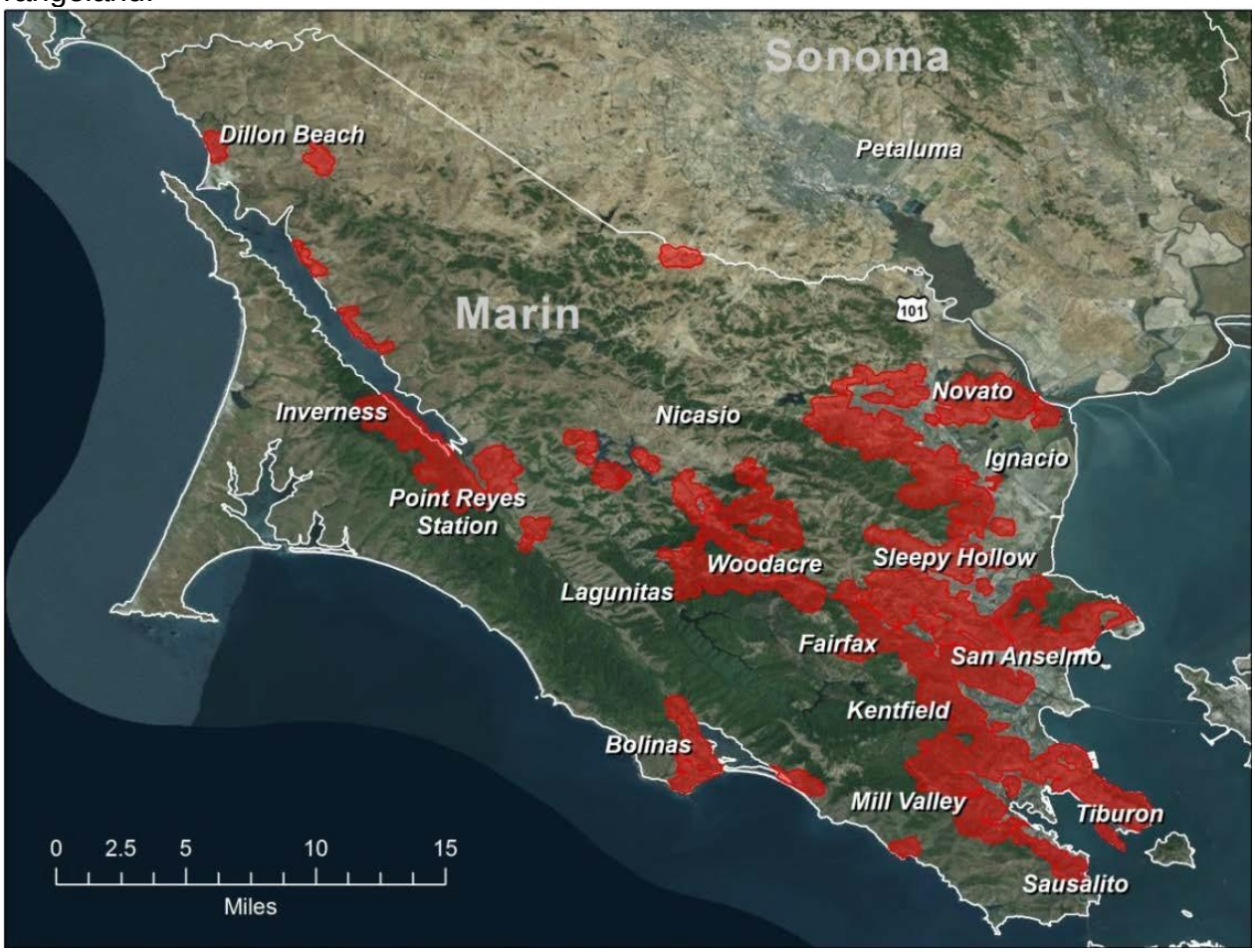


Figure 1. Map of Marin County and the wildland urban interface boundaries (red).

[1] U.S. Census Bureau Marin County population estimate for 2014, **http://quickfacts.census.gov/qfd/states/06/06041.html**, 2015

Approximately 60,000 acres—18% of the county's land area—falls within the wildland urban interface(WUI) where communities (i.e., homes and structures) are intermixed with open

space and wildland vegetation. A recent assessment by the Marin County Fire Department (MCFD) revealed that there are approximately 64,000 parcels with 69,000 living units valued at $98.3 billion (assessed value of land and improvements, July 1, 2022) within the WUI. Because of the mix and density of structure and natural fuels combined with limited access and egress routes, fire management becomes more complex in WUI environments. In Marin County specifically, many of the access roads within the WUI are narrow and winding and are often on hillsides with overgrown vegetation, making it even more difficult and costly to reduce fire hazards, fight wildfires, and protect homes and lives in these areas.

1.1 Fire Agencies, Capabilities, and Preparedness

Fire protection in California is the responsibility of either the federal, state, or local government. On federally owned land, or federal responsibility areas (FRA), fire protection is provided by the federal government, oftentimes in partnership with local grants and contracts. In Marin County, Marin County Fire Department (MCFD) has entered a contract with the National Park Service to provide initial attack for fires within the park boundaries. In state responsibility areas (SRA), CAL FIRE typically provides fire protection. However, in some counties CAL FIRE contracts withcounty fire departments to provide protection of the SRA – this is the case in Marin County, where CAL FIRE contracts with MCFD. Local responsibility areas (LRA) include incorporated cities and cultivated agriculture lands, and fire protection is typically provided by city fire departments, fire protection districts, counties, and by CAL FIRE under contract to local government.[2] **Figure 2** shows the FRA, SRA, and LRA in Marin County.

[2] **http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_faqs#desig01**

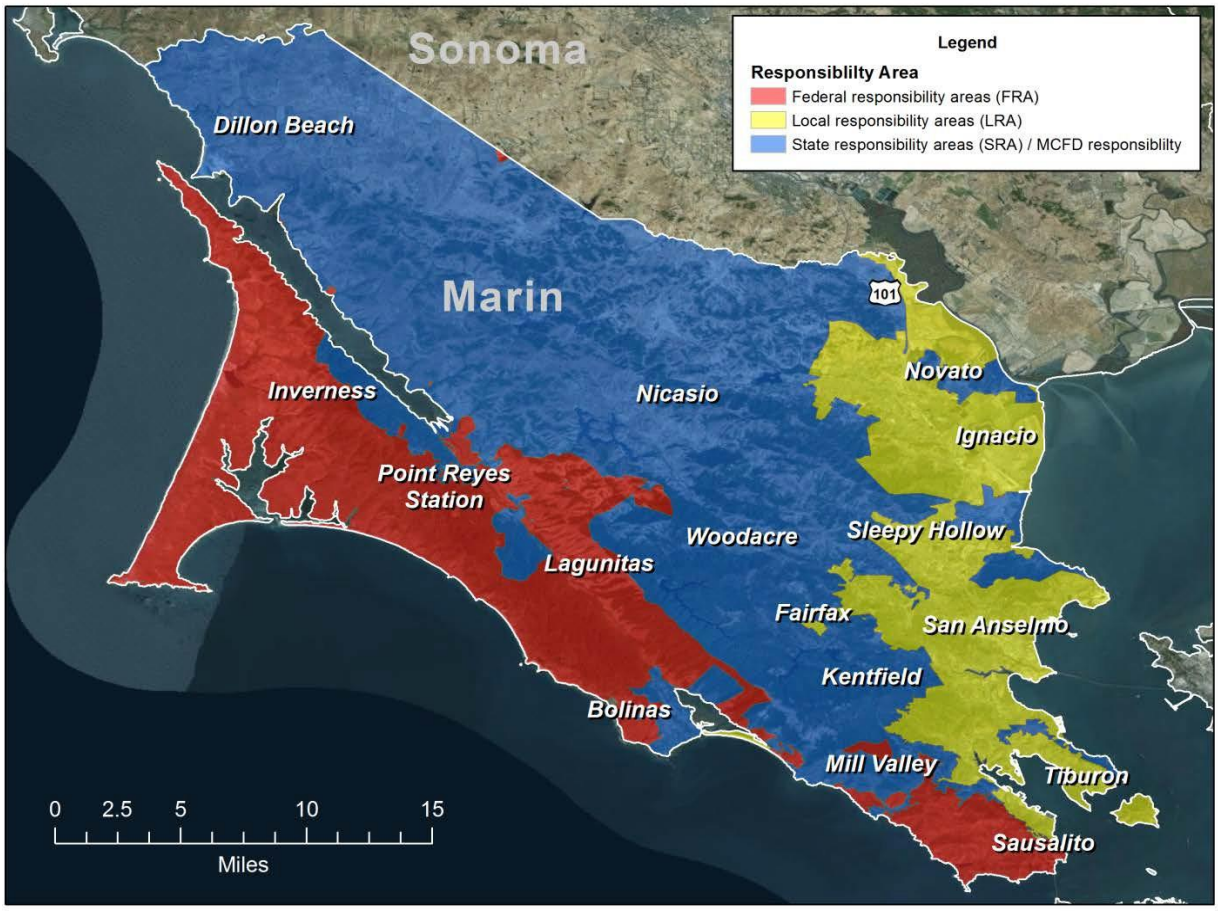


Figure 2. Map of the federal responsibility areas (red), state responsibility areas & MCFD (blue),and local responsibility areas (yellow) in Marin County.

CAL FIRE contracts with MCFD to provide wildland fire protection and associated fire prevention activities for lands designated by the State Board of Forestry as SRA. Marin is one of six counties in the state who contract with CAL FIRE to protect SRA. The MCFD is responsible for the protection of approximately 200,000 acres of SRA within the county and is the primary agency that handles wildland fires. MCFD also provides similar protection services to approximately 100,000 acres of FRA in the Golden Gate National Recreation Area (GGNRA), the Muir Woods National Monument, and the Point Reyes National Seashore.

Within Marin County, there are 96,127 parcels and 107,420 living units; of these living units, 69,406 units are located in the WUI with an assessed value of $98.3 billion. There are 17128 parcels and 14,697 living units located in the county's SRA; of these, 15,770 parcels with 13,863 living units are located in the WUI. Location within the WUI places these parcels and living units at greater risk from wildfires due to surrounding fuels and vegetation and their proximity to wildlands. **Table 2** lists the number of parcels and living units located in the SRA by fire jurisdiction.

Table 2. Number of parcels and living units located in the SRA by fire jurisdiction.

Fire Jurisdiction	Number of Parcels	Number of Living Units
Marin County Fire Department (CSA-31, 19, and 13)	7565	6333
Southern Marin Fire Department	2754	2667
Novato Fire Protection District	2018	1726
Bolinas Fire Protection District	1197	731
Ross Valley Fire Department	1063	975
Kentfield Fire Protection District	806	814
Inverness Public Utilities District	744	617
Marinwood Fire Department	408	355
Stinson Beach Fire Protection District	325	288
Tiburon Fire Protection District	248	191
Total	**17128**	**14697**

MCFD staffs an Emergency Command Center (ECC) that dispatches for MCFD and local volunteer firedepartments, coordinates wildland incidents within the SRA or FRA, and acts as the county's Office of Emergency Services (OES) coordination center for fire dispatching. In addition to MCFD, there are eleven additional professional fire service agencies and three volunteer departments—Tomales Volunteer Fire Company (TVFC), Nicasio Volunteer Fire Company and Muir Beach Volunteers—that provide fire services in Marin County. TVFC provides 12 firefighters to MCFD's Tomales response zone, While Muir Beach and Nicasio supplements fire response in Throckmorton's and Woodacre's response zones, respectively. In addition, there is one private fire brigade, Skywalker Fire, situated at Skywalker Ranch on Lucas Valley Road, which also supports the Woodacre Station's fire response. **Figure 3** shows a jurisdictional map for MCFD and the other eleven professional fire service agencies in Marin County, and **Table 3** provides information on all the fire service agencies in the county.

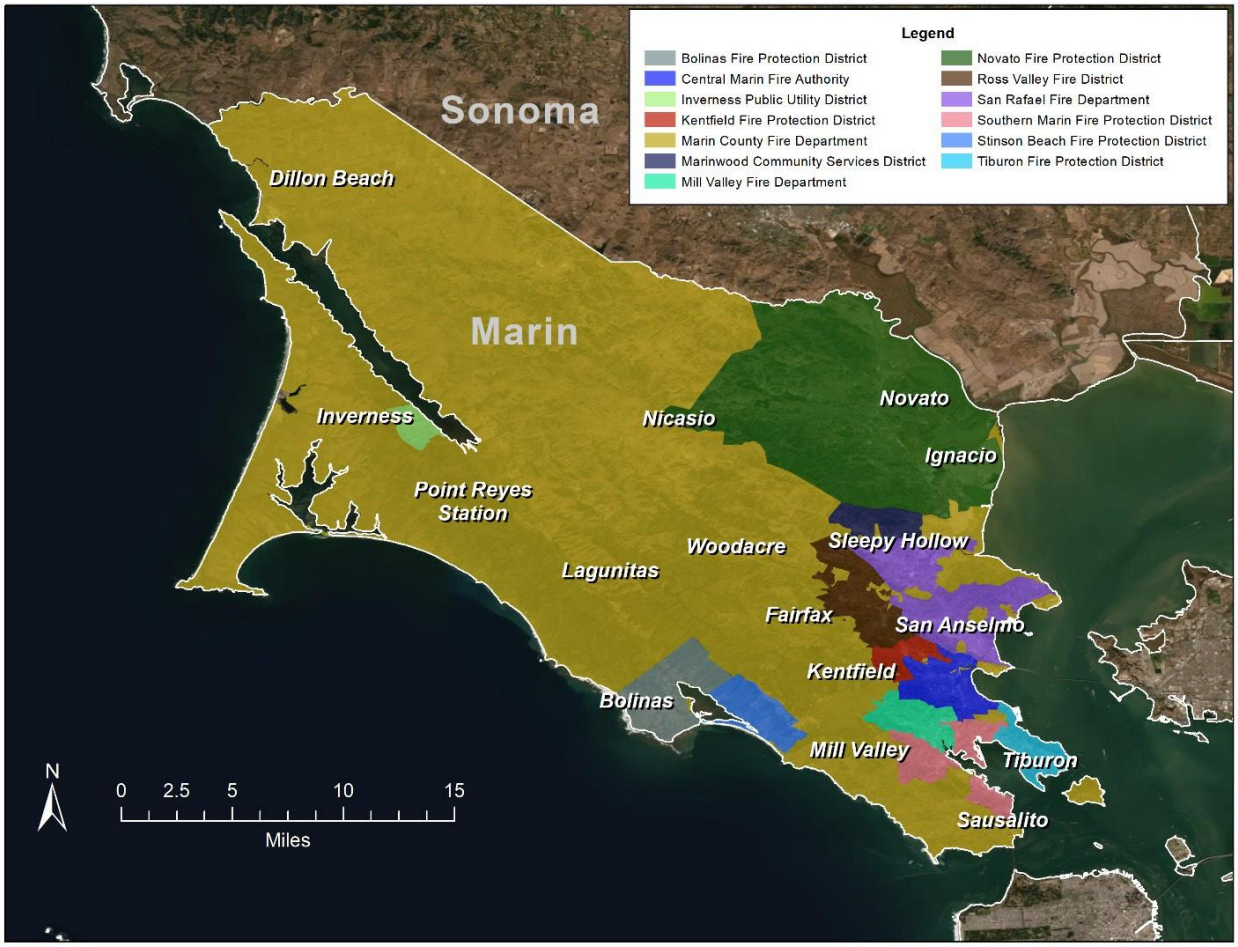


Figure 3. Map of Marin County professional fire service agency jurisdictions.

Table 3. Marin County fire service agencies.

Personnel	Fire Stations	Fire Apparatus	Additional Equipment/Services
Marin County Fire Department			
220 firefighters (full time,seasonal, volunteer), 4-14 person Tamalpais Fire Crews, 1-14 person Fuels crew	Eight	Seven Type 1 (5 frontline and 2 reserves), Twelve Type 3 (7 frontline and 5 reserves), two Type 6. 4 CCV, one transport/bulldozer, three water tenders, four ambulances/ medic, 2 Medium Rescues	Twelve Fire Detection Cameras, two Lookout Towers
Novato Fire Protection District			
76 (60 emergency response personnel, 15 administrative personnel,one fire mechanic)	Five stations, one administrative office building, one training tower	Seven Type 1 ALS (2 reserve), two Type 3 ALS, four ALS ambulances (two first out, one cross staffed and one reserve), one ALS aerial ladder truck, one water tender	Weather station, thermal imaging cameras
Kentfield Fire Protection District			
20 firefighters (full-time,seasonal, volunteer)	One	Three Type 1, one ladder truck, two utility units	N/A
Bolinas Fire Protection District			
21 firefighters (full-time,part-time, seasonal, volunteer)	One	Two Type 1, one Type 3, one MCI trailer	N/A
Stinson Beach Fire Protection District			
5 personnel (30	One	Two Type 1, one Type 3, one water	N/A

volunteers)		tender, one BLS ambulance, two command vehicles	
Personnel	**Fire Stations**	**Fire Apparatus**	**Additional Equipment/Services**
Inverness Volunteer Fire Department			
25 firefighters (full-time,part-time, volunteer)	One	Two Type 1 engines, one Type 6 engine, one small rescue, two utility/command vehicles	N/A
San Rafael Fire Department			
72 line personnel (full-time), 10 administrative/prevention personnel	Six	Nine Type 1 (two reserve), one Type 3, one Type 5, two ladder trucks, four medic ambulances, five utility units,four BC command vehicles	Eight thermal imaging cameras
Ross Valley Department			
32 personnel (full-time)	Four	Four Type 1 (one reserve), one Type 3, one OES Type 3	N/A

Personnel	Fire Stations	Fire Apparatus	Additional Equipment/Services
Tiburon Fire Protection District			
29 personnel (2 administrative, 27 full-time)	Two	Four Type 1, two Type 3, one rescue, one fireboat, two medic/ambulances, two utility vehicles, two staff vehicles, three command vehicles	Three I/R cameras, emergency siren system
Central Marin Fire Authority			
39 personnel (full-time)	Four	Four Type 1 (one reserve), two ambulances (one reserve), two Type 3 (one reserve), one water tender – Type 1 tactical, four command vehicles (two trucks, two SUVs), four utility vehicles (three trucks, one SUV)	N/A
Mill Valley Fire Department			
31 personnel (1 administrative, 1 Chief, 2 fire prevention, 27 full-time firefighters)	Two	Three Type 1 (one reserve), one Type 3, one ALS ambulance, three Battalion Chief vehicles, four utility vehicles, 1 staff vehicle	N/A
Marinwood Fire Department			
29 firefighters (9 full-time, 20 volunteer)	One	One Type 1, one Type 3, utility truck	N/A

Southern Marin Fire Protection District			
61 (8 administrative, 8 fire prevention, 47 full-time firefighters)	Three	Four Type 1 (1 reserve), one Type 3, two ALS ambulances, one medium rescue, one ladder truck, one Battalion Chief vehicle (1 reserve), three staff vehicles, six prevention vehicles, three utilities	One water rescue apparatus, one fireboat, one IRB, two RWC, one dive tender unit

1.2 Agency Coordination

In addition to the CAL FIRE contract, Marin County has a well-organized local mutual aid system, based on the principles of resource sharing and cooperation with a goal of providing the public withthe highest level of service that no one agency is equipped to provide. These agreements include resources from all fire agencies, law enforcement, volunteer fire departments, the California Office of Emergency Services (OES), the National Park Service (NPS), CAL FIRE, and local landowners. **Table 4** lists the mutual aid agreements/plans and assistance-for-hire agreements. Mutual aid agreements are agreements among emergency responders to lend assistance across jurisdictional boundaries to supplement the resources of any fire agency during a period of actual or potential need.

Table 4. Mutual aid agreements/plans and assistance-for-hire agreements.

Mutual Aid Agreements and Plans
Countywide Mutual Threat Zone Plan
Marin Sonoma County Mutual Threat Zone Plan
Marin County Mutual Aid Agreement
County of Marin Urban Search and Rescue
County of Marin Office of Emergency Services
State of California Master Mutual Aid
North Bay Incident Management Team
Skywalker Ranch Fire Brigade
Assistance-for-Hire Agreements
Marin Municipal Water District
National Park Service in the areas of Point Reyes National Seashore, GoldenGate National Recreation Area, and Muir Woods National Monument

The Emergency Command Center (ECC) has been maintained by MCFD since the 1930s and serves as an independent dispatch center. The ECC receives, disseminates, and transmits information to field units, and has the additional responsibility to act in a supervisory role for incidents prior to the arrival of field units. TheECC also acts as the central ordering point for all state resources that are committed to SRA incidents in the county, and for Region II California Office of Emergency Services requests and OES coordination of local government fire resources entering or leaving the Marin County operational area. The ECC processes approximately 4,500 calls annually and is also responsible for handling all business calls received by the department. In 2015, the ECC upgraded to a new Computer Aided Dispatch (CAD) system to improve response

coordination with all units.

The Communications Division of the Marin County Sheriff's Office operates the Marin County Public Safety Communications Center, which is located in the "The Commons" in San Rafael. The center provides service to the Sheriff's Office, four police departments, nine fire departments, six paramedic service areas, the Marin County Department of Public Works, and many other city and county government service departments. The center is the primary 9-1-1 public safety answering point for all unincorporated areas of the county, as well as Mill Valley, Belvedere, Sausalito, and Tiburon.

1.3 Population and Housing

According to the most recent census data (2020), the population of Marin County is 262,327, with 87% of people living in LRA, 12% living in SRA, and 1% living in FRA. **Table 5** showsthe population distribution in Marin County by city or town.

Table 5. Population distribution by city, town, or community.

City, Town, or Community	Population	% County Total
San Rafael	60,335	23%
Novato	55089	21%
Mill Valley	15740	6%
San Anselmo	13,116	5%
Larkspur	12,375	5%
Tamalpais-Homestead Valley	11,261	4%
Corte Madera	9,866	4%
Tiburon	9,151	4%
Fairfax	7,591	3%
Sausalito	7,139	3%
Kentfield	6,930	3%
Lucas Valley-Marinwood	6,841	3%
Strawberry	5,759	2%
Santa Venetia	4,790	2%
Marin City	3,173	1%
Point Reyes Station, Alto, Stinson Beach, San Geronimo, Muir Beach, Dillon Beach, Tomales, Nicasio	2,897	1%
Ross	2,309	1%
Sleepy Hollow	2,200	1%
Belvedere	2,098	1%
Black Point-Green Point	1,655	1%

Lagunitas-Forest Knolls	1,504	1%
Woodacre	1,303	1%
Inverness	1,127	0.4%
Bolinas	1,077	0.4%

Most of the towns and cities in Marin County are “built-out,” resulting in modest levels of new development. However, some future residential development is expected on the hillsides of the SanGeronimo Valley, and in Lucas Valley, Nicasio, and Point Reyes Station. In addition, as the value of parcels increases, more lots along the Throckmorton Ridge and Panoramic Highway are being developed, and/or substantially remodeled. Furthermore, with the State’s efforts to increase the number of affordable housing units, Marin County has seen a substantial increase in the number of Accessory Dwelling Units (ADUs) on previously developed lots, increasing traffic and circulation congestion on surface streets.

1.3.1 Population Flux

An important consideration from a fire planning and emergency response perspective is the tourist population and temporal shifts in the transient population during the summer fire season, particularly in the western coastal areas. On warm days during the summer, the transient tourist population more than doubles as people come to the county’s parks, beaches, and recreation areas.There is often heavy traffic on roadways to and from west Marin County and along Highway 1. Point Reyes National seashore alone hosts over 2.4 million visitors per year. Consideration of the tourist population flux is important for planning strategic fuels treatmentprojects, reducing potential ignition sources, and allocating emergency response personnel.

1.4 Land Ownership

Landowners and vegetation managers in Marin County are some of the key stakeholders in the CWPP development process. Land ownership in Marin County is quite diverse and includes federal, state, local (county), and private property owners; **Table 6** shows the distribution of land ownership inthe county.

Table 6. Distribution of land ownership in Marin County.

Landowner	Percent Ownership
Private	56%
National Park Service	24%
Marin Municipal Water District	6%
County Open Space District	5%
State Parks	4%
Other Parks[a]	5%
Total	**100%**

[a] Includes land controlled by municipalities and school districts, Army Corps, California Department of Agriculture, California Fish & Game, North Marin Water District, and private organizations.

1.5 Natural Resources

1.5.1 Biodiversity

Marin County has a wide variety of plants including several rare or locally endemic species. The landscape provides a range of elevations, aspects, soil types, and moisture levels that support savannas, grasslands, oak-bay woodlands, chaparral, redwood forests, and wetlands.

Rare, threatened, or endangered species (both plants and animals) are present in Marin County. Extensive information about vegetation and their habitats is included in the Marin County Parks and Open Space District's (MCOSD) Vegetation and Biodiversity Management Plan. The county has critical habitats for the following list of special-status or locally rare species—see the Vegetation and Biodiversity Management Plan (May & Associates Inc., 2015) for Latin names:

1.5.1.1 **Wildlife (birds)** – Cooper's hawk, sharp shinned hawk, white-tailed kite, grasshopper sparrow, northern spotted owl, olive-sided flycatcher, brant, northern harrier, San Francisco common yellowthroat, California black rail, snowy egret, osprey, California clapper rail, Samuel's song sparrow, California horned lark, yellow warbler, burrowing owl, Sacramento splittail, California black rail, golden eagle, Virginia rail, and San Pablo song sparrow.

1.5.1.2 **Wildlife (fish, frogs)** – Coho salmon, central California coast steelhead, Chinook salmon, California red-legged frog (a threatened species)

1.5.1.3 **Wildlife (other)** – pallid bat, American badger, salt marsh harvest mouse, land snail

1.5.1.4 **Broadleaf herbaceous annuals and perennials** – indigo bush, coast ground cone, Tiburon buckwheat, Mt. Tamalpais jewel flower, Brewer's red maids, Hooker's tobacco brush, silver lupine (host plant of mission blue butterfly), coast rhododendron, marsh milk vetch, Humboldt Bay owl's clover, Point Reyes bird's beak, bent-flowered fiddleneck, Mt. Tamalpaismanzanita, Mt. Tamalpais lessingia, common manzanita, Brewer's claytonia, Van Houtte's columbine, serpentine reed grass, St. Helena morning glory, Calistoga navarettia, rough leaf aster, needle-leaved yellow linanthus, coast piperia, California lace fern, bristly linanthus, Wallace spike-moss, marsh zigadenus, Oakland star tulip, Mt. Tamalpais thistle, Marin dwarf flax, Marin County navarettia, Santa Cruz microseris, coast rock crest, California bottlebrush grass, California fremontia, Durango root, bristly leptosiphon, wind poppy, San Francisco gum plant, San Francisco leafy fleabane, black sage, tufted eschscholzia, wooly headed lessingia, fragrant fritillary, Baker's navarettia, streamside daisy, featherleaf navarettia, Lobb's buttercup, Tiburon Indian Paintbrush, Tiburon Jewel flower, California grass of Parnassus, Tiburon mariposa lily, Santa Cruz clover, pitted onion, long-rayed brodiaea, serpentine coyote mint

Challenges to Marin County's biodiversity include controlling and eliminating invasive species because they displace native plants and can change ecosystem functions. Small shrubs are particularly hard to control because they may be widely distributed spatially. In addition to displacing native species, some invasive shrubs can form a dense understory beneath forest canopies and could alter fire behavior and severity. Invasive trees, shrubs, plants, and grasses in Marin County include:

1.5.1.5 **Trees** – acacia, blue gum eucalyptus, Monterey cypress, Monterey pine

1.5.1.6 **Shrubs** – cotoneaster, French broom, Himalayan blackberry, Pride of Madeira, Scotch broom, Spanish broom

1.5.1.7 **Plants** – Bull thistle, purple star thistle, wooly distaff thistle, yellow star thistle, fennel, highwayice plant (also known as Hottentot fig), perennial pepper weed (also known as tall whitetip), puncture vine, stinkwort, thoroughwort (also known as eupatorium)

1.5.1.8 **Perennial Grasses** – cordgrass, erect veldt grass, Fescue, Harding grass, jubata grass/pampasgrass, velvet grass

1.5.1.9 **Annual Grasses** – barbed goat grass, Italian wildrye, medusa head, rattlesnake grass, wild oats

1.5.2 Watersheds and Water Districts

There are more than 21,000 acres of protected watershed land on Mt. Tamalpais and in the west Marin hills, including seven reservoirs which provide 75% of the water for central and southern

Marin. The Marin Municipal Water District (MMWD) was founded in 1912 and manages the watershed land in central and southern Marin, including the seven reservoirs. The MMWD watershed has 92 miles of roads, 59 miles of trails, and a network of wildfire protection fuel breaks. Access and use of the lands by the public is limited to protect the natural landscape. During extreme fire weather conditions, such as Red Flag Warnings and other emergencies, vehicle access is limited on MMWD land.

The North Marin Water District (NMWD), founded in 1948, is an independent special district in the northern portion of the county and operates under the authority of Division 12 of the California Water Code. NMWD provides water service to the greater Novato area and to areas of West Marin (Point Reyes Station, Olema, Bear Valley, Inverness Park, and Paradise Ranch Estates). NMWD purchases approximately 80% of its Novato water supply from the Sonoma County Water Agency, with the remaining 20% derived from the District's Stafford Lake Reservoir (located in Marin County just west of Novato) and recycled water (Bentley and Landeros, 2015).

1.6 Marin County's Wildland Urban Interface

The WUI zone map used throughout this CWPP was assembled using geographic information system (GIS) data layers acquired from the Marin County GIS web portal, MarinMap. The WUI zone helps inform decisions on where to focus vegetation management and fuel reduction projects. The WUI zone determination is also a major component of MCFD's Strategic Fire Plan (Marin County Fire Department, 2017), which in turn is part of CAL FIRE's Strategic Fire Plan.

Homes and structures located anywhere in and around the WUI are at a higher risk for exposure to wildland fire. Fire can spread rapidly throughout WUI areas through adjacent structures and/or vegetation, or by ember dispersion. Property owners in the WUI have a responsibility to prepare their property for structure defense by providing adequate defensible space and complying with WUI building codes and ordinances (see Section 7). The WUI boundaries for Marin County were determined based on areas with high structure density and proximity to areas with a high density of burnable fuels.

Figure 4 shows Marin County's WUI boundaries overlaid with population density; as shown in the figure, much of the county's population resides in or near the WUI. Unincorporated rural areas within the county include the coastal communities of Muir Beach, Stinson Beach, and

Bolinas; communities near Tomales Bay including Olema, Point Reyes Station, Inverness, Inverness Park, Marshall, Tomales, and Dillon Beach; and rural areas in the interior valleys including Nicasio, Lagunitas, Forest Knolls, San Geronimo, and Woodacre. These communities are primarily situated within or adjacent to the WUI, with moderate to dense concentrations of structures. Marin County has approximately 60,000 acres of WUI adjacent to 200,000 acres of watershed. Response times in these communities present significant challenges to keeping fires from directly impacting the communities and sub- divisions (especially those within the SRA) as emergency fire access and evacuation egress is limited by narrow, winding roads lined with dense vegetation.

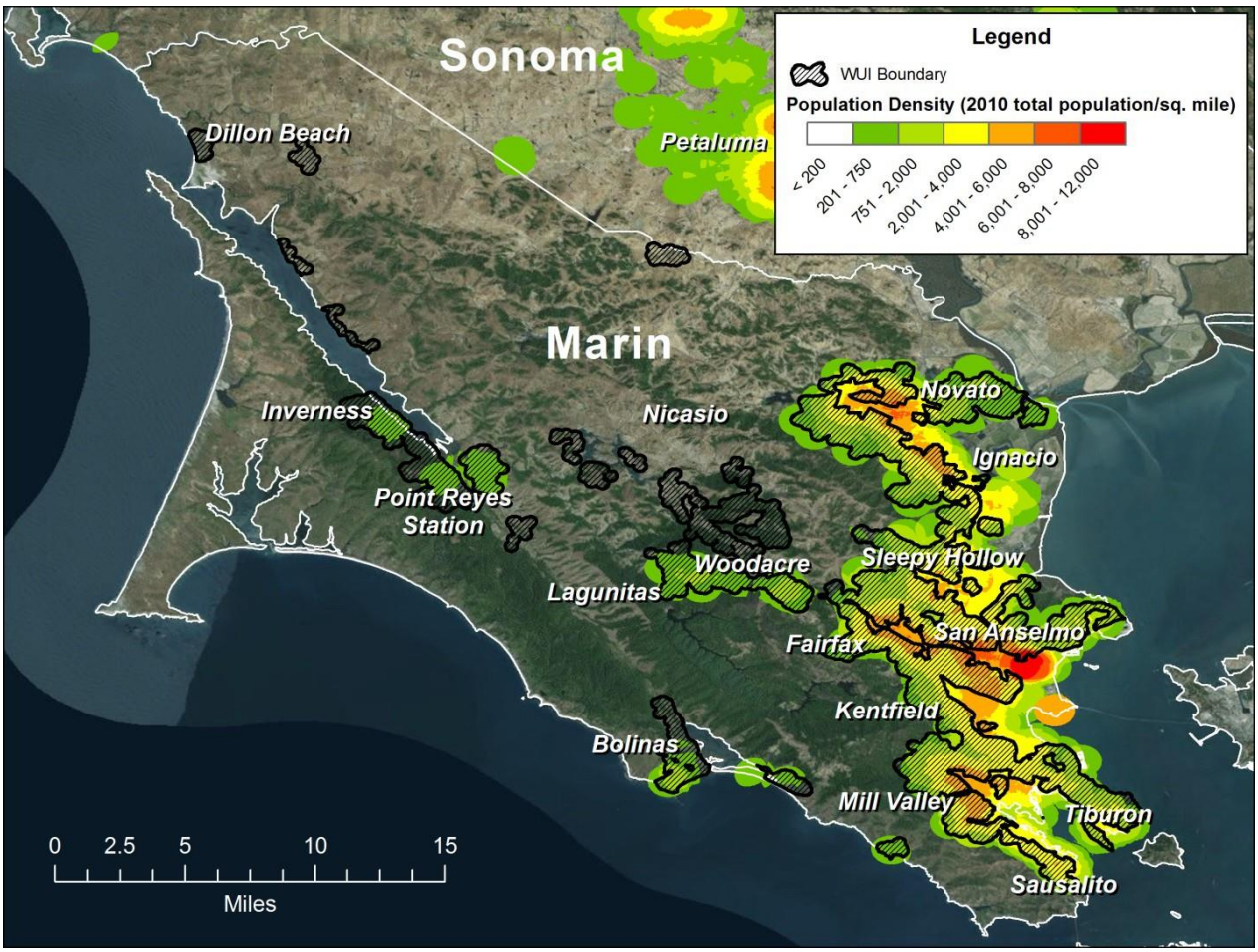


Figure 4. Population density in and around Marin County's WUI.

1.7 Roads and Streets

Many homes in Marin County stand on hillsides and ridges, with narrow and winding roads providing the only access routes through neighborhoods and communities. In addition, cul-de-sacs generally serve new housing developments and most of the smaller canyons, valleys, and hillsides. Some planned unit developments are accessed by privately maintained roads, which create access issues (i.e., narrow paved widths and limited on-street parking). According to California Fire Code specifications, roadways that are considered hazardous in terms of fire access and protection are those with

- Less than 20 feet of unobstructed paved surface and 13.6 vertical feet,
- Dead-ends longer than 800 feet, and
- Cul-de-sac diameter less than 68 feet.

Driveways that are less than 16 feet wide or that do not have adequate turnaround space are also considered hazardous. A large number of roadways and driveways in many of Marin County's communities fall into one or more of the above categories.

An article in the Marin Independent Journal (August 23, 2019) discussed how several communities in Marin could face major traffic during a disaster. The article was based on research by Streetlight DataInc.[22] that was inspired, in part, by the gridlock faced by residents of Paradise, California, during the Camp Fire in 2018. Researchers looked at communities of 40,000 residents or less across the country,showing how traffic would flow during an emergency and pointing out potential bottlenecks. Of the 30,000 communities analyzed, about 800 had scores that were three or more times the national average, including 107 in California, indicating that residents in California have fewer options than average when evacuating during an emergency. Twenty-two of the towns and cities are in the Bay Area, and of these, seven are in Marin County.

Vegetation maintenance adjacent to roadways is an issue throughout Marin County. Primary highways such as Highways 1, 101, and 37 are maintained at the state level by the California Department of Transportation (Caltrans). Other primary and secondary roads are maintained at the county, city, or town level. Primary and secondary roads in State Park or NPS lands are maintained by the land ownership agency. There are many private roads in unincorporated parts of Marin County. The California Civil Code requires that these roads be maintained by private

property owners and responsibility be shared equitably by the landowners benefiting from these roads.

2. Fire Environment

The mix of weather, diverse vegetation and fuel characteristics, complex topography, and land use and development patterns in Marin County are important contributors to the fire environment. The MCFD Woodacre ECC currently manages the data from five Remote Automated Weather Stations (RAWS) for predicting fire danger utilizing the National Fire Danger Rating System (NFDRS) during the fire season. The RAWS are located in Woodacre, Middle Peak (of Mount Tamalpais), Mount Barnabe, Big Rock and Novato.

2.1 Weather

Marin County is bounded by the cool waters of the Pacific Ocean to the west, the San Francisco, and Richardson Bays to the southeast, the San Pablo Bay to the east, and Sonoma County agricultural lands to the north. The combination of these large bodies of water, location in the mid-latitudes, and the persistent high pressure over the eastern Pacific Ocean results in several micro-climates. Weather in the county consists of warm, dry summers and cool, wet winters. The climate in early fall and late spring is generally similar to the summer, and late fall is similar to winter. Spring is generally cool, but not as wet as the winter. While these general weather conditions are fairly representative of the typical Marin County weather, complex topography, annual variability of weather patterns, and less frequent and transient weather patterns are important to fire conditions.

Typical Summer Weather Conditions

In the late spring through the fall, the combination of frequent and strong high-pressure systems (known as the Pacific High) over California, combined with the cool waters of the ocean/bays, results in persistent fog and low clouds along the coast (including over southern Marin County near the San Francisco Bay). The fog often penetrates into the inland valleys of northern and central Marin County, especially during overnight hours. At the coastline, mist from fog can keep the land surfaces modestly moist, while inland land surfaces above the fog or inversion are often very dry.

The Pacific High that persists from late spring through early fall over the eastern Pacific, combined with a thermal low pressure over the Central Valley of California, results in an almost continuous sea breeze. These winds usher in cool and moist air and can be strong (15 to 25 mph), especially over the ridge tops and through valleys running northwest to southeast, including San Geronimo/Ross, Hicks, and Lucas Valleys. These westerly winds are usually highest in the afternoon, decrease in the evening, and are light overnight before increasing again in the late

morning/early afternoon.

Extreme Summer Weather Conditions

Occasionally in the mid- to late-summer and more often in the fall and early winter, the Pacific High moves inland and centers over Oregon and Idaho, while low pressure moves from the Central Valleyof California to southern California and Arizona. The resulting north-to-south pressure gradient can be strong enough to retard the typical sea breeze and can result in winds blowing from the land to the ocean. These easterly winds occur as systems of high pressure form in the Great Basin and flow over the Sierra Nevada Mountains (from the east) toward the Pacific Ocean (to the west). As winds flow over the Sierra Nevada, the winds compress, become warmer, and lower the relative humidity while drying out vegetation. As the winds move through canyons, they pick up speed and create strong gusts (**Figure 6**). These Northern California Diablo winds are most common in the late summer through early winter. It is under these wind regimes that California typically experiences its largest and most destructive fires.

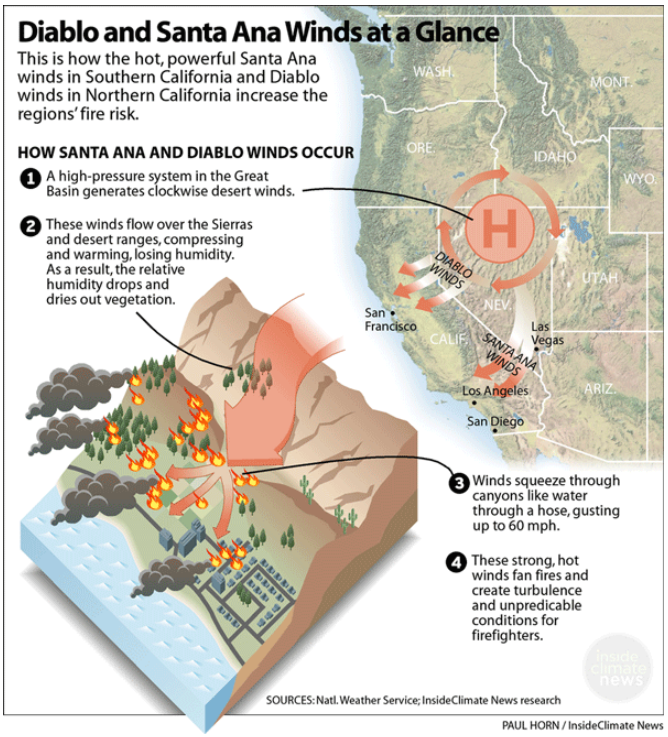


Figure 6. Illustration and explanation of the Diablo and Santa Ana winds. Source: NationalWeather Service, Inside Climate News research.

Under these “Diablo” wind conditions, observed most recently during the northern California fires of 2017, 2018, and 2020, temperatures in Marin County can reach 100°F or higher in the inland areas and 80°F or higher at the coast, and relative humidity can be very low. In addition, wind speeds can be high (20 to 40 mph) and gusty and are often much higher over the mountains and ridge tops of Marin (such as Mt. Tamalpais, Loma Alta, and Mt. Burdell) than over low-lying areas. Historically, the largest and most destructive fires in Marin, including the Vision Fire, the Angel Island Fire, and the Woodward Fire, have occurred during these offshore (also known as Foehn) wind events.

A few times per year in the summer and fall, monsoonal flow from Mexico brings moist and unstable air over central and northern California, which can result in thunderstorms with or without precipitation. With the otherwise dry summer conditions, the lightning can ignite fires. These monsoonal flow patterns are usually only one- to two-day events.

In August 2020, Northern California experienced a rare dry lightning weather event that ignited hundreds of wildfires. The lightning was caused by widespread, severe summer thunderstorms that formed from an unusual combination of very hot, dry air at the surface and advection of moisture from the remains of Tropical Storm Fausto that traveled northward into the Bay Area. Many of the lightning-ignited fires formed complex fires, the largest of which were the August Complex, the SCU Lightning Complex, the LNU Lightning Complex, and the Creek fire. As of November 8, 2020, approximately 4.2 million acres had burned in California as a result of these and other fires.[23]

Winter Weather Conditions

Beginning in late November and lasting through the end of March, the Pacific High moves south and weakens, allowing storms that originate in the Gulf of Alaska to move over California. These storms bring precipitation and, at times, strong winds out of the south. Each storm usually results in one-fourth inch to several inches of rain over a day or so. Near Mt. Tamalpais, rainfall amounts are enhanced by orographic lifting, resulting in higher rain amounts in the Kentfield and Fairfax areas compared to the rest of the county. Typically, after the first rain in November, the cool weather and occasional storm keeps the ground wet through late Spring. However, in some years, significant rain does not occur until later in the year (e.g., early-to-late December) and there can be several weeks without any storms and rain. During storms, temperatures are usually mild.

When there are no storms over California, a land-breeze typically forms (i.e., winds blowing from the Central Valley to the Pacific Ocean). These winds can reach 30 mph, and travel through the southeast to northwest lying valleys, over low-lying ridges such as the Marin

Headlands, and through the Golden Gate. These winds are usually highest in the mid-morning hours and decrease in the afternoon as the Central Valley warms during the day. The winds are associated with cold and modestly moist air.

Spring Transitional Conditions

In late February/early March through late April, the Pacific High strengthens and moves north, and storms impacting the county become less frequent. During this time of year there is often a low-pressure area over the desert in southwest California. The combination of the Pacific High to the north and low-pressure to the southwest results in strong winds blowing from the northwest to the southeast. Like the sea breeze, these winds bring in cool, moist air and are usually highest in the afternoon hours. Because of winter and spring rains, the land is wet and there is little danger of wildland fire despite the high winds and only occasional precipitation. There is often little coastal fog this time of year.

2.2 Vegetation and Fuels Characteristics

Vegetation, which is also known as fuel, plays a major role in fire behavior and potential fire hazards. A fuel's composition, including moisture level, chemical make-up, and density, determines its degree of flammability. Of these, fuel moisture level is the most important consideration. Generally, live trees contain a great deal of moisture while dead logs contain very little. The moisture content and distribution of fuels define how quickly a fire can spread and how intense or hot it may become. High moisture content will slow the burning process since heat from the fire must first eliminate moisture.

In addition to moisture, a fuel's chemical makeup determines how readily it will burn. Some plants, shrubs, and trees such as chamise and eucalyptus (both present in Marin County) contains oils or resins that promote combustion, causing them to burn more easily, quickly, and intensely. Finally, the density of a fuel influences its flammability; when fuels are close together but not too dense, they will ignite each other, causing the fuel to spread readily. However, if fuels are so close that air cannot circulate easily, the fuel will not burn freely.[10]

[10] **http://www.nps.gov/fire/wildland-fire/learning-center/fire-in-depth/fire-behavior.cfm**

Marin County has extensive topographic diversity that supports a variety of vegetation types. Environmental factors, such as temperature, precipitation, soil type, aspect, slope, and land use history, all help determine the existing vegetation at any given location. In the central and eastern parts of the county, north facing slopes are usually densely wooded from lower elevations to ridge peaks with a mixture of mostly hardwood tree species such as coast live oak, California bay, Pacific madrone, and other oak species. Marsh lands are also present throughout the county; once ignited, marsh fires can be difficult to contain and extinguish.

Grasslands with a mixture of native and non-native annual and perennial plant species occur most often in the northern and western parts of the county due to a combination of soil type, lower rainfall, and a long history of ranching. The southern and western facing slopes tend to have a higher percentage of grasslands, which in turn have the potential to experience higher rates of fire spread. Grassland fires are dangerous even without extreme fire weather scenarios due to the rapid rate of fire spread; in some cases, fires spread so quickly that large areas can burn before response resources are able to arrive.

In the west portion of the county closer to the coast, where precipitation is higher and marine influence is greater, most areas are densely forested with conifer species (i.e., Bishop pine, Douglas- fir, and coast redwood) and associated hardwood species. Chaparral vegetation also occurs in parts of the county, especially on steeper south and west facing slopes. This mix of densely forested areas mixed with chaparral results in higher fuel loads and potentially higher fire intensity. Expansion of the residential community into areas of heavier vegetation has resulted in homes existing in close proximity to dense natural foliage; these homes are often surrounded by highly combustible or tall vegetation, increasing the potential that wildland fires could impact them. As part of the development of this CWPP, an updated vegetation map layer was created using the most recent vegetation information available from a variety of state and local data sources. Vegetation distribution in Marin County is characterized by approximately 20 different types of vegetation which have been classified into 15 fire behavior fuel models. **Table 7** lists the fuel model types for Marin County, while **Figure 5** shows a fuel model map; the data shown were developed to support this CWPP and represent the most up-to-date and highest-resolution vegetation coverage information for the county. The methods used to develop the data set are described in Section 4.

Table 7. Fuel model types for Marin County.

Scott & Burgan Fuel Model Description and Number	Acres	Percent of County Total
Moderate load, dry climate grass (104)	79,727	24%
Short, sparse, dry climate grass (101)	62,050	18%
Very high load broadleaf litter (189)	51,227	15%
Low load, humid climate timber-shrub (144)	29,637	9%
Very high load, dry climate timber-shrub (165)	29,120	9%
High load, dry climate shrub (145)	24,186	7%
Urban/developed (91)	18,714	6%
Low load compact conifer litter (181)	7,008	2%
Moderate load dry climate shrub (142)	6,308	2%
Low load, very coarse, humid climate grass (103)	6,147	2%
Very high load, dry climate shrub (147)	5,572	2%
Open water (98)	5,514	2%
Moderate load, humid climate timber-grass-shrub (163)	2,324	1%
Bare ground (99)	2,169	1%
Other	6,412	2%
Total	**336,116**	**100%**

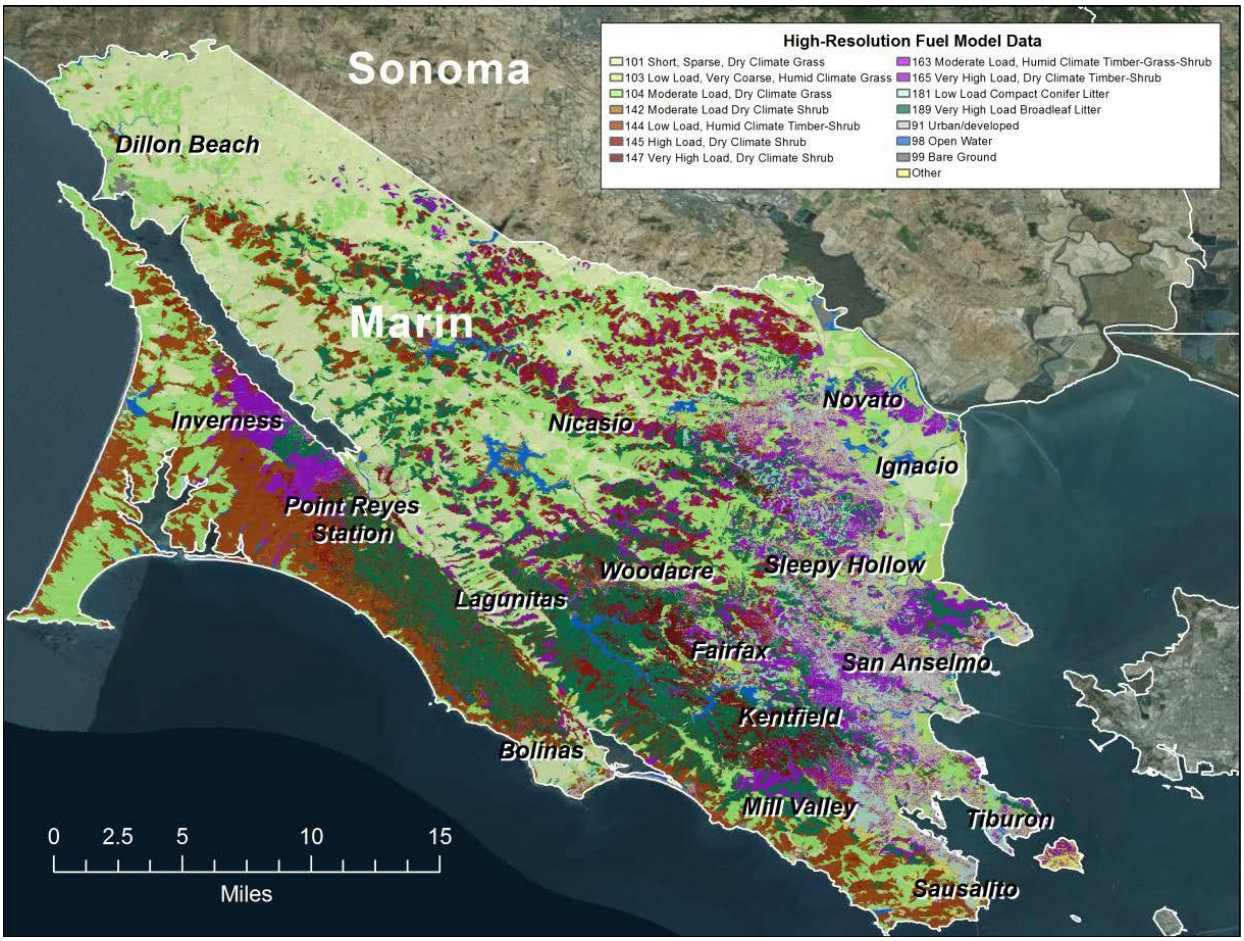


Figure 5. Updated high-resolution (5 x 5 meter) fuel model map for Marin County.

2.2.1 Vegetation Diseases and Infestations

Insect infestations and plant diseases, such as California oak mortality syndrome (sudden oak death), are increasing and threaten to change the structure and overall health of native plant communities in Marin County (May & Associates Inc., 2015). Sudden oak death has no known cure and is the biggest concern; this syndrome is caused by the fungus-like Phytophthora ramorum, which has led to widespread mortality of several tree species in California since the mid-1990s; the tan oak (Lithocarpus densiflorus) in particular appears to have little or no resistance to the disease. Sudden oak death has resulted in stands of essentially dead trees with very low fuel moistures. Studies examining the impacts of sudden oak death on fire behavior indicate that while predicted surface fire behavior in sudden oak death stands seems to conform to a common fuel model already in use for

hardwood stands, the very low moisture content of dead tan oak leaves may lead to crown ignitions more often during fires of “normal”intensity (Lee, 2009).


Photo by USFS Region 5[11]

Two other plant diseases prevalent in Marin County are pitch canker (which affects conifers such as Bishop pine and other pine species), and madrone twig dieback (which affects Pacific madrones). Pitch canker is caused by the fungus Fusarium circinatum F. subglutinans, F. sp. pini), which enters the tree through wounds caused by insects. While some trees do recover, most infected trees are eventually killed by the fungus. Management of this disease largely focuses on containment to reduce the fungus spreading to other trees. Pitch canker is a particular issue in the NPS lands of Pt. Reyes National Seashore, where many acres of young Bishop pines that were seeded on the Inverness Ridge by the Mount Vision Fire of 1995 have been infected. These dead and dying trees have created large swaths of land with dense and dry fuel loads.

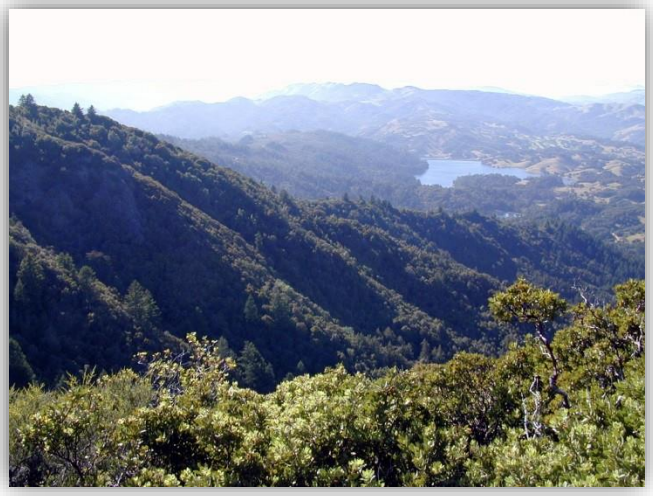
Madrone twig dieback is caused by the native fungus Botryosphaeria dothidea and appears to begetting worse throughout the county due to drought effects on Pacific madrones.

Three additional threats to trees common to Marin County include:

- Bark and ambrosia beetles (Monarthrum dentiger and monarthrum scutellare), which target oak and tan oak trees. Sudden oak death may be exacerbating the effects of beetle infestations which prey on trees already weakened by this disease.
- Root rot, caused by oak root fungus (Armillaria mellea), is primarily associated with oaks and other hardwoods but also attacks conifers. These fungal infestations cause canopy thinning and branch dieback and can kill mature trees. As with the beetle infestations, sudden oak death may be exacerbating the effects of root rot fungus in the county forests.
- Velvet-top fungus (Phaeolus schweinitzii) is a root rot fungus affecting Douglas-fir and other conifers, with the infection typically occurring through a wound.

[11] “Dead Coast Live Oak in Marin.Steve Swain[1]” (**https://www.flickr.com/photos/usfsregion5/5812704230/**) by the USFS Region 5 (**https://www.flickr.com/photos/usfsregion5/**) is licensed under CC BY 2.0 (**creativecommons.org/licenses/by/2.0/legalcode**). No changeswere made to this image.

2.3 Topography



Topography characterizes the land surface features of an area in terms of elevation, aspect, and slope. Aspect is the compass direction that a slope faces, which can have a strong influence on surface temperature, and more importantly on fuel moistures. Both elevation and aspect play an important role in the type of vegetation present, the length of the growing season, and the amount of sunlight absorbed by vegetation. Generally, southern aspects receive more solar radiation than northern aspects; the result is that soil and vegetation on southern aspects is warmer and dryer than soil and vegetation on northern aspects. Slope is a measure of land steepness and can significantly influence fire behavior as fire tends to spread more rapidly on steeper slopes. For example, as slope increases from 20 – 40%, flame heights can double and rates of fire spread can increase fourfold; from 40 – 60%, flame heights can become three times higher, and rates of spread can increase eightfold.[12]

Marin County is topographically diverse, with rolling hills, valleys, and ridges that trend from northwest to southeast. Elevation throughout the county varies considerably, with Mt. Tamalpais' peak cresting at 2,574 feet above sea level and many communities at or near sea level. Correspondingly, there is considerable diversity in slope percentages. The San Geronimo Valley slopes run from level (in the valley itself) to near 70%. Mt. Barnabe has slopes that run from 20 to 70%, and Throckmorton ridge has slopes that range in steepness from 40 – 100%. These slope changes can make fighting fires extremely difficult.

2.4 Fire History

Understanding fire history is important when predicting potential future fire frequency, fire behavior, and ignition sources. The historical record shows that many large wildfires (greater than 500 acres) have occurred in Marin since 1850. Many more frequent and smaller fires have occurred throughout Marin and this knowledge helps us understand the likely processes,

scenarios, and locations of future fires.

Marin's native vegetation evolved with the presence of frequent wildfires, ignited both by natural causes (primarily lightning) and by native peoples. Relatively short intervals of 2 to 20 years between wildfires promoted the health and regeneration of native grasslands, oak woodlands, and forests, favoring plant (and animal) species that were best adapted to fire. These low-intensity and relatively frequent wildfires are generally considered to have been "beneficial" to the landscape, supporting and expanding native grasslandsand increasing biodiversity and productivity of chaparral and coastal scrub ecosystems (Sugihara etal., 2006).

The most frequently burned landscapes in California prior to 1850 were ignited, often on a nearly annual basis, by Native Americans (Lewis et al.,1993; Keter,1995) and were generally near villages or where vegetation was cultured for food and basketry materials, such as grasslands and oak woodlands. In general, the most frequent fires occurred in grass lands and oak woodlands in areas like the GGNRA headlands. Lightning fires were common and would burn large swaths of the landscape, with research showing that the average wildfire interval in Marin County before the arrival of Europeans was less than seven years (Stephens et al., 2007; Jacobs et al.,1985).

Fire records for Marin are incomplete, but historic newspaper articles and old fire planning studies document an active fire history going back to the early 20th century. Throughout its history, Marin County has experienced many wildland fires. The most recent significant fire in Marin was the Woodward Fire which started on August 17, 2020, by lightning from a rare dry lightning weather event. The Woodward Fire wascontained by October 9, 2020, at 4,929 acres.[27] The last fire in Marin that resulted in significant structure loss was the Vision Fire in 1995, which destroyed 48 structures in the community of Inverness.

In 1929, the base of Mt. Tamalpais—specifically the community of Mill Valley—experienced a significant fire known as the Great Mill Valley Fire. That fire's footprint is now developed with approximately 1,100 homes (with an "improvement" assessed value of $1.64 billion) which have significantly altered the natural vegetation through urban and suburban development. **Figure 8** shows a map of fires larger than 200 acres that have occurred in Marin from 1878 to 2019 (CAL FIRE California Fire Perimeters 1878 to 2019).[28] Note that the map in Figure 6 also shows the perimeter of the Woodward Fire, which occurred in 2020.

[27] **https://www.nps.gov/pore/learn/management/firemanagement_woodwardfire.htm.**
[28] **https://www.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=6fd0d8d6f47d414da7bcb1dcd0539999**.

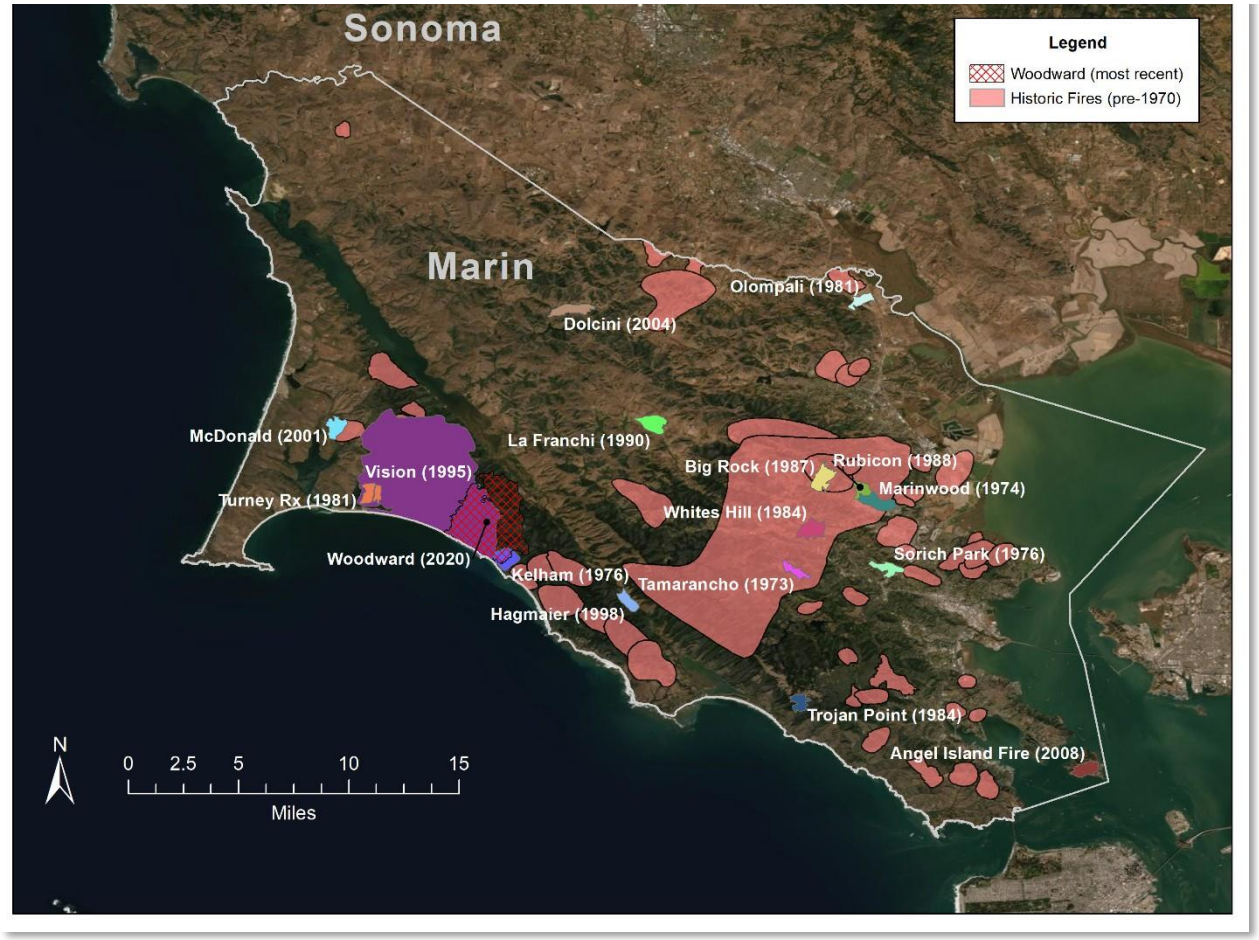


Figure 6. Map of fires larger than 200 acres that have occurred in Marin from 1828 to 2019. Note that the map also shows the perimeter of the Woodward Fire, which occurred in 2020.

13 Adapted from **http://www.marincounty.org/depts/fr/divisions/administration/history/1910**

3. Ignition History

Ignition data from CAL FIRE were mapped to evaluate ignition sources and patterns within the county. **Figure 9** shows a map of the ignition history for Marin County from 2004 through 2019, classified by ignition category (CAL FIRE California Ignition History 2004 to 2019).

The 9-year ignition history identifies the majority of ignition sources as structure, natural vegetation, and vehicles.

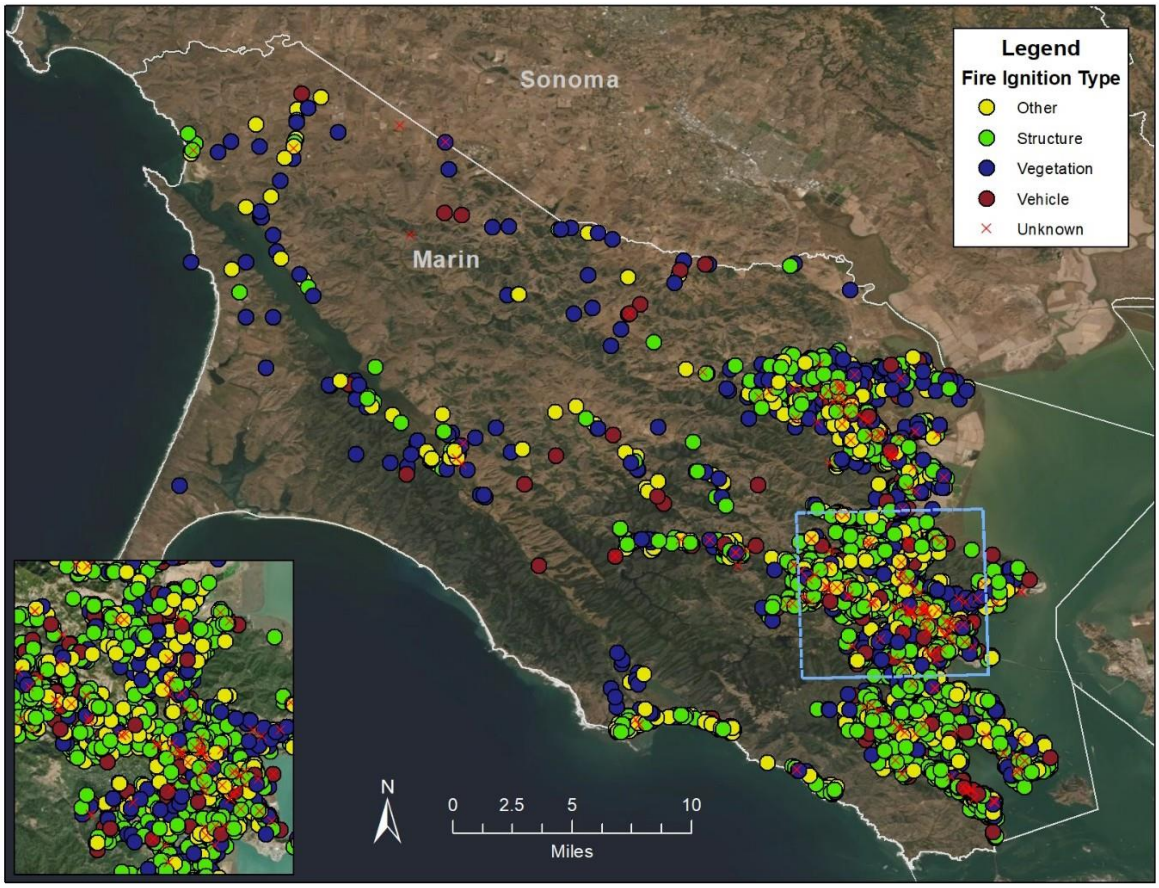


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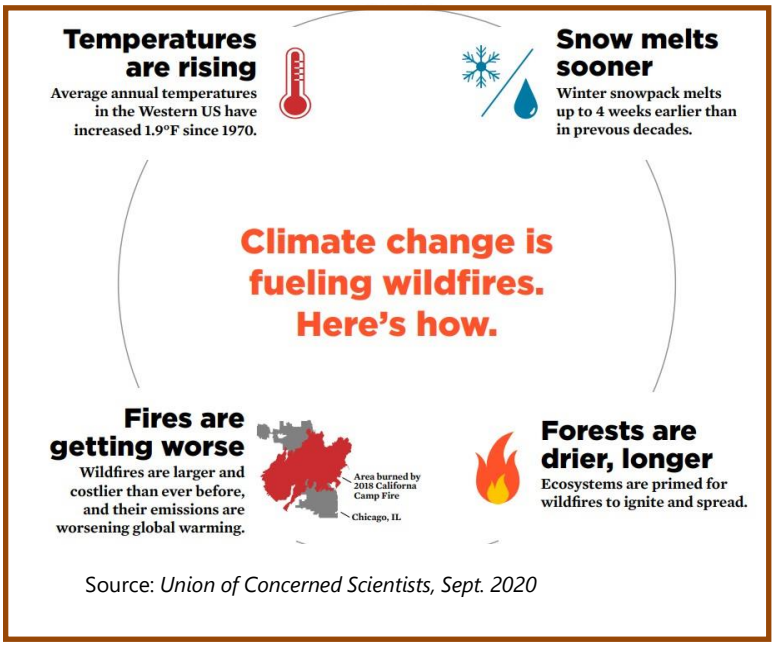
Figure 9. Map of ignition history data for Marin County from 2004 through 2019.

2.6 Climate Variability

Abundant scientific research projects higher summer temperatures which will likely increase the annual window of high fire risk. A warmer climate will certainly amplify the effects of drought and is expected to increase the number of days in a year that fuels /vegetation are at critical live-fuel moisture levels, thereby extending fire seasons and increasing acreage burned. Future changes in fire frequency and severity are difficult to predict.

Regional climate change associated with elevated greenhouse gas concentrations could alter large weather patterns, thereby affecting fire weather conducive to extreme fire behavior. Fuel and vegetation treatments will be challenging to implement at spatial scales large enough to make a difference especially if the number and frequency of wildfires increases greatly in the future, but fuel and vegetation treatments can enhance resilience in areas with high resource and economic values (e.g. the wildland urban interface).Dry winters plus warm spring temperatures contribute to early snow melt, resulting in drier soils in early summer, leading to a longer dry season with dryer vegetation increasing the likelihood of more fires.

The western U.S. is likely to continue its trend toward warmer and drier conditions, on average, with warmer spring and summer temperatures, reduced snowpack, and earlier snowmelts, and longer, drier summer fire seasons (Westerling et al., 2006; Westerling, 2018). Models and observations predict that warming and drying conditions are likely to cause increased fire activity in the future, including reconstructions of fire and climate in the past (Swetnam, 1993); trends over the last few decades (Westerling et al., 2006);and predictive models (Westerling and Bryant, 2007). Increased drought and heat have already caused an increase in tree mortality.



Source: *Union of Concerned Scientists, Sept. 2020*

Large and destructive wind-driven fires exhibiting extreme fire behavior, such as those that occurred in 2017, 2018, and 2020 in California, are likely to continue in the coming years, emphasizing the immediate need for pre-fire planning and mitigation to protect homes, infrastructure, and other assets at risk.

Healthy forests, natural vegetation, and home landscapes sequester carbon from the atmosphere.

The term “carbon sequestration” refers to the biological process where plants take carbon dioxide out of the atmosphere through photosynthesis, store the carbon in their tissues, and send carbon through roots to the soil, where it can be stored long-term. Encouraging land management practices that support carbon sequestration has the potential to help mitigate climate change.

4. Collaboration

A key requirement when developing a CWPP is stakeholder and community involvement and collaboration. A CWPP provides a mechanism for obtaining community input and identifying high risk areas, possible fire hazards, and potential projects intended to mitigate areas of concern and fire hazard. This Plan integrated this community-focused approach through a number of public and stakeholder meetings and is intended to provide the community a forum for identifying assets and communities at risk from wildfire.

Stakeholder input and review was actively sought throughout the development of this CWPP. The information contained in this plan is a reflection of county stakeholders and the public working together to develop a living document that can be used over the next 5 to 10 years to implement the recommended action plan described in Section 8. In addition to feedback from elected officials and public citizens throughout Marin County’s cities and towns, **Table 9** lists the stakeholders comprised of fire agencies, land management agencies, utility operators, homeowners’ associations, FIRESafe MARIN, and other private and public entities that participated in this CWPP process.

Table 9. Participants in this CWPP process.

Public, Private, and Volunteer Fire Agencies and Associations			
Marin County Fire Department	Ross Valley Fire Departmen t	San Rafael Fire Departme nt	Southern Marin Fire Protection District
Tiburon Fire Protection District	Central Marin Fire District		Marinwood Fire Department
Mill Valley Fire Departme nt	Novato Fire Protection District	Bolinas Fire Protection District	Stinson Beach Fire Protection District
Inverness Public Utilities District	Nicasio Volunteer Fire Department	CAL FIRE	Skywalker Ranch Fire Brigade
Muir Beach Volunteer Fire Department	Kentfield Fire Protection District	Tomales Volunteer Fire Department	Marin County Fire Chiefs Association
Land Management Agencies			
National Park Service	Marin Municipal Water District	Marin County Parks and Open Space District	California State Parks
Private Groups and Foundations			
Pacific Gas and Electric		North Bay Conservation Corps	
Homeowners Associations			
Homeowners Associations throughout Marin County	West Marin ranch and agricultural landowners		Large private landowners

3.1 Marin Wildfire Prevention Authority

Following the North Bay fires of 2017 and fire season of 2018, the Marin County Civil Grand Jury (Grand Jury) conducted an assessment of Marin County's fire vulnerability and preparedness. Following the assessment, the Grand Jury issued a report in April 2019 entitled *Wildfire Preparedness:A New Approach* (Marin County Civil Grand Jury, 2019). The Grand Jury report concluded that Marin faces unprecedented danger to life and property from wildfire. Following the Grand Jury report, tax Measure C was passed and the MWPA was formed to develop and implement a comprehensive wildfire prevention and emergency preparedness plan throughout

almost all of Marin County. Key elements of this program include:

5. Vegetation Management
   - Through multiple strategies (work crews, goats, contractors, and machinery) the MWPA will fund efforts to reduce fuels and help to ensure that we are implementing the most cost-effective practices for fuel reduction on an ongoing basis.

2. Wildfire Detection & Evacuation Program Improvements
   - The MWPA will implement safety measures that will improve early wildfire detection, warning and alerts as well as improve disaster evacuation routes for organized evacuation.

6. Grants
   - The MWPA will provide a local grant program ensuring residents with access and functional needs, seniors, and financially disadvantaged reduce fire risk of their properties and the greater surrounding community.
   - The MWPA will also seek grants and leverage local investments for wildfire prevention and disaster preparedness programs.

7. Public Education
   - The MWPA will provide expert information and assistance to help the public reduce the risk, prevent wildfires, and be prepared for potential disaster.
   - Additionally, the MWPA will support FIRESafe MARIN community outreach efforts

8. Defensible Space Evaluations
   - Funding will be allocated to expand and enhance defensible space home evaluations to ensure homes meet fire and building codes, as well as education to reduce the vulnerability of a home.
   - This work could be done by the JPA with a shared service model or by the responsible fire agency.

6. Local Wildfire Prevention Mitigation
   - The MWPA will provide local funding to JPA members for specific local wildfire mitigation needs specific to their service area.

3.2 FIRESafe MARIN

FIRESafe MARIN (FSM), Marin County's Fire Safe Council, promotes public and private

partnerships toenhance wildfire safety and build Firewise Communities.[14] FSM is a nonprofit organization with the dual mission of reducing wildland fire hazards and improving fire-safety awareness in Marin County. FSM receives significant investments through CAL FIRE SRA Grants, PG&E Grants, other state and federal entities, and private donations. This CWPP work was funded through a CAL FIRE SRA grant to FSM.

3.3 Fire Agencies

To engage local fire departments and agencies in the CWPP process, a stakeholder meeting was held specifically for fire chiefs representing all fire departments in the county. The meeting was held on August 20, 2015, from 9:00-11:30 a.m. at the Novato Fire District administrative office. Meeting attendance included at least one representative from each department or district in Marin County.

The format of the meeting included a brief presentation by the CWPP team followed by a question and answer session. During this meeting, the fire chiefs were asked to identify the areas of concernand hazard mitigation projects within their jurisdictions (see **Figure 8** in Section 4.1.1). This information was processed for use in developing this CWPP.

3.4 Land Management Agencies

To engage Marin's land management agencies, three stakeholder meetings were held. The format of the meetings included a brief CWPP project update followed by a question and answer session. Each land management agency was asked to provide information regarding areas of concern and hazard mitigation projects within their jurisdictions. This information was processed for use in developing this CWPP.

The cities within Marin County, along with land management agencies, work to reduce fire hazards as directed by their management and planning documents. Planning is driven by the goals of protecting natural habitat and special species while managing the growth of invasive species. Management strategies can be challenging and require interagency cooperation and collaboration in fuel break and fuel reduction areas. Emphasis during fuel treatment planning will need to consider how to minimize the introduction, spread, and removal of invasive species. Agencies within Marin County include:

- **National Park Service** – works under the guidance of a Fire Management Plan (FMP) which has gone through the federal environmental compliance process. The FMP's priority is to increase the reduction of hazardous fuels in high priority areas using prescribed fire and mechanical treatments (e.g., along road corridors, around structures, and in strategic areas tocreate fuel breaks).
- **Marin Municipal Water District** – currently operates under the Mt. Tamalpais Area Vegetation Management Plan (VMP). The MMWD released its draft Wildfire Protection and Habitat Improvement Plan in August 2012 (Leonard Charles and Associates, 2012).

9. The National Fire Protection Association (NFPA) established the Firewise Communities Program to encourage local fire safety solutions by involving homeowners to take individual responsibility for preparing their homes for the risks of wildfires. The Firewise program uses their website (**http://www.firewise.org/**) to provide information and promotes ways to keep homes from igniting.

- **Marin County Parks and Open Space District** – released its draft Vegetation and Biodiversity Management Plan (VBMP) in April 2015 to direct resource management efforts on the county's 34 preserves to maintain and increase biodiversity while reducing the risk of wildfire(May & Associates Inc., 2015). MCOSD manages nearly 16,000 acres including an extensive network of approximately 249 miles of roads and trails. A significant portion of MCOSD's preserves are adjacent to private homes, structures, and evacuation routes; consequently, a great deal of effort is involved in working with neighbors and other local agencies to resolvedisputes over responsibility for fuel reduction and defensible space.
- **CA State Parks** – reviews all proposed fuel breaks and vegetation modification zones for environmental impacts. The impacts of greatest concern are the spread and proliferation of invasive species and the cost of invasive management in the fuel reduction zones, fragmentation of suitable habitat for native species, impacts to listed and special status species, and sediment issues associated with an increase in bare soil. In lieu of installing fuelbreaks, the State Parks work with MCFD on vegetation modification zones to reduce fire hazards. Vegetation modification areas were completed to State Parks specifications to meetthe goals of fuel reduction while minimizing environmental impacts. State Parks treat many

  fuel modification zones due to increases in invasive plant infestations in the locations where vegetation modification has been employed.
- **Marin Audubon Society** – established in 1956 as part of the effort to prevent development of houses on Richardson Bay tidelands. The Marin Audubon Society (MAS) was one of the founders of Audubon Canyon Ranch, and was instrumental in protecting Bothin Marsh in Mill Valley and the Marin Islands National Wildlife Refuge in San Rafael, which supports the largest heron rookery in San Francisco Bay. MAS restores wetlands on its properties and thendonates many of them to the California Department of Fish and Game and the Marin County Open Space District.[15]

3.5 California Forest and Rangeland Priority Landscapes

The 2010 California's Forest and Rangelands assessment identifies the Bay/Delta in several priority landscape analyses:

1.1 Population Growth and Development Impacts – Bay/ Delta had the highest proportion of at-risk acres on annual grassland, coastal oak woodland, montane hardwood and redwood.

1.2 Sustainable working forest and rangelands – Risk reduction on Rangelands – Bay/Delta was identified as having priority landscapes where range productivity is threatened by wildfire.

2.3 Forest Pest and other threats to Ecosystem Health and Community Safety – Marin County has the 4th highest number of impacted acres by county. 98% of the high priority acres in (Bay/Delta and So Coast) are in the zone of infestation for sudden oak death.

3.3 Planning for and Reducing Wildfire Risks to Communities – Bay/Delta area has 67 communities with CWPPs or have been certified as a FIREWISE community and suggest the presence of community planning resources and experience.

3.6 Green Infrastructure for Connecting People to the Natural Environment – managing green infrastructure. The Bay/Delta area has large acreages of medium priority landscapes, which are typically high value areas at medium threat or medium values at a high threat.

3.7 Climate Change Threats and Opportunities – threats to forest carbon loss due to wildfire, insects, and disease. Year 2020 projections show all bioregions high priority landscapes thru 2050. Threats to forest carbon from development show the greatest threat to loss of terrestrial carbon (forest and range) from development in the Bay Area.

Forests and Rangeland Resource Strategies:

1, Conserve Working Forest and Range Landscape
   1.1 Reduce urban sprawl, strengthen planning at the local level, and improve access to tools and data sources.
2. Protect Forests and Rangelands from Harm
   2.1. Protect life and property from wildfire through efficient and effective fire protection planning and suppression, financial management and firefighter/public safety strategies.
3. Enhance Public Benefits from Trees, Forests and Rangelands
   3.1 Promote formation of local Fire Safe Councils for priority communities
   3.2 Promote the National FIREWISE/USA program.

10. Hazard, Asset, Risk AssessmentApproach

In the context of wildfire hazard, the term “hazard” refers to the presence, structure, and makeup of vegetation fuels and the amount of potential energy that may be released in a given environment or weather condition. The term “risk” is the chance, high or low, that any hazard will cause harm to an asset. An “asset” is anything that has value, such as property, structures, infrastructure, natural resources, etc. The county-level hazard assessment presented in this section focuses on fire hazard relative to structures (buildings and homes) throughout the county.

CAL FIRE is required by law to map areas of significant fire hazards based on fuels, terrain, weather,and other relevant factors. These zones, referred to as Fire Hazard Severity Zones (FHSZ), influence how people construct buildings and protect property to reduce risk associated with wildland fires. The maps were last updated in the 2007. Efforts have been underway for the past several years to update the maps to incorporate improved fire science, data, and mapping techniques. The updated FHSZ maps were completed in 2022 and are undergoing review by the Board of Forestry and are expected to be released in mid-2023.

While the CAL FIRE FHSZ maps are useful in examining potential fire hazard severity at the state level,the underlying data and methods used to develop the FHSZ maps can be improved upon by using local (and more recent) fuel characteristics and improved fire modeling methods. The CAL FIRE FHSZ maps also do not take into account local perspectives on wildfire vulnerabilities and preparedness.

To improve upon and help supplement the state-level fire hazard assessment information, an independent hazard assessment was performed to help identify and prioritize areas within the county that are potentially at a high threat from wildfire based on recent fuels data, advanced modeling techniques, and local input. The assessment was performed by modeling potential fire behavior combined with building structure density to assess relative potential fire hazard throughout the county.

4.1 Assets at Risk

“Assets at risk” are structures, infrastructure, and other resources that can be damaged or destroyedby a wildland fire. Assets in Marin County include real estate (homes and businesses), emergency communication facilities, transportation and utility infrastructure, watersheds, protected wildlands, tourist and recreation areas, and agricultural lands. CAL FIRE’s California Fire Plan identifies the following assets warranting consideration in pre-fire planning: watersheds and water; wildlife; habitat; special status plants and animals; scenic, cultural, and historic areas; recreation; rangeland; structures; infrastructure; and air quality.

Photo by Miquel Vieira[28]

As discussed in Section 1, many homes in the county are located in the WUI; if a major wildlandfire were to result in the loss of many homes, it could have a negative impact on Marin County’s property tax base.

The Mt. Tamalpais watershed supplies central and southern Marin County with 75% of their fresh water. Given the area’s seasonal rainfall, any major wildfire impacting the heavily forested watershed would result in major silting and

subsequent degradation of water quantity and quality in the watershed.

This watershed—as well as the lands managed by MCOSD, State Parks, and NPS—is largely contiguous. The area harbors several endangered, threatened, and special-status species, including the Coho salmon and northern spotted owl. The area is also part of a major migrating bird flyway and nesting area.

Marin County is also a major tourist destination. Major parks within Marin County include California State Parks (Mt. Tamalpais, Samuel P. Taylor, and China Camp), NPS's GGNRA, Muir Woods National Monument, and Point Reyes National Seashore. An estimated 12 to 14 million tourists come to Marin each year to enjoy outdoor activities. In 2018, tourism contributed an estimated $575 million to the economy.[31] A major wildfire affecting any of these parks could have negative impacts on the local economy for years after the event.

Agricultural operations include livestock and livestock products; aquaculture; field crops; and fruit, vegetable, and nursery crops. The gross value of all agricultural production was approximately $98 million in 2019.

To help protect people and property from potential catastrophic wildfire, the National Fire Plan identifies communities that are at high risk of damage from wildfire. These high-risk communities identified within the WUI were listed in the Federal Register in 2001.

In California, CAL FIRE has the responsibility for managing the list. With California's extensive WUI situation, the list of communities extends beyond just those adjacent to Federal lands; there are 1,329 communities currently on the California Communities at Risk List.

Marin County has 23 of these at-risk communities, as shown in **Table 9**. A countywide assessment of the wildland fire threat undertaken by CAL FIRE revealed that nearly 313,000 acres (approximately 82% of the total land area of the county) are ranked as having moderate to very high fire hazard severity zone ratings. With the CAL FIRE's aforementioned re-evaluation of the County's FHSZs, the land area classified as high and very-high fire hazard severity zones is expected to increase substantially.

Table 9. Marin County communities at risk and fire district jurisdiction.

Community	Fire Department/District
Bolinas	Bolinas Fire Protection District
Corte Madera	Central Marin Fire Authority
Fairfax	Ross Valley Fire Department
Inverness	Inverness Fire Department
Inverness Park	Marin County Fire Department
Kentfield	Kentfield Fire Protection District

Lagunitas-Forest Knolls	Marin County Fire Department
Larkspur	Central Marin Fire Authority
Lucas Valley-Marinwood	Marinwood Fire Department
Marin City	Marin County Fire Department
Mill Valley	Mill Valley Fire Department
Novato	Novato Fire Protection District
Olema	Marin County Fire Department
Point Reyes	Marin County Fire Department
Ross	Ross Valley Fire Department
San Anselmo	Ross Valley Fire Department
San Rafael	San Rafael Fire Department
Santa Venetia	San Rafael Fire Department
Sausalito	Southern Marin Fire Protection District
Stinson Beach	Stinson Beach Fire Protection District
Strawberry	Southern Marin Fire Protection District
Tamalpais-Homestead Valley	Southern Marin Fire Protection District
Tiburon	Tiburon Fire Protection District
Tomales	Marin County Fire Department
Woodacre	Marin County Fire Department

One of the objectives in updating the CWPP was to compile an updated list of priority hazard reduction strategies and projects throughout the county (see **Appendix B**). As part of the CWPP process, fire departments, land management agencies, and other stakeholders were asked to identify and provide information about the areas they are most concerned about within their jurisdictions and to catalog priority areas and hazard mitigation projects in those areas. Not surprisingly, almost all of the areas identified by stakeholders fall within or are adjacent to Marin's WUI. Many of the areas and projects identified are also along evacuation routes.

4.2 Risk Assessment Approach

To help identify and prioritize areas within the county that are potentially at a high risk of wildfire threat, a hazard assessment was performed using recently updated fuels data and representative weather scenarios. **Figure 10** shows the steps used to perform the county-level fire hazard assessment.

[32] National Fire Plan Communities at Risk List, **https://osfm.fire.ca.gov/divisions/wildfire-planning-engineering/fire-plan/communities-at-risk/** (last accessed November 13, 2020).

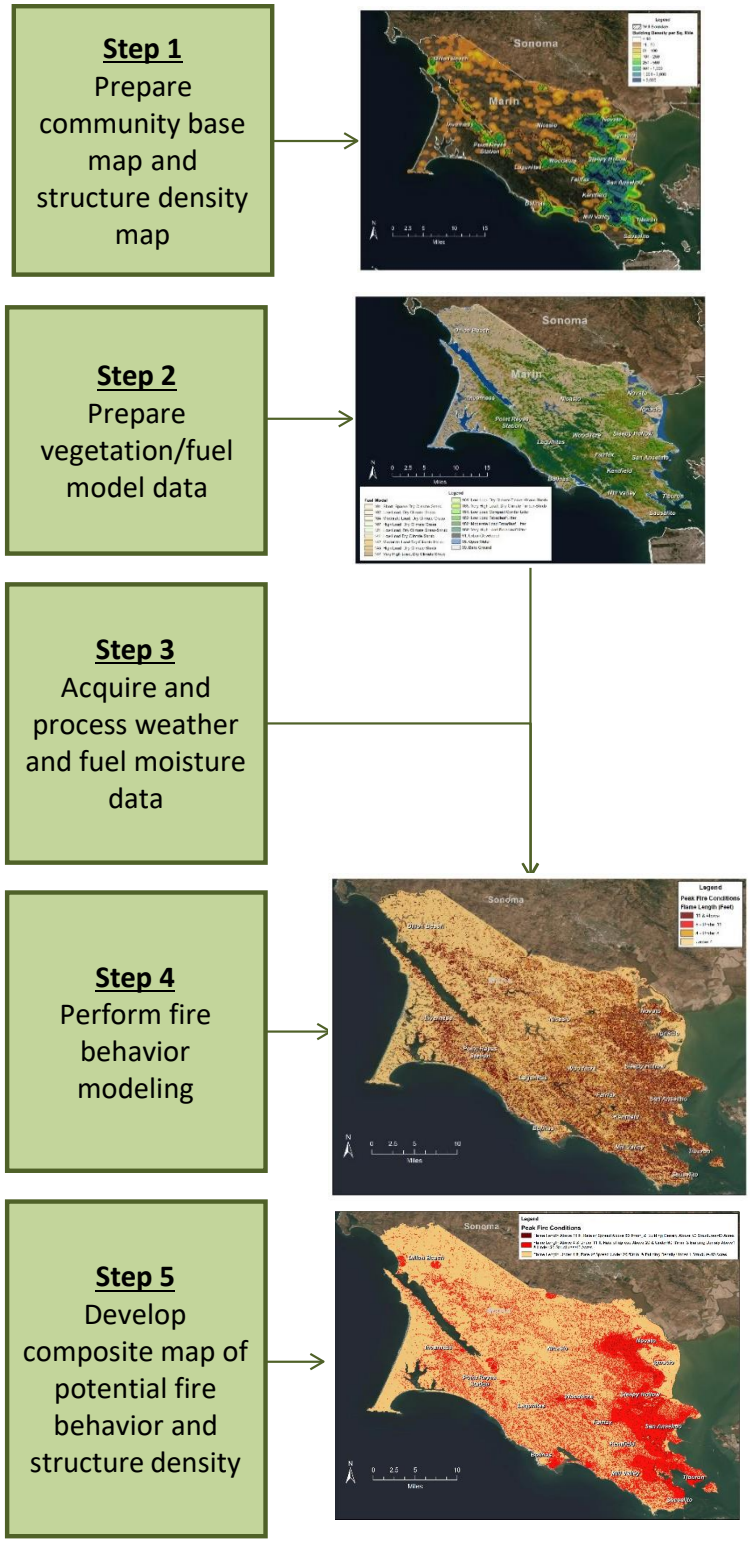


Figure 10. The steps used to perform the county-level hazard assessment.

4.2.1 County-Level Fire Hazard Assessment Methodology

Step 1: Prepare Community Base Map and Structure Density Map

A base map of Marin County was assembled using GIS data layers acquired primarily from Marin County's GIS portal, **marinmap.org**. The base map includes map layers of political boundaries, fire districts, land ownership, census data, infrastructure, building footprints, a parcel map, a map of structure density, and WUI boundaries.

Building footprint data for Marin County were acquired from the Marin County parcel tax assessor's dataset representing data through 2019. The building footprint data were mapped and used to identify areas with high structure density and therefore, high asset value. **Figure 11** shows the structure density map for Marin County. The community base map and corresponding map layers have been made available for viewing through an ESRI Story Map website.

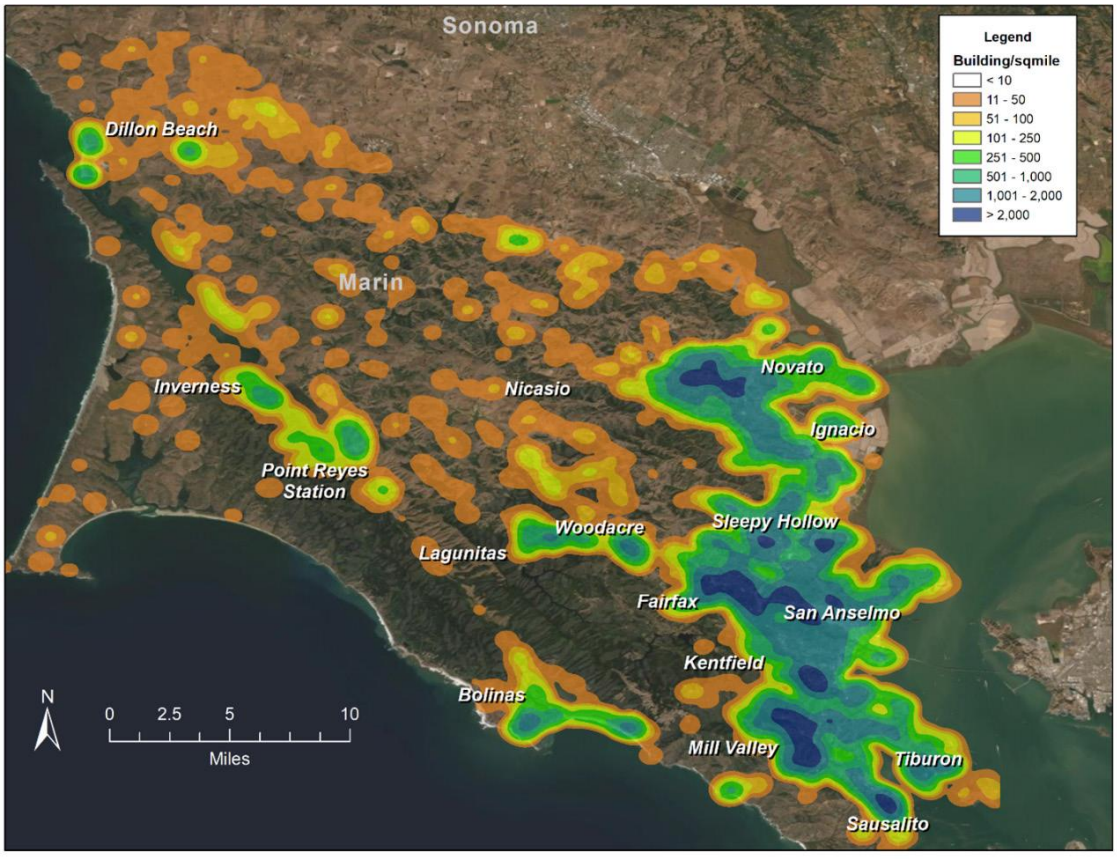


Figure 11. Structure density in Marin County.

Step 2: Prepare Vegetation and Fuel Model Data

FlamMap is a fire behavior model that can be used to predict potential fire behavior based on fuels (and fuel moisture), topography, and weather conditions. As part of the development of this CWPP, an updated, high-resolution (5 x 5 meter) gridded vegetation map was developed using a combination of ground vegetation data and recently obtained LiDAR measurements provided by theVegetation Map and Landscape Database project (see Section 5.2.1 and Appendix A). The 5 x 5-meter fuel model data were used as input to FlamMap for modeling potential fire behavior.

Step 3: Acquire Local Weather and Fuel Moisture Data

In addition to fuel characteristics, the FlamMap fire behavior model requires information about fuel moisture and weather conditions. Three fire weather scenarios were chosen to represent seasonal wildfire conditions for (1) an average fire season, (2) peak fire conditions, and (3) extreme Diablo wind conditions representing red flag warning conditions. The average fire season scenario was created by summarizing the weather and fuel moisture parameters from April through October (a typical fire season) and was used to represent the fire weather conditions during an average summerday in Marin County. The peak fire conditions scenario was created using the 97th percentile weather data from July through October and represents the hottest and driest time periods during the summer months when fire behavior would be intense and difficult to control. The extreme Diablo wind scenario represents the late summer through fall weather conditions under which a red flag warning would typically be declared with high temperatures, low relative humidity, and high easterly offshore winds.

The fire weather statistics model, IFT-FireFamilyPlus, available through the Interagency Fuels Treatment Decision Support System (IFTDSS), was used to summarize fuel moisture, wind speed, and wind direction data for each fire weather scenario using data from five RAWS available in the Weather Information Management System (WIMS). Weather data were summarized by station and weather scenario for the Mt. Barnabe, Big Rock, Woodacre, Middle Peak, and Robinhood RAWS stations (**Figure 12**). **Table 10** lists the fuel moisture and weather values used for the average fire season scenario, the peak fire conditions scenario, and the extreme Diablo wind scenario.

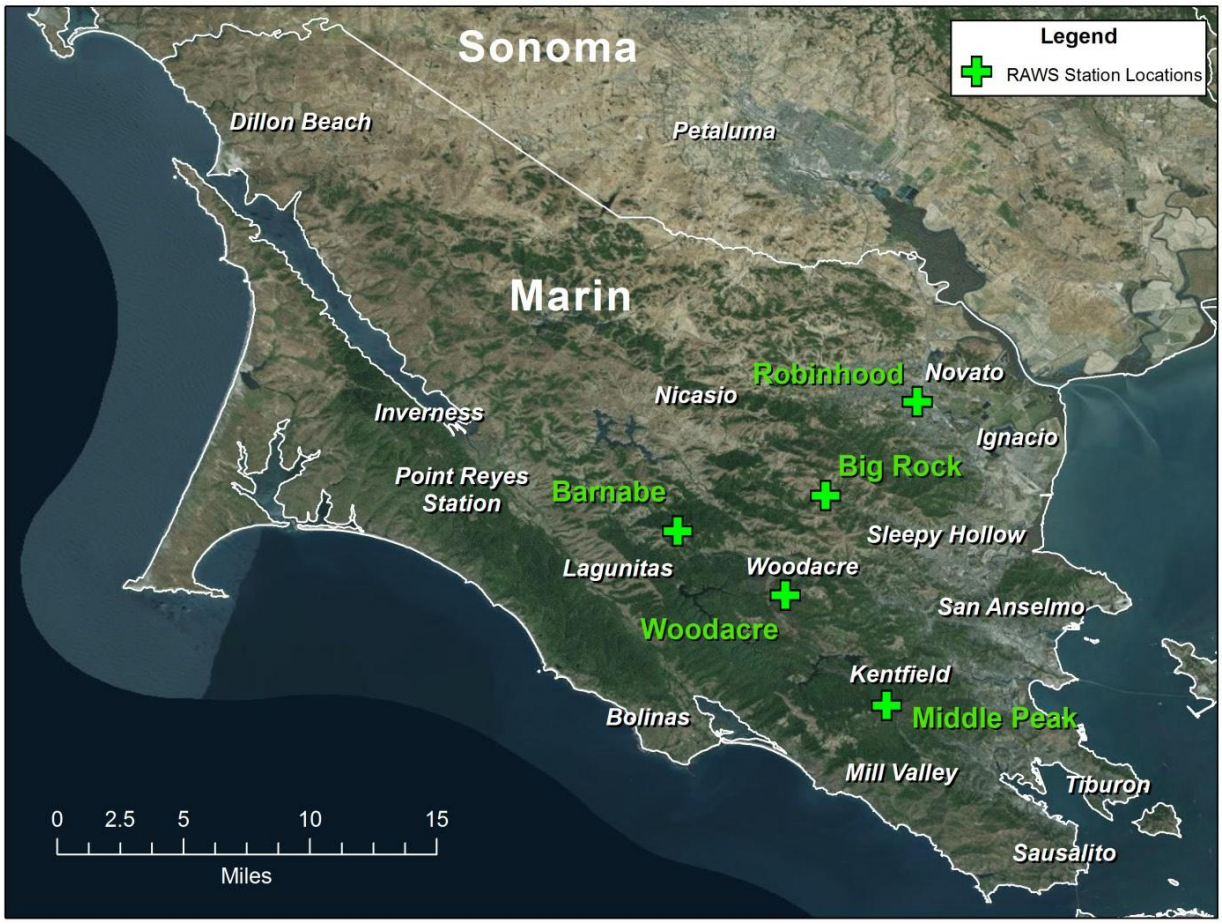


Figure 12. RAWS station locations in Marin County.

Table 10. Fuel moisture and weather values used for the average fire season, peak fireconditions, and extreme Diablo wind conditions modeling scenarios.

Parameter (units)	Average Fire Season Scenario	Peak Fire Condition sScenario	Extreme Diablo Wind Conditions Scenario
1-hour fuel moisture	8%	3%	3%
10-hour fuel moisture	8%	4%	4%
1,000-hour fuel moisture	13%	6%	6%
Herbaceous fuel moisture	35%	4%	3%
Live wood fuel moisture	99%	68%	67%
Wind speed	6 miles per hour	13 miles per hour	30 miles per hour
Wind direction	308°	293°	45°

Step 4: Perform Fire Behavior Modeling

Wildfire modeling attempts to predict fire behavior including how quickly a fire might spread, how much heat it might generate, and in which direction it might move. Most fire behavior models require the following key inputs: (1) fuel model information, (2) fuel moisture, (3) weather, and (4) topography. The results of fire behavior modeling can indicate how difficult a fire might be to suppress and how likely the fire would be to transition from the ground to the tree canopy. When flames move into the canopy, extreme fire behavior may occur.

FlamMap was used to model flame length and rate of spread. Flame length is commonly used as anindicator of how difficult a fire may be to suppress. **Table 11** shows the fire suppression interpretations of flame length; fires with lower flame lengths and rate of spread are typically easier to suppress, while fires with higher flame lengths and rate of spread are much more difficult to manage.

Table 11. Fire suppression interpretations of flame length and fire line intensity.

Flame Length (feet)	Fire Intensity (btu/feet/second)	Interpretations
0-4	0-100	Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.
4-8	100-500	Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to hold fires. Equipment such as bulldozers, engines, and retardant aircraft canbe effective.
8-11	500-1,000	Fires may present serious control problems – torching out, crowning, and spotting. Control efforts at the head of the fire will probably be ineffective.
11+	1,000+	Crowning, spotting, and major runs are common. Control efforts at the head of the fire will probably be ineffective.

Rate of spread is an indicator of how rapidly a fire might spread and is defined as the rate of forward spread of the fire head expressed in feet per minute. FlamMap runs were performed for the three weather scenarios identified in Table 10 using the updated fuel model data developed for Marin County (see Figure 7 in Section 5.2.1) and topographical data (slope, aspect, and elevation).

Step 5: Develop Composite Maps

The Environmental Systems Research Institute (ESRI) ArcGIS software, Spatial Analyst, was used for this analysis. Spatial Analyst is a raster- or grid-based software package that provides a platform for developing and manipulating gridded data. Spatial Analyst can be used to develop suitability models that produce maps highlighting “suitable” geographic areas based on defined model criteria and weighting schemes.

The composite maps for the hazard assessment were developed using a suitability modeling approach. Suitability modeling is a GIS-based method used for identifying areas based on specific criteria. For this work, suitability modeling was used to identify areas of high fire hazard based on firebehavior potentials and areas of high structure density.

4.2.2 Modeling Results

The approach outlined in Section 4.1.1 was used to perform the hazard assessment modeling using the structure density data (Figure 11) and the weather and fuel moisture data for the average fire season, peak fire conditions, and extreme Diablo wind conditions scenarios (Table 10). The remainderof this section discusses the modeling results.

Average Fire Season Modeling Results

The average fire season modeling scenario is based on the fuel moisture and weather data shown inTable 10. Modeled flame length for the average fire season scenario is shown in **Figure 13**; dark red and red show potential flame lengths greater than 8 feet, indicating areas that might exhibit more extreme fire behavior and/or be relatively more hazardous from a fire suppression perspective.

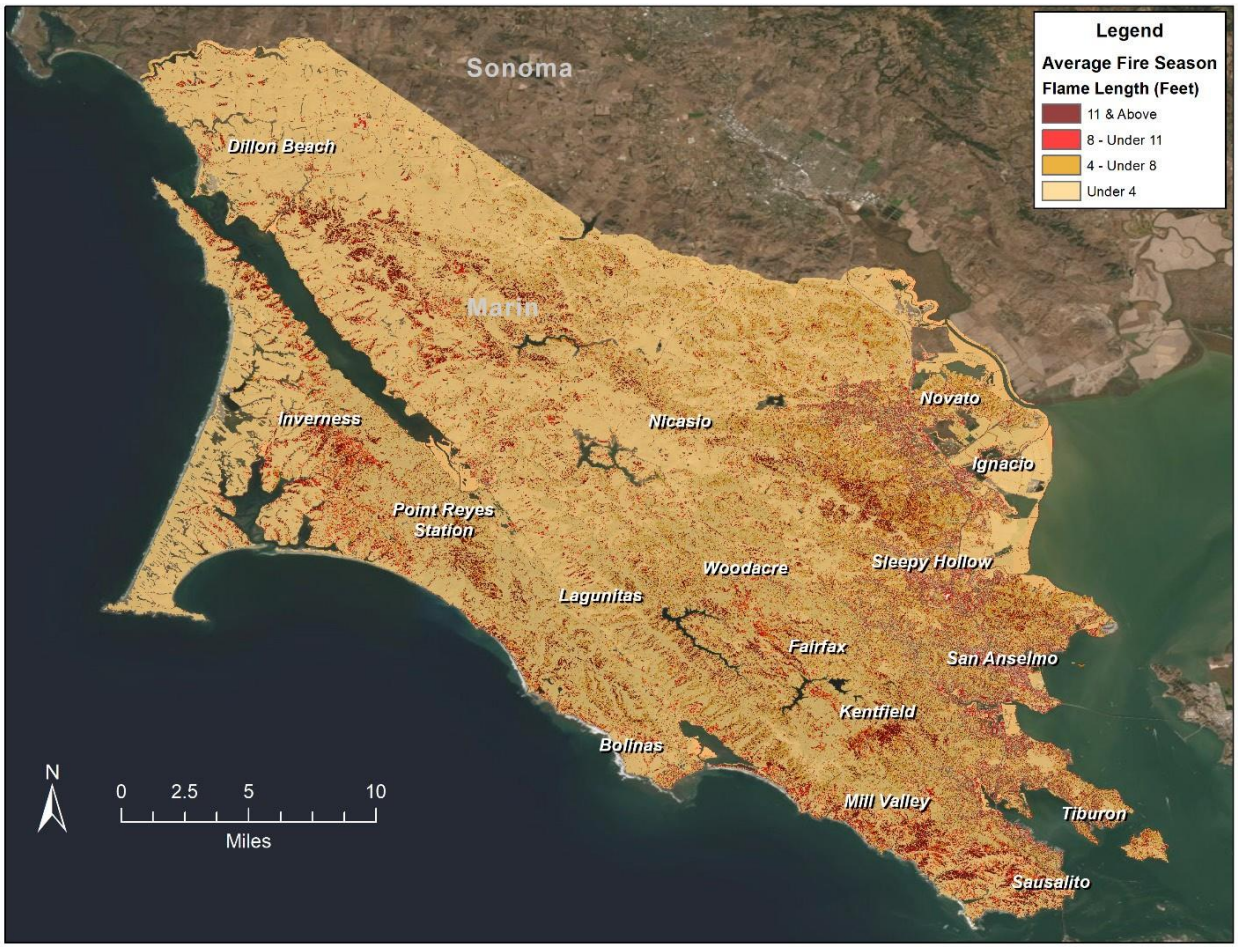


Figure 13. Potential flame length for the average fire season weather scenario

Rate of spread is defined as the rate of forward spread of the fire head expressed in feet per minute. The higher the rate of spread, the more difficult a fire is to suppress. The rate of spread model output for the average fire season scenario is shown in **Figure 14**; dark red and red show areas where more extreme fire behavior is likely given an ignition.

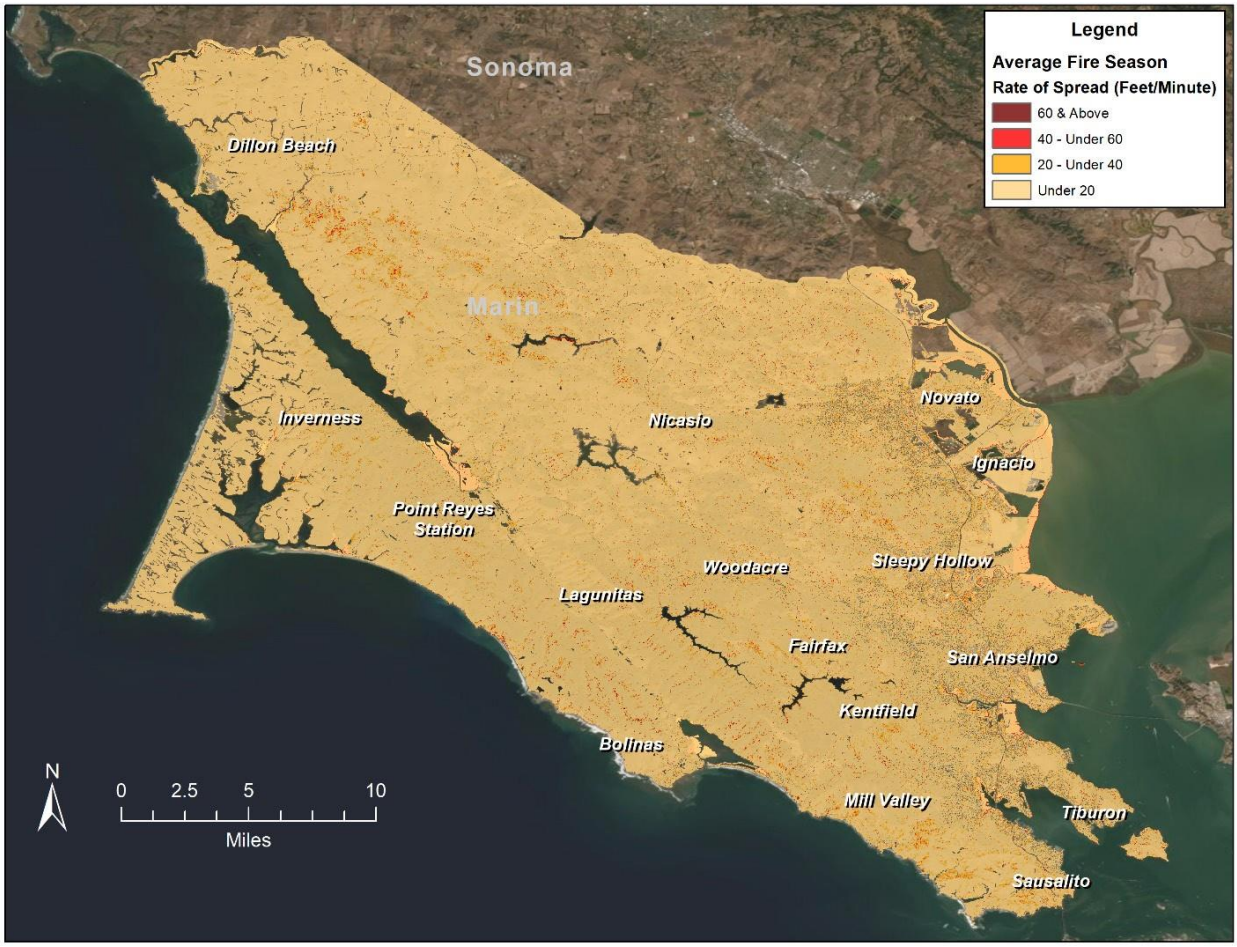


Figure 14. Predicted rate of spread for the average fire season weather scenario.

Using GIS data processing techniques (see Section 4.1.1), the structure density, flame length, and rateof spread maps were merged and processed to identify areas that have very high structure density, flame lengths, and rate of spread. **Figure 15** shows this composite map, dark red and red show areas of very high to high structure density, flame length, and rate of spread. These are areas of high asset value where fire behavior is likely to be extreme under the defined weather conditions.

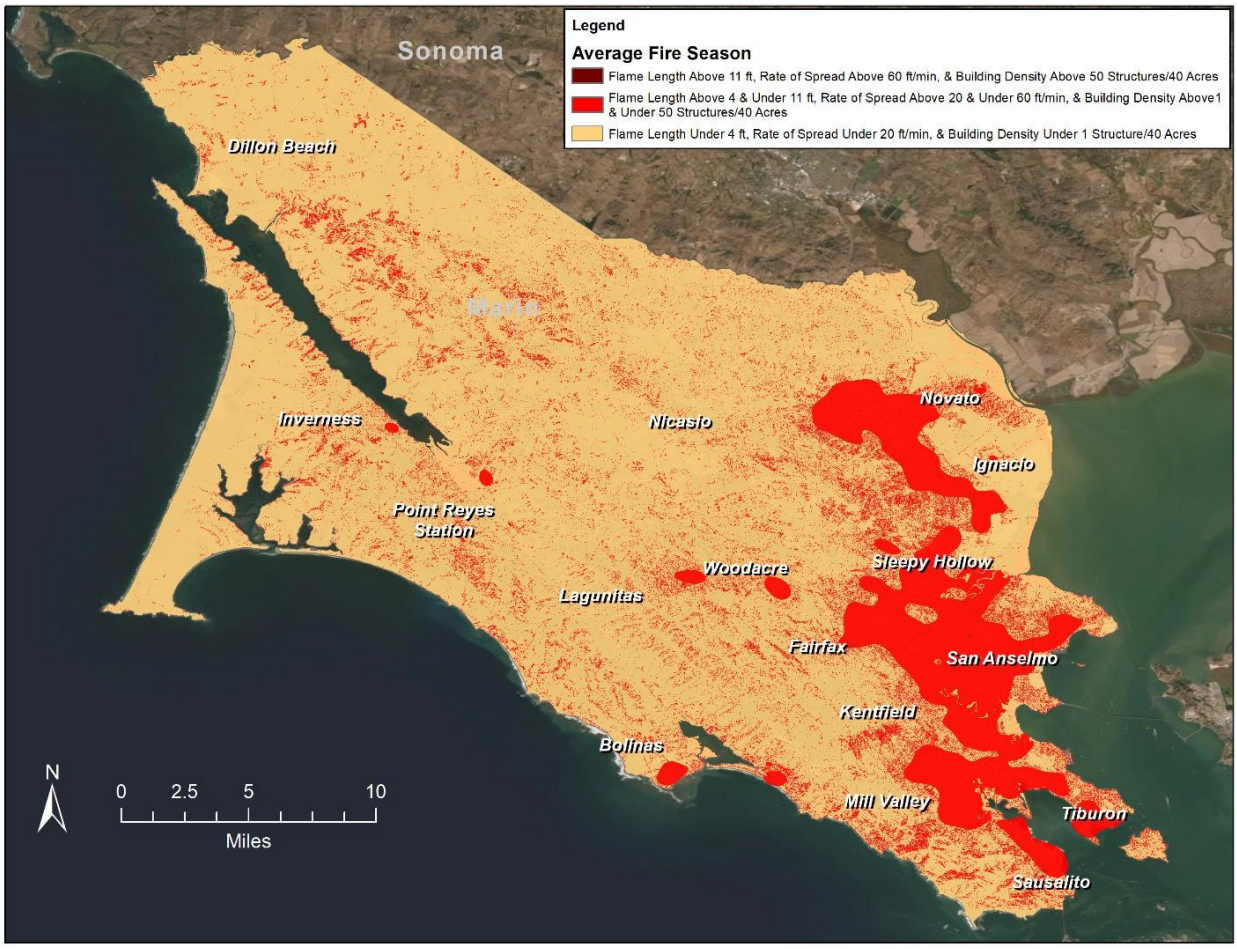


Figure 15. Composite map of structure density, flame length, and rate of spread for the average fire season model scenario.

Peak Fire Conditions Modeling Results

The peak fire conditions modeling scenario is based on the fuel moisture and weather data shown inTable 10. Modeled flame length for the peak fire conditions scenario is shown in **Figure 16**; dark red and red show potential flame lengths greater than 8 feet, indicating areas that would likely exhibit more extreme fire behavior and be relatively more hazardous from a fire suppression perspective (see Table 11). Note that for the peak fire conditions scenario, much more of the county area has flame lengths above 8 feet compared to the average fire season scenario shown in **Figure 13**.

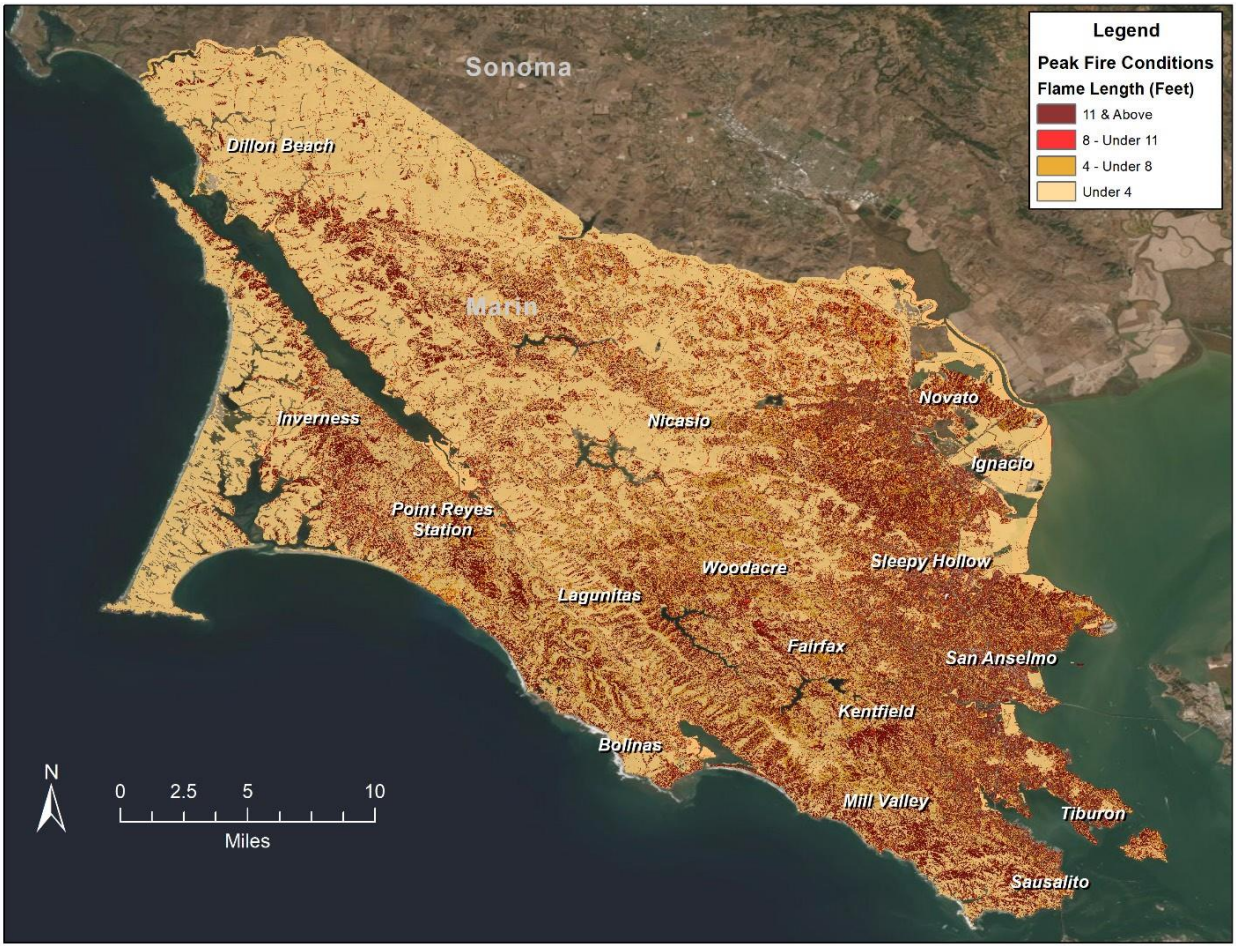


Figure 16. Potential flame length for the peak fire conditions scenario.

The rate of spread model output for the Peak Fire Conditions scenario is shown in **Figure 17**; dark redand red show areas that are likely to exhibit more extreme fire behavior and faster rates of spread.

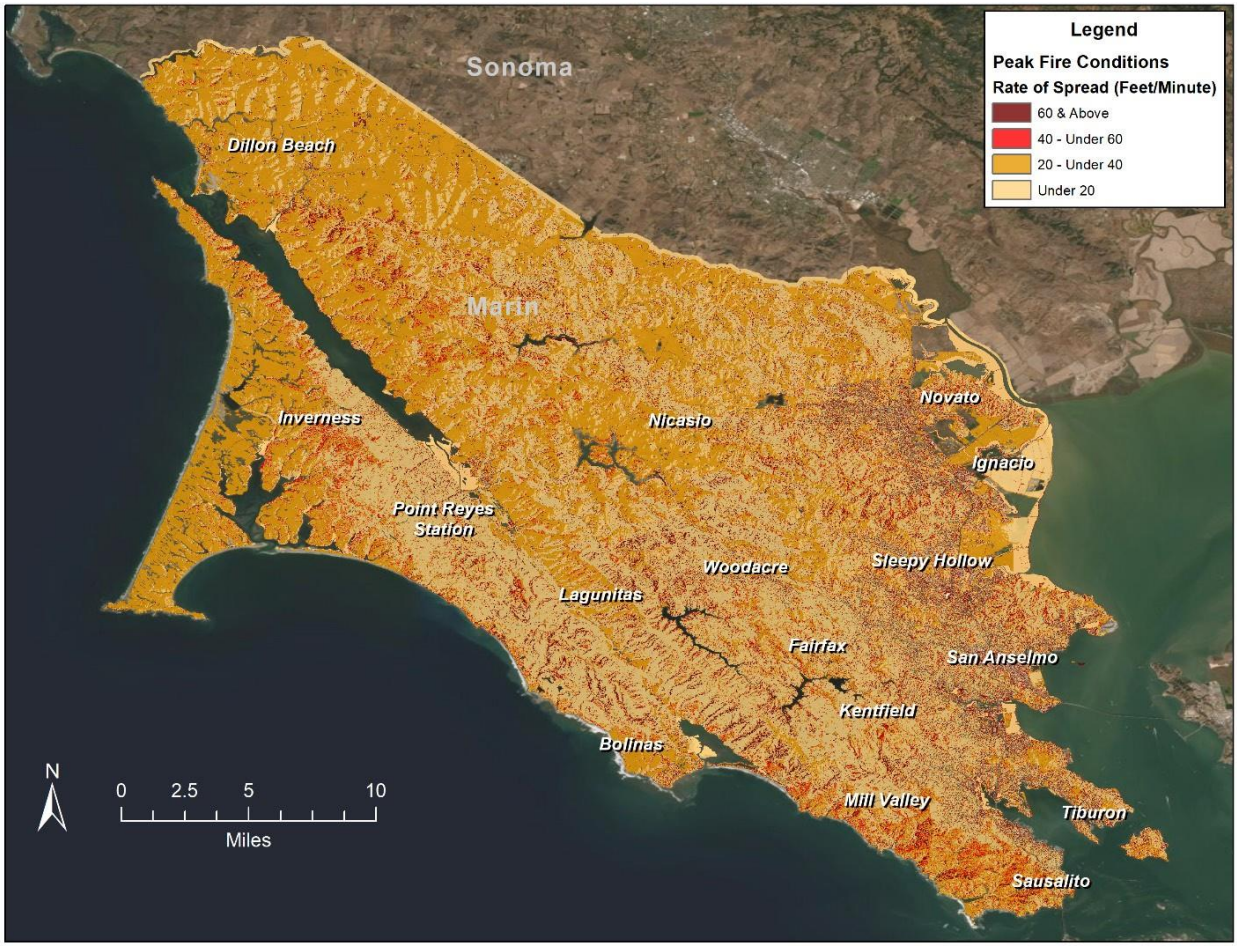


Figure 17. Predicted rate of spread for the peak fire conditions scenario.

Using GIS data processing techniques (see Section 4.2), the structure density, flame length, and rateof spread maps were merged to identify areas that have very high structure density, flame lengths, and rate of spread. **Figure 18** shows this composite map for the peak fire conditions scenario, dark red and red show areas of very high to high structure density, flame length, and rate of spread. Again, for the peak fire conditions scenario, much more of the county area is located in red areascompared to the average fire season scenario shown in Figure 15.

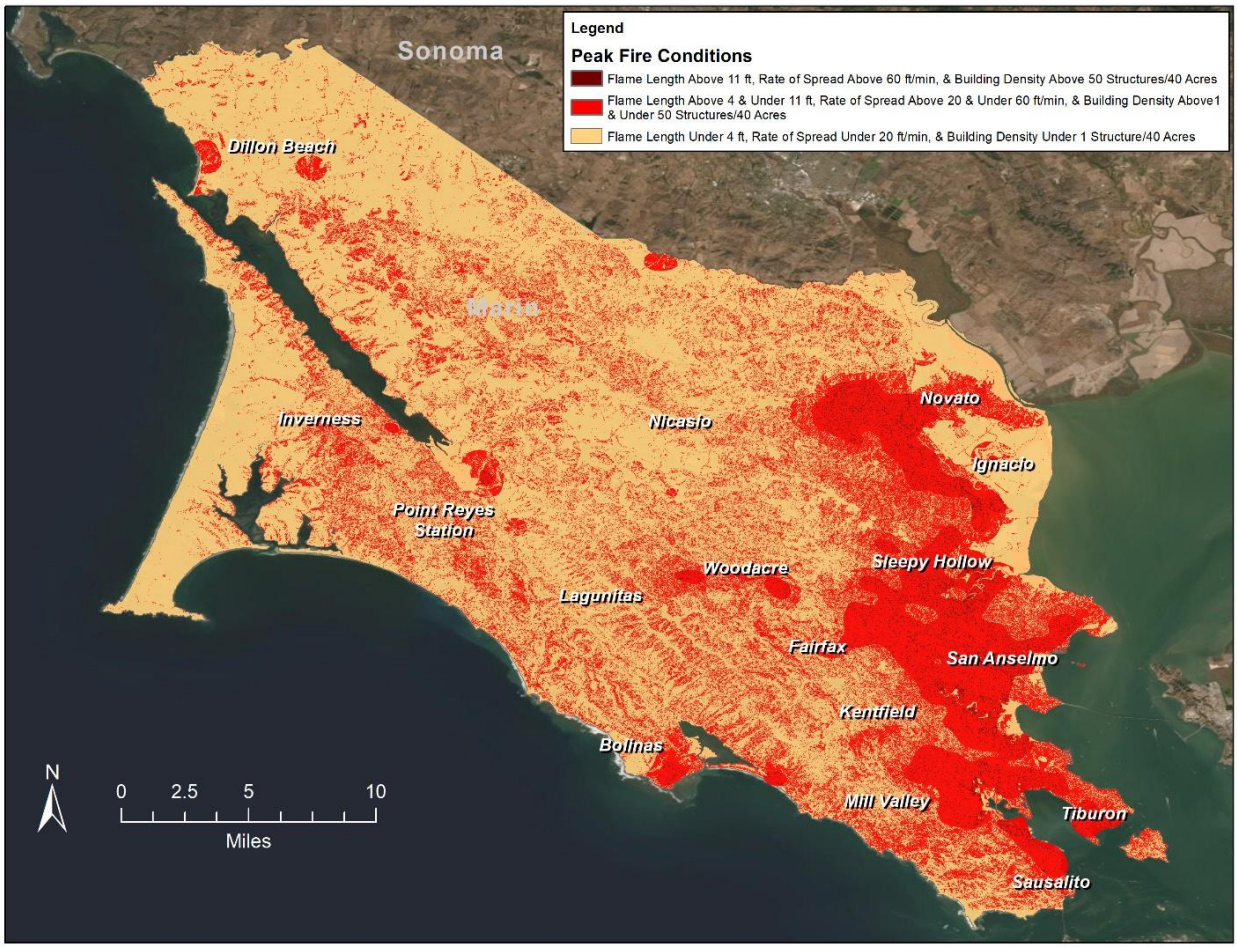


Figure 18. Composite map of structure density, flame length, and rate of spread for the peakfire conditions scenario.

Extreme Diablo Wind Conditions Modeling Results

The extreme Diablo wind conditions modeling scenario is based on the fuel moisture and weather data shown in Table 10. Modeled flame length for the extreme Diablo wind conditions scenario is shown in **Figure 19**; dark red and red show potential flame lengths greater than 8 feet, indicating areas that would likely exhibit more extreme fire behavior and be relatively more hazardous from afire suppression perspective (see Table 11). Note that under the extreme Diablo wind conditions, much more of the county area has flame length above 8 feet compared to the peak fire conditionsscenario shown in Figure 16.

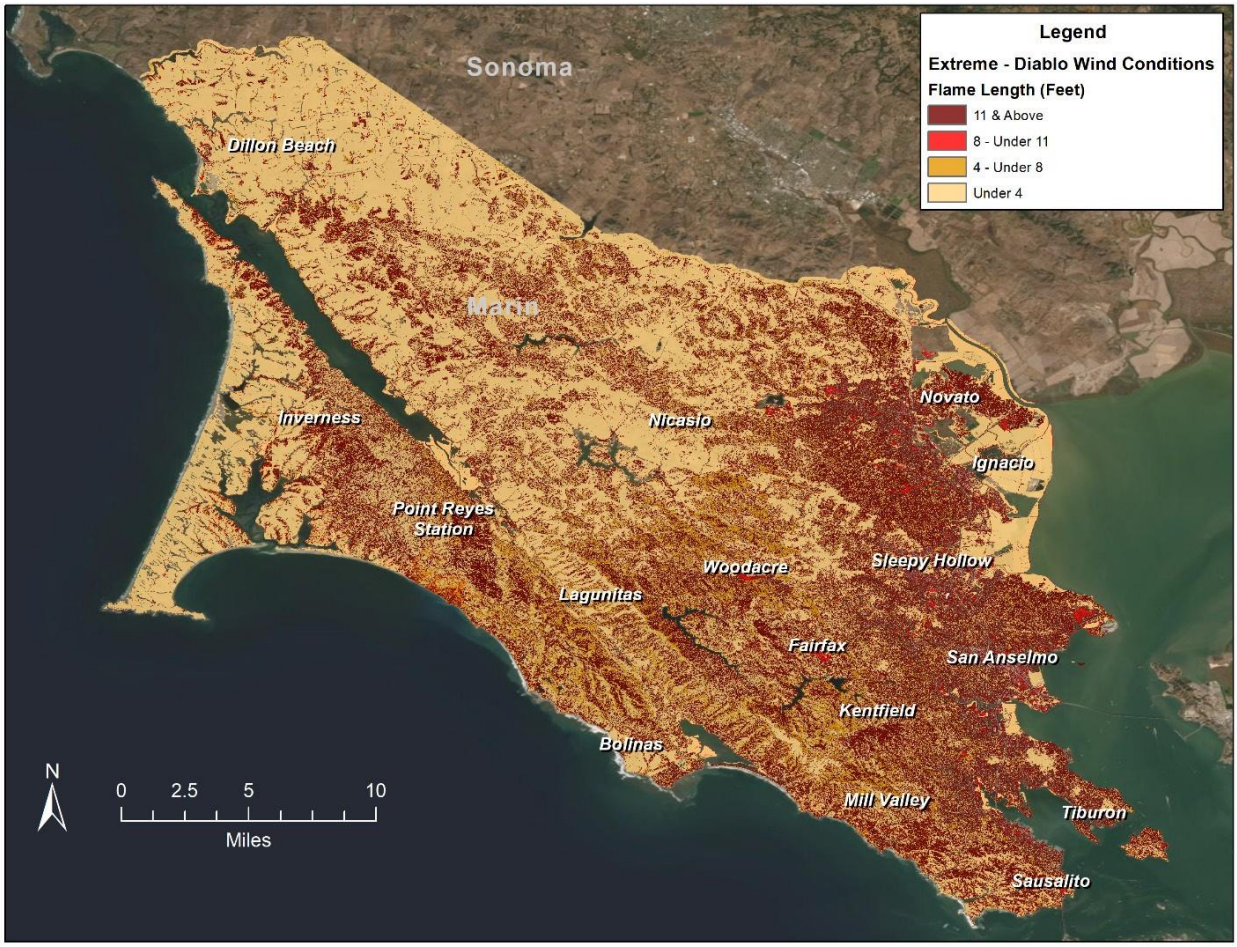


Figure 19. Potential flame length for the extreme Diablo wind conditions scenario.

The rate of spread model output for the extreme Diablo wind conditions scenario is shown in **Figure 20**; dark red and red show areas that are likely to exhibit more extreme fire behavior.

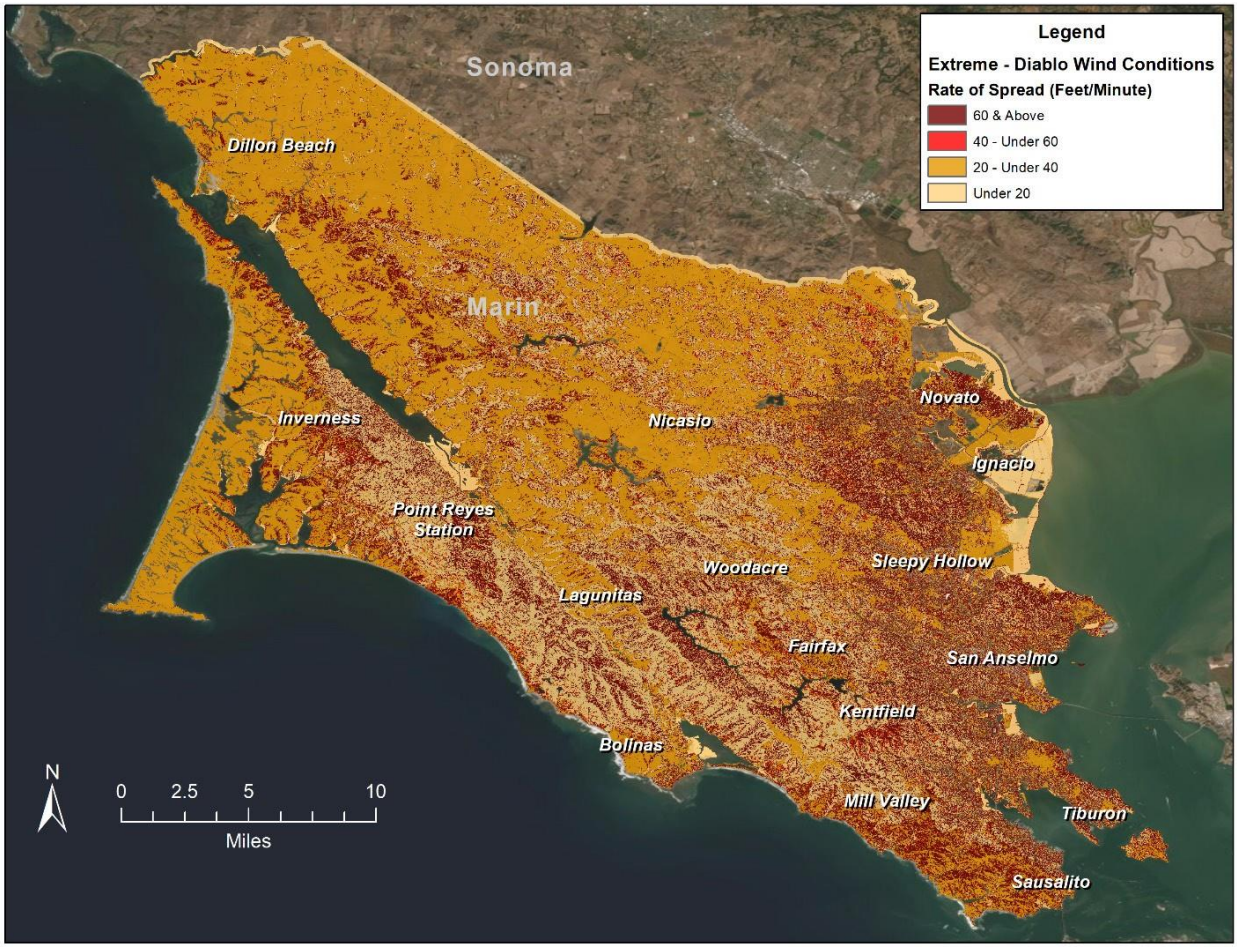


Figure 20. Predicted rate of spread for the extreme Diablo wind conditions scenario.

Using GIS data processing techniques (see Section 4.2), the structure density, flame length, and rate of spread maps were merged to identify areas that have very high structure density, flame lengths, and rate of spread. **Figure 21** shows the composite map for the extreme Diablo wind conditions scenario, dark red and red show areas of very high to high population density, flame length, and rate of spread. Again, note that under the extreme Diablo wind conditions scenario, much more of the county area is located in these very high to high condition areas compared to the peak fire season scenario shown in Figure 18.

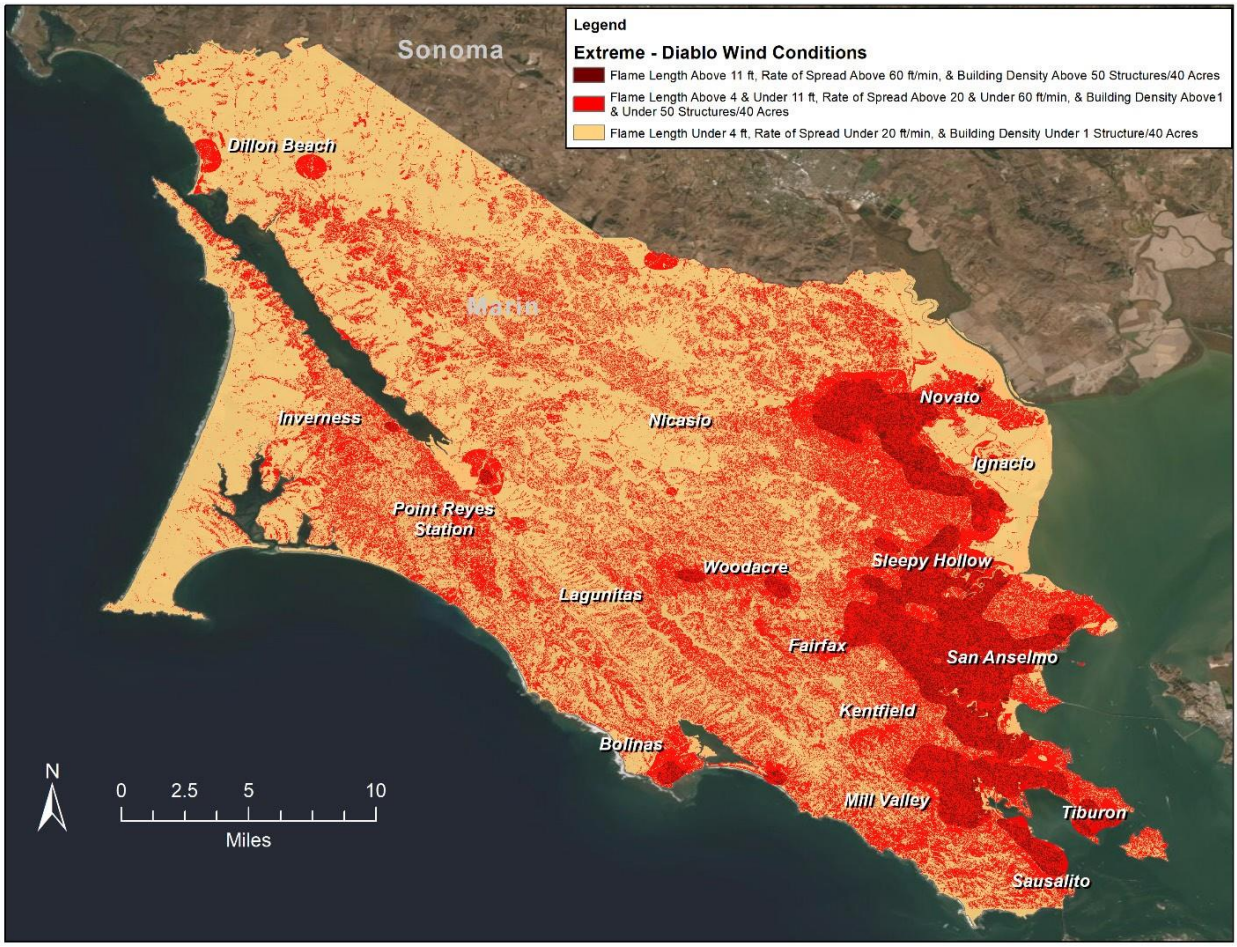


Figure 21. Composite map of structure density, flame length, and rate of spread for the extreme Diablo wind conditions scenario.

The results of the county-level hazard assessment for the peak fire conditions scenario was overlaid with fire agency jurisdiction boundaries, and the total burnable area falling into each of the three categories was calculated. The category definitions are

1. **Category 1.** Flame Length Under 4 feet, Rate of Spread Under 20 feet/minute, & Building Density Under 1 Structure/40 acres

2. **Category 2.** Flame Length Above 4 feet & Under 11 feet, Rate of Spread Above 20 feet/minute & Under 60 feet/minute, & Building Density Above 1 & Under 50 Structures/40 acres

3. **Category 3.** Flame Length Above 11 feet, Rate of Spread Above 60 feet/minute, & Building Density Above 50 Structures/40 acres

Figure 22 shows the peak fire conditions modeling scenario composite map results overlaid with fire agency jurisdiction boundaries. **Table 12** lists the number of total burnable acres, and the percentage of acres in Categories 1, 2, and 3 for the peak fire conditions composite map, by fire jurisdiction. **Figures 23 and 24** show the data in Table 12 (excluding MCFD and NFPD); the number of total burnable acres, and the percentage of acres in Categories 1, 2, and 3 for the peak fire conditions composite map, by fire jurisdiction.

The results show that MCFD and NFPD have the largest area of burnable acres. For MCFD, approximately 25% of the total burnable area falls into Categories 2 and 3 of the county-level hazardmaps. For Novato, approximately 45% of the total burnable area falls into Categories 2 and 3. Except for Bolinas, Stinson, and Inverness, the majority of burnable acreage in all other areas falls into Categories 2 and 3.

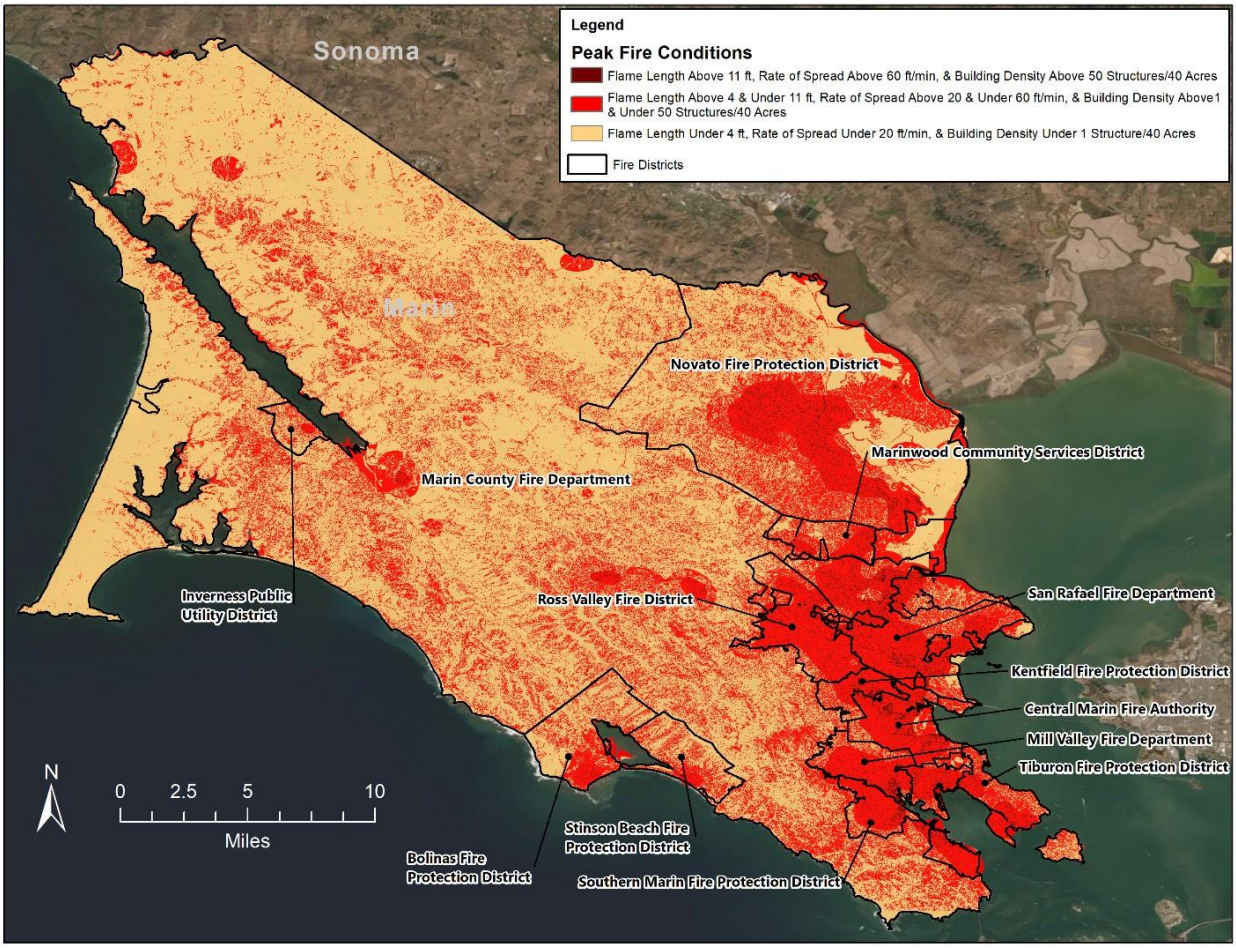


Figure 22. Composite map of structure density, flame length, and rate of spread for the peakfire conditions scenario overlaid with fire agency jurisdiction boundaries.

Table 12. Number of total burnable acres, and the percentage of acres in Categories 1, 2,and 3 for the peak fire conditions composite map, by fire jurisdiction.

Fire Jurisdiction	Total BurnableAcres	% CompositeCategory 1	% CompositeCategory 2	% CompositeCategory 3
Marin County Fire Department	243,448	76%	24%	0.2 %
Novato Fire ProtectionDistrict	45,992	56%	41%	3%
San Rafael Fire Department	10,763	14%	76%	11%
Bolinas Fire ProtectionDistrict	5,947	59%	40%	1%
Ross Valley Fire District	5,742	14%	78%	8%
Southern Marin FireProtection District	4,645	10%	81%	9%
Central Marin FireAuthority	4,075	9%	79%	13%
Stinson Beach FireProtection District	3,707	57%	42%	1%
Mill Valley Fire Department	3,080	13%	78%	8%
Tiburon Fire ProtectionDistrict	2,690	17%	76%	6%
Marinwood CommunityServices District	2,608	28%	67%	5%
Kentfield Fire ProtectionDistrict	1,748	14%	77%	9%
Inverness Public UtilityDistrict	1,352	60%	40%	0.5 %

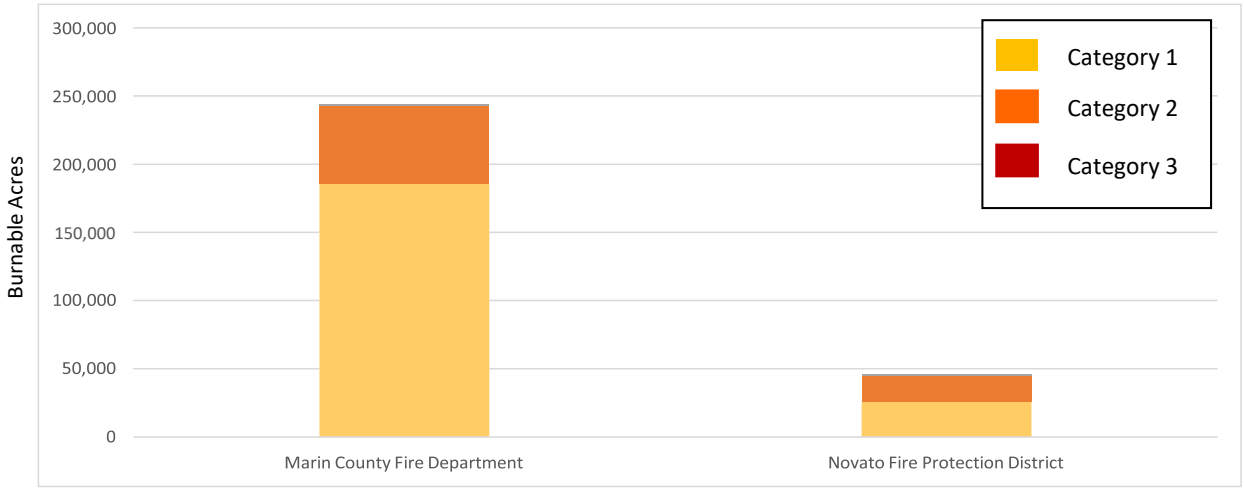


Figure 23. Number of total burnable acres, and the percentage of acres that fall intoCategories 1, 2, and 3 under the peak fire conditions scenario for Marin County Fire Department and Novato Fire Protection District.

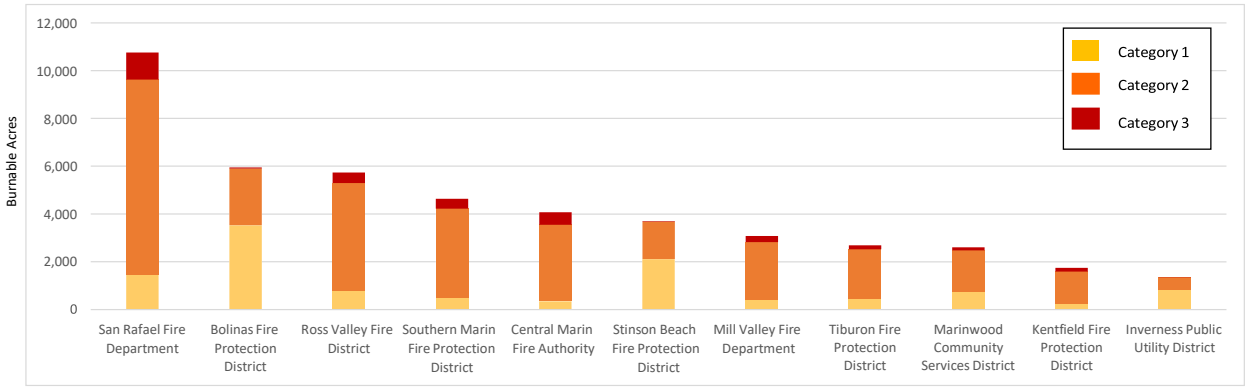


Figure 24. Number of total burnable acres, and the percentage of acres that fall into Categories 1, 2, and 3 under the peak fire conditions scenario by fire agency jurisdiction.

On a relative basis, Category 3 represents a higher hazard rating than Category 2, and Category 2 represents a higher hazard rating than Category 1. The data in Figure 22 should be viewed at a finer scale within each fire agency jurisdiction and community to get a proper context of the areas of concern at a local scale. It is important to note that the modeling performed in this section does notaccount for factors such as sensitive habitats, plant species, practical implementation of fuel reduction projects, or reductions in project costs. Fire protection and land management agencies should work collaboratively to determine which areas to focus efforts on, and what projects and prescriptions best serve specific areas.

5. Parcel-Level Fire Hazard Assessment

Structures can ignite during wildfires from ember (also called firebrand) penetration, direct flame contact, and/or radiant heat. Many wind-driven wildfires spread through firebrands, which are burning materials that are blown by wind from one place to another. Winds can blow firebrands more than a mile away from their source, starting new fires wherever they land. Flames often occur within columns of heat known as convection columns and can ignite anything flammable that they come into contact with. Radiation is the process by which wildfires heat up the surrounding area. Radiant heat from a wildfire can ignite combustible materials from distances of 100 feet or more.[33]

Embers can be blown through the air and can travel miles. They can result in the rapid spread of wildfire by spotting (in which embers are blown ahead of the main fire, starting other fires). When embers land on or near a house, they can easily ignite nearby vegetation or accumulated debris or enter the home or attic through openings or vents, igniting furnishing or combustible debris in those locations.[34] Recent research about home destruction versus home survival in wildfires indicates that embers and small flames are the primary source of structural ignition in wildfires.[35]

Post-fire studies have shown homes ignite due to building materials, construction, the condition of the home, and surrounding vegetation and debris. The Home Ignition Zone(HIZ) is defined as the area within 200 feet of a home. To provide maximum wildfire protection for your home, a combination of near-home vegetation management, appropriate building materials, and related design features must be used.[36] In several of the most recent and large fires in suburban areas, including the Tubbs fire in Santa Rosa in 2017, thousands of structures were lost due to the close proximity of homes and fire spreading from structure to structure. In these situations, fire behavior and spread can become very difficult to predict and manage. In recent years, much more focus has been directed athome hardening to help reduce structural ignitability.

[33] Federal Emergency Management Agency (**https://emilms.fema.gov/IS320/WM0102020text.htm**).
[34] FIRESafe MARIN (**https://www.firesafemarin.org/how-homes-ignite**).
[35] National Fire Protection Association (**https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Preparing-homes-for-wildfire#:~:text=home%20survival%20in%20wildfires%20point,homes%2C%20debris%20and%20other%20objects**).
[36] FIRESafe MARIN (**https://www.firesafemarin.org/home-hardening**).

Homeowners must be actively involved in fire hazard mitigation on and around their properties. Defensible space requirements help reduce vegetation and fuels in and around structures. Home hardening helps make homes more fire resistant and can protect a structure from igniting in the presence of embers. Defensible space and property inspections are currently the best way to assesspotential fire hazard on properties; however, using available vegetation, fire behavior, and structure information can also provide a way to approximate potential fire hazard at the parcel level.

Parcel-level wildfire hazard maps and threat ratings have been developed for many parts of the country. While typical wildfire hazard maps incorporate fire behavior information including fuels, topography, and potential fire behavior, parcel-level fire hazard maps include information about building characteristics such as the age and size of the structure. Parcel-level fire hazard ratings canbe useful for prioritizing the properties that need to improve defensible space and reduce structuralignitability.

To expand on the county-level hazard assessment, parcel-level maps were developed to provide a composite threat rating (by land parcel) based on potential flame length, rate of spread, burn probability, fire history, the year the structure was built, total building square footage, and building perimeter length.

5.1 Parcel-Level Fire Hazard Assessment Methodology

The parcel-level wildfire threat map was developed based on a variety of input datasets that characterize hazards, including the (1) likelihood of wildfire impact and (2) living unit structure characteristics within a given parcel. The following data inputs were used for this assessment.

Fire information layers:

1. FlamMap flame length for peak fire season conditions
2. FlamMap rate of spread for peak fire season conditions
3. Randig burn probability based on 25,000 random ignitions for peak fire season conditions
4. Parcel-based fire history (to determine if a parcel has burned in the past)

Building characteristics layers:

- The year the structure was built
- Total square footage of the living unit area and garage
- Total perimeter length of the living unit and garage

The fire behavior layers for flame length and rate of spread were obtained from the FlamMap fire behavior modeling performed for the county-level hazard assessment for the peak fire season modeling scenario. Burn probability is defined as the likelihood that a given location on a landscape will burn if provided an ignition. Burn probability data were obtained using the Randig module within

FlamMap for the same peak fire season modeling scenario (see Table 10. Fire history data were acquired from CAL FIRE from 1970 through 2020 (a subset of the same data set shown in Figure 8). The land parcel and building footprint data were acquired from the Marin County tax assessor's records for 2019. The input data layers were processed using ESRI's ArcGIS geospatial processing software. **Figure 25** shows the steps used to process the input data files and develop the parcel-level fire hazard maps.

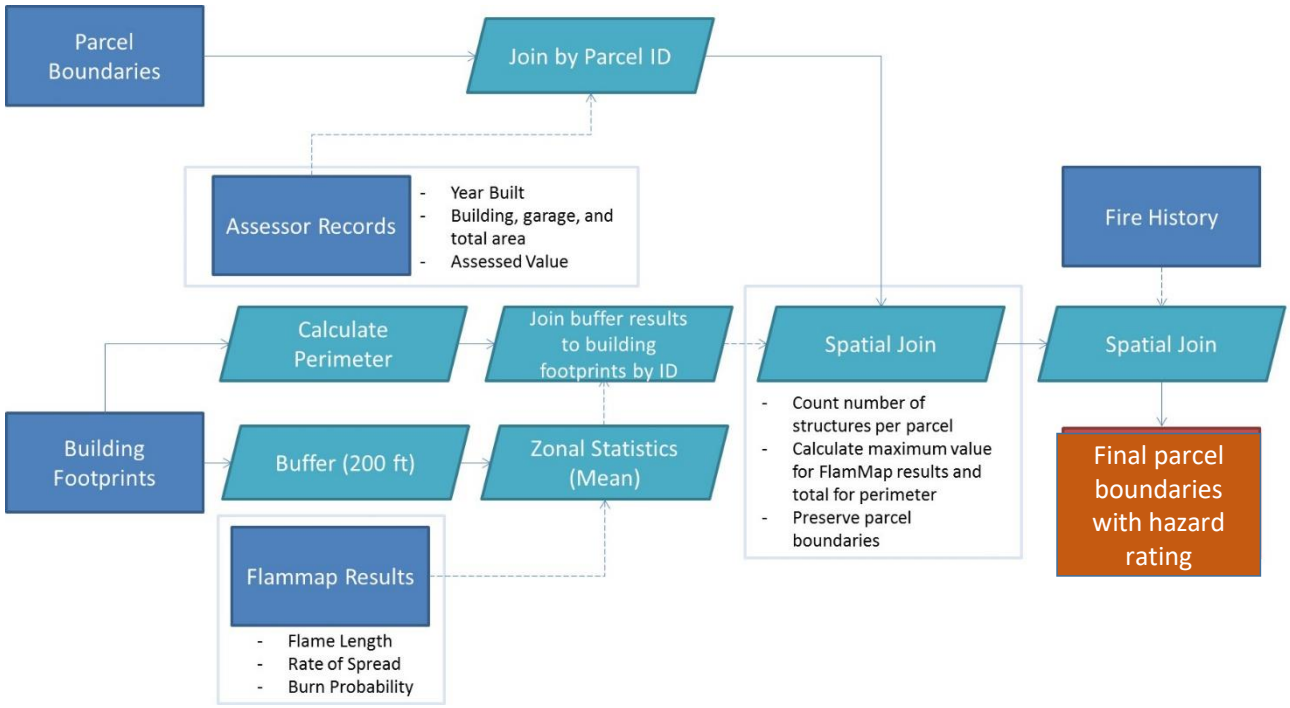


Figure 25. Data processing steps used to develop the parcel-level fire hazard map.

5.1.1 Step 1: Prepare the Building Footprint and Parcel Data for Analysis

The parcel and building footprint data obtained from the tax assessor data set was validated and analyzed for completeness. The data used for this assessment is from 2019 and is the most recent data available. The data were mapped and examined for completeness and to identify data gaps.

5.1.2 Reclassify the Input Data Sets

Suitability analysis requires all data sets to be in the same units and scale. Because each of the data sets used as input to the analysis are in different units, the input data layers were reclassified to a scale of classes 1 through 4. For example, the data layer for flame length is a gridded data set

that provides a value for flame length for each grid cell in the data layer. Flame length is reported in unitsof feet. To reclassify the flame length data layer, the following translation was used:

5.1.2.1 Class 1 = flame length less than or equal to 4 feet
5.1.2.2 Class 2 = flame length greater than 4 feet and less than or equal to 8 feet
5.1.2.3 Class 3 = flame length greater than 8 feet and less than or equal to 12 feet
5.1.2.4 Class 4 = flame length greater than 12 feet

Class 1 represents low flame lengths while Class 4 represents the highest flame lengths. All of the input data sets were reclassified to this scale. **Table 13** lists the input data layers, corresponding units(in parentheses), and the reclassification scheme for each data layer.

Table 13. Reclassification scheme used for the parcel-level assessment input data layers.

Input Data Layer (units)	Class 1	Class 2	Class 3	Class 4
Flame length (feet)	<= 4	> 4 & <= 8	> 8 & <= 12	> 12
Rate of spread (chains/hour)	<= 5	> 5 & <= 10	> 10 & <= 30	> 30
Randig burn probability	<= 0.0001	> 0.0001 & <= 0.0005	> 0.0005 & <=0.001	> 0.001
Parcel-based fire history (hasparcel burned in the past?)	No	--	--	Yes
Year structure was built (year)	2009–2018	1992–2008	1968–1991	Pre 1968
Total area of living and garage space (square feet)	<= 1,500	> 1,500 & <= 2,500	> 2,500 & <= 4,000	> 4,000
Building perimeter (feet)	<= 100	> 100 & <= 300	> 300 & <= 500	> 500

5.1.3 Calculate the Parcel-Level Hazard Rating for Each Parcel

After the input data layers were reclassified, a suitability analysis was performed. Suitability analyses mathematically combine the input data layers to arrive at an output map that represents one composite map based on the defined classifications. The suitability model algorithm (1) adds

the reclassified data layers together, grid cell by grid cell; (2) divides the total value of each grid cell by the number of input layers (in this case, seven); and (3) produces one output map. In the output map,the fire threat ratings are relative; Category 1 represents a low fire threat rating, Category 2 represents a moderate fire threat rating, and Category 3 represents a high fire threat rating.

5.1.4 Results of Parcel-Level Fire Hazard Assessment

The results of the parcel-level fire hazard assessment for the county are shown in **Figure 26.** In relative terms, Category 1 represents a low fire threat rating, Category 2 represents a moderate fire threat rating, and Category 3 represents a high fire threat rating. **Figure 27** shows the results of the parcel-level assessment for Mill Valley and Fairfax.

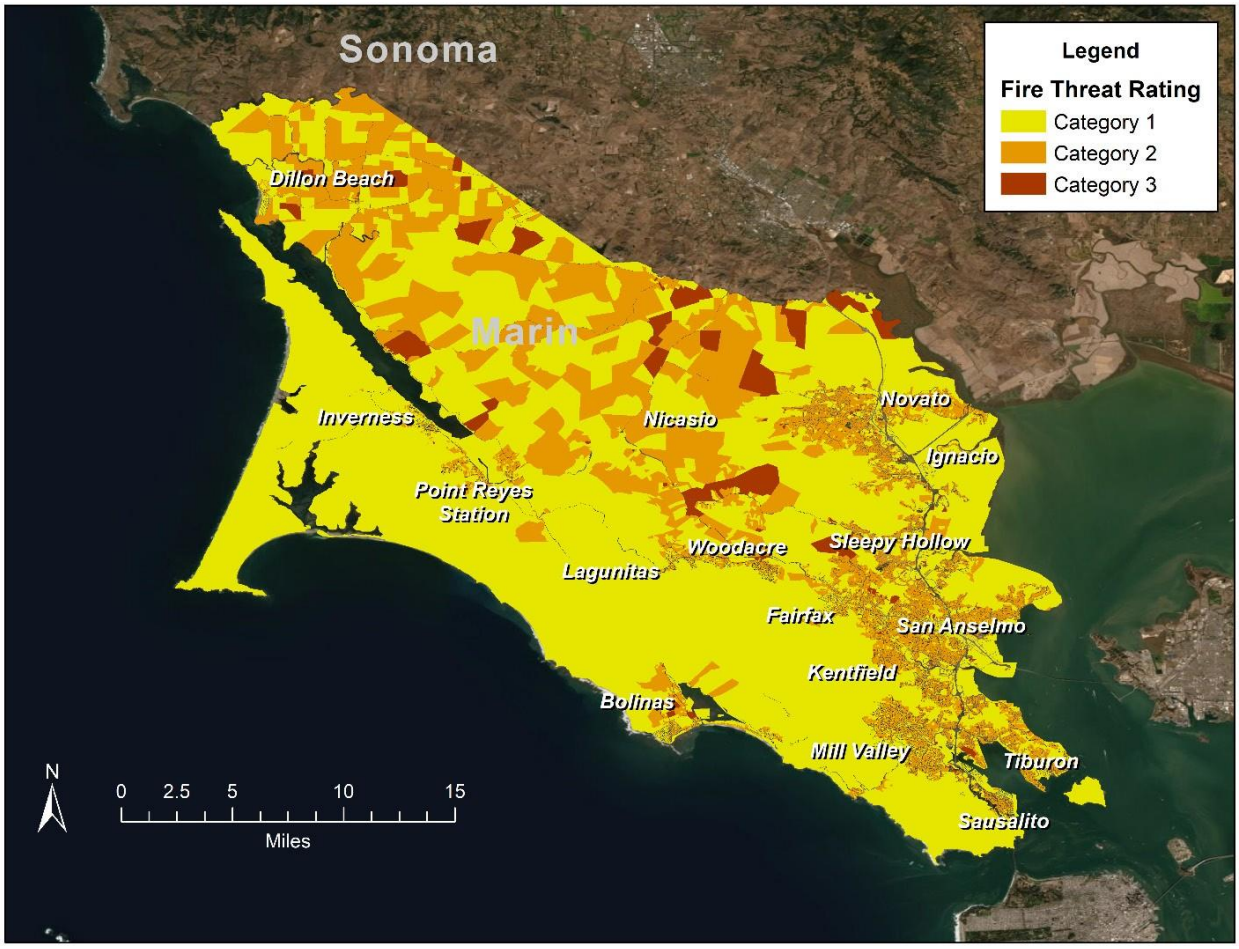


Figure 26. Results of the parcel-level fire hazard assessment for Marin County.

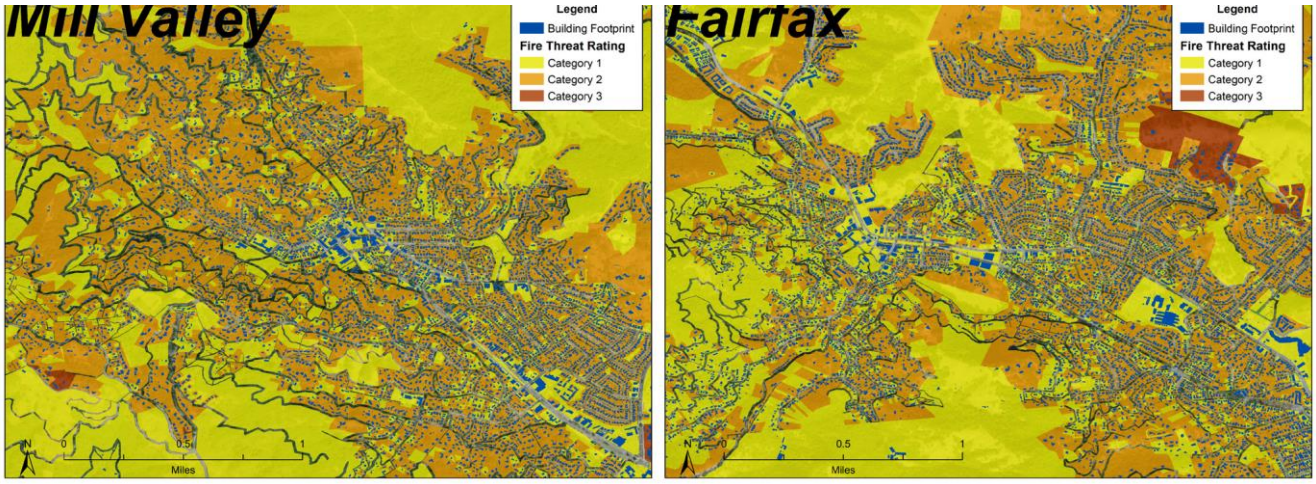


Figure 27. Results of the parcel-level fire hazard assessment for the communities of Mill Valley and Fairfax.

Based on the results of the parcel-level assessment, many parcels in Marin fall into Category 2. When interpreting the parcel-level hazard analysis results, it is important to consider property type. For example, is the property located in an urban or a rural environment and if it is in a rural environment,is it in the wildland urban interface (i.e., directly adjacent to dense wildland vegetation) or in the intermix where vegetation and structures are intermixed? This is important to consider because fires in the intermix tend to spread from vegetation-to-homes while fires in the interface tend to spread from home-to-home. Another consideration is how far homes are from the WUI boundary and proximity to natural vegetation.

Topography, which describes the shape and dimensions of a landscape, plays an important role in fire behavior. Topographical features can help accelerate or slow the spread of fire. Elevation and aspect can determine how hot and dry a given area will be. For example, higher elevations may be drier than lower elevations, and a north-facing slope will be slower to heat up and dry out than a south-facing slope. Slope can also determine how quickly a fire will move uphill. For example, if a fireignites at the bottom of a steep slope, it will spread much more quickly up the slope because it can pre-heat the fuel/vegetation in its path with rising hot air, and upward drafts are more likely to createspot fires.[37]

[37] National Park Service (**https://www.nps.gov/articles/wildland-fire-behavior.htm**).

6. Pre-Fire Management Strategies and Tactics

This CWPP provides county-scale planning information but also recognizes and supports more focused fire planning efforts to address specific city, community, or neighborhood-scale needs. The CWPP provides guidance for localized plans prepared to more specifically address site-specific issues,fuels treatment options, specific vegetation prescriptions, refined or redefined community and WUI boundaries, emergency preparedness, and other issues important to community wildfire safety. Localized plans have priority and authority over county-level recommendations.

Marin County fire agencies take a holistic approach to pre-fire and fuels management by implementing a variety of practices and programs focused around the WUI where the wildfire threat to human life and property is greatest. The objective of developing mitigation strategies is to establish a multifaceted approach, recommendations, and options to minimize the risk of catastrophic wildfire within the WUI while ensuring the protection and enhancement of economic and ecological values and resources. The mitigation measures discussed in this section are focused on

- Public and community outreach
- Wildfire preparedness and planning
- Reducing structural ignitability
- Defensible space
- Vegetation management
- Evacuation planning and preparation
- Implementing ESPs and increased public awareness of ecological processes and naturalresource management

Mitigation strategies may be addressed in multiple plans, reports, and documents, making consistency important when pre-planning for wildfires and other disasters.

6.1 Public Education and Community Outreach

Effective mitigation strategies for achieving countywide protection and consistency require acceptance throughout the county. Homeowners, land managers, and fire officials must work together to achieve these goals. The community must have the desire and ability to manage wildfire risk and maintain a dialogue with local fire officials.

FIRESafe MARIN supports fire agencies and communities throughout Marin by hosting a number of public outreach and community workshops each year to educate Marin residents about wildfire

preparedness. *Living With Fire* is a wildfire preparedness education program developed by FIRESafeMARIN in conjunction with the Marin County Fire Chiefs Association, Marin County Fire Prevention Officers Association, and wildfire and home hardening experts. The *Living With Fire* program covers:

- Personal preparedness, safety, and evacuation
- Home hardening and reducing structural ignition
- Defensible space and firescaping
- Community and neighborhood preparedness including Firewise USA® and *Ready, Set, Go!*
- ESPs may be considered as part of the *Living with Fire* program, or by another means of public outreach, to educate and ensure the protection of the natural environment of Marinwhile protecting it from wildfire

In 2019, FIRESafe MARIN produced a *Living With Fire in Marin County* booklet. The 55-page booklet is available on the FIRESafe MARIN website (**www.firesafemarin.org**). The FIRESafe MARIN website is also a good source of information for the public to learn about wildfire preparedness and available resources.

While FIRESafe MARIN hosts many outreach and education events throughout the county, it is also important to engage the public at the community level to build awareness of local issues and to encourage community members to work together to make their homes and neighborhoods more fire resilient.

6.2 Wildfire Preparedness and Planning

Wildfire preparedness and planning measures help protect buildings, homes, and neighborhoods from wildfire. While large, landscape-scale fuel treatments can change fire behavior, research has shown that the area around a house and the flammability of the house itself are the most important drivers of wildfire hazard in the WUI. The following summarizes some of the key research findings that have led to modern-day home hardening and defensible space guidelines:

- The density and flammability of houses themselves is a key determinant of wildfire spread inthe WUI (Spyratos et al., 2007).

- Firebrands, lofted burning embers carried by the wind from the main fire, are a major causeof house destruction (Reinhardt et al., 2008).

- Structure-to-structure spread has been a driver of home loss in a number of fires (Mell et al.,2011).

- Attributes such as roofing material can predispose a house to ignition, and then todestruction, under wildfire conditions (Cohen and Quarles, 2011).

- Creating and maintaining a 0- to 5-foot noncombustible zone around a building, including the entire footprint of attached decks, protects from ignitions that can result from wind- blown embers accumulating at the base of exterior walls, and from exposure to radiant heator direct flame contact (Hedayati et al., 2018).

- Within 30 feet, fire can produce sufficient radiant heat to cause combustion (Cohen, 2004).

- The presence of herbaceous fuel near houses can result in loss during wildfire (Syphard et al.,2014).

- Thinning vegetation within 100 feet of houses can significantly reduce house ignitions (Soretet al., 1996).

A wildfire-resistant home must be impervious to ignition from wind-blown embers. Even if the flames never reach a house, the structure must be able to withstand exposure to millions of tiny embers that can be carried a mile or more ahead of a wildfire. These embers can penetrate vents, screens, and gaps in wood and enter the home where they can ignite materials inside the home. To make a structure more fire resilient, a combination of structural design features, appropriate building materials, debris clearance, and vegetation management must be used.

6.3 Reducing Structural Ignitability

Coordinated pre-fire management efforts occur continuously throughout the county and across fire agencies. These activities include business and home inspection programs, land development plan reviews and construction inspections, fire alarm and suppression system plan reviews, fire investigations, inspections of hazardous and assembly occupancies, reviews of vegetation management plans (VMPs; a requirement for all new construction and substantial remodels in the WUI), and building code and standard development. Because most of Marin is built-out, remodeled homes account for a significant change to home hardening, more information about Marin's building codes and standards for reducing structure ignitability are discussed below.

Reducing structural ignition is the highest priority when considering mitigation strategies to reduce the likelihood of urban conflagration. High-intensity wildfires in the WUI typically do not spread directly through residential developments. Access roads, driveways, utility corridors, and home sites produce gaps in the forest and shrub canopy sufficient to discontinue high-intensity canopy fires. Home destruction largely results from direct firebrand ignitions, or lofted burning embers, fire spreading from structure to structure through radiant heat fluxes and combustible member connections (fences, for example) between structures, and fires spreading on the ground within the community. When homeowners take action to lessen the ignitability of the home ignition zone, they dramatically increase the survivability of their home (Cohen and Quarles, 2011).

Fire-resistant building materials and designs are extremely effective at reducing structural ignitions. These include a wide variety of materials combined with engineering and design choices for nearly

every aspect of home construction. They range from relatively expensive materials such as tempered glass and upgraded roofing to simple, inexpensive, but effective features such as fine wire mesh covering attic and basement vents. Many of these features can be retrofitted or applied to new construction.

While new construction and substantial remodels are required to use ignition-resistant materials meeting the standards of Chapter 7A of the CBC, owners of existing homes should be encouraged to make simple but effective upgrades. By reducing structural ignitability, in conjunction with improved defensible space and vegetation maintenance in open spaces, overall community risk can be dramatically reduced.

Building Codes to Reduce Structural Ignitability

MCFD and Community Development jurisdictions have identified that fire protection modifications to locally adopted codes including the California Building Code, California Residential Code and California Fire Code, are reasonably necessary because of Marin's local climate and topography. The climatic seasonal reduction in vegetative moisture content, combined with Marin's populated steep terrain, require enhanced fire protection measures.

California Building Code (CBC) Chapter 7A specifically addresses the wildland fire threat to structures by requiring the use of fire-resistant materials and construction techniques. New buildings, additions and exterior remodels to buildings located in any FHSZ (for properties in SRA; VHFHSZ in LRA) or any WUI fire area designated by the enforcing agency constructed after the application date shall comply with the provisions of Chapter 7A as amended locally. These requirements apply to new construction and as locally amended, also address existing structures or remodels and additions to existing structures.

There are several strategies to identify and implement regulatory and nonregulatory approaches toreduce structural ignitability.

- Encouraging individual responsibility
- Zoning regulations
- Development standards
- Building codes
- Fire prevention codes
- Fire department response

Various laws and regulations govern hazard mitigation in the WUI. These laws and regulations are thebasis for prescribing best practices for creating defensible space and increasing wildfire preparedness.

California State Regulations, Adopted Locally

New editions of the California Building Standards Code are published every three years in a triennial cycle with supplemental information published in other years. Publication of triennial editions of the CCR began in 1989. The most recent version of the code is the 2022 edition published January 1, 2023. Please refer to the most recently adopted and locally amended code.

California Code of Regulations (CCR), Title 24, Parts 1-12

- CA Building Code, Chapter 7A, Materials and Construction Methods for Exterior WildfireExposure, (CCR, Title 24, Part 2, v1)
- CA Fire Code Chapter 49, Requirements for Wildland-Urban Interface Fire Areas, (CCR, Title24, Part 9)
- CA Building Code Chapter 17, Special Inspections and Tests (CCR, Title 24, Part 2, v2)

Fire Safe Regulations

- California Code of Regulations, Title 19. Public Safety. Division 1. State Fire Marshal
- California Code of Regulations, Title 14, Division 1.5, Department of Forestry and FireProtection
- 2021 International Wildland-Urban Interface Code
- California Public Resources Code §4290 & §4291

Local Ordinances

At the sub-county level, communities may consider the adoption of local ordinances to address specific concerns not covered by existing codes or amendments. For example, in addition to the County of Marin adopting and extensively amending (2006) the 2003 ICC WUI Code, in 2007, the City of San Rafael adopted an ordinance that requires property owners in the WUI to remove or trim away junipers. This code is under Chapter 4 of the San Rafael Municipal Code. Similarly, in 2019, the City of Mill Valley adopted a ban on several specific fire-hazardous plants that include (but may not be limited to) Italian cypress, bamboo, juniper, and acacia. In other parts of California, there are examples of ordinances adopted at the local level to reduce fire hazard and structure ignitability; for instance, the City of Big Bear Lake in San Bernardino County passed an ordinance for wood or shake roof replacement.

Current codes including PRC 4291 (applicable to SRA) and CAFC 4907.2 (as amended) already adopted and applicable throughout the county, when enforced, can provide effective mitigation of vegetation hazard in the defensible spacezones around structures.

Federal Regulations

At the Federal level, the Federal Disaster Mitigation Act of 2000 (DMA 2000) provides the

"legal basis for the Federal Emergency Management Agency (FEMA) mitigation planning requirements for state and local governments as a condition of mitigation grant 12 assistance." The DMA 2000 requires

localities to adopt a Local Hazard Mitigation Plan (LHMP) in order to obtain FEMA and federal grant eligibility. The LHMP is administered at the county level.

In addition to the LHMP, California requires a Safety Element as part of any General Plan. The goal of the Safety Element is to "reduce the potential risk of death, injuries, property damage, and the economic and social dislocation resulting from hazards." The Safety Element is used to develop action-oriented policies and implementation measures that should correspond with the data collected, and other examples such as access and evacuation routes, road and structural identification, roadway widths, and water supply. An example of a policy that might appear in the Safety Element is that "no development shall be approved unless the local government can determine that development is reasonably accessible and served in the case of a wildfire."

Ignition-Resistant Roofing to Reduce Structural Ignitability

Disaster examinations reveal that most destroyed homes are not ignited directly by intense wildfire(Mell et al., 2011). This indicates that flame contact from surface fires and direct firebrand (lofted burning embers) ignitions are the cause. Firebrands that result in roof ignitions commonly originate from a fire over ½ mile away depending on the fire intensity and the type of fuel burning.

For a home, the roof is the most common structural fuel bed for ignition by firebrands or embers. For this reason, materials used to construct a roof are of great importance to the home. Homeowners should be aware of the dangers associated with having wood shingle (shake) rather than fire-resistant roof types. All newly constructed homes are required to utilize roof materials of Class-A or better. Many roofing materials meet the Class-A standard, allowing flexibility in achieving architectural aesthetics while providing fire resistance. While Class-A roofing materials are considered the most fire- resistant, even a Class-A roof may be vulnerable to fire if leaf litter or needles are allowed to accumulate.

Typical Class-A roofing products include (but are not limited to):

- Asphalt Shingles
- Metal
- Concrete (standard and lightweight)
- Clay Tile
- Synthetic
- Slate
- Hybrid Composites

Wood and Shake Roofs in Marin County

Inspection data collected over the past two years for approximately 8,700 properties indicates that about 3% of residential roofs in Marin County are made of wood shingles or shakes, making these properties among the most vulnerable to ignition by firebrands. Because wood shake roofing is relatively long lasting, with a lifespan of 20-50 years, the existing structures are likely to remain highly combustible for many years unless the roofing

is replaced. **Figure 28** shows a map of the locations where inspections have been conducted by MCFD over the past two years. **Figure 29** shows a map ofthe homes that have wood roofing. Because of the ignitability of wood roofing, fire agencies throughout Marin should consider providing incentives for homeowners to replace wood roofs.

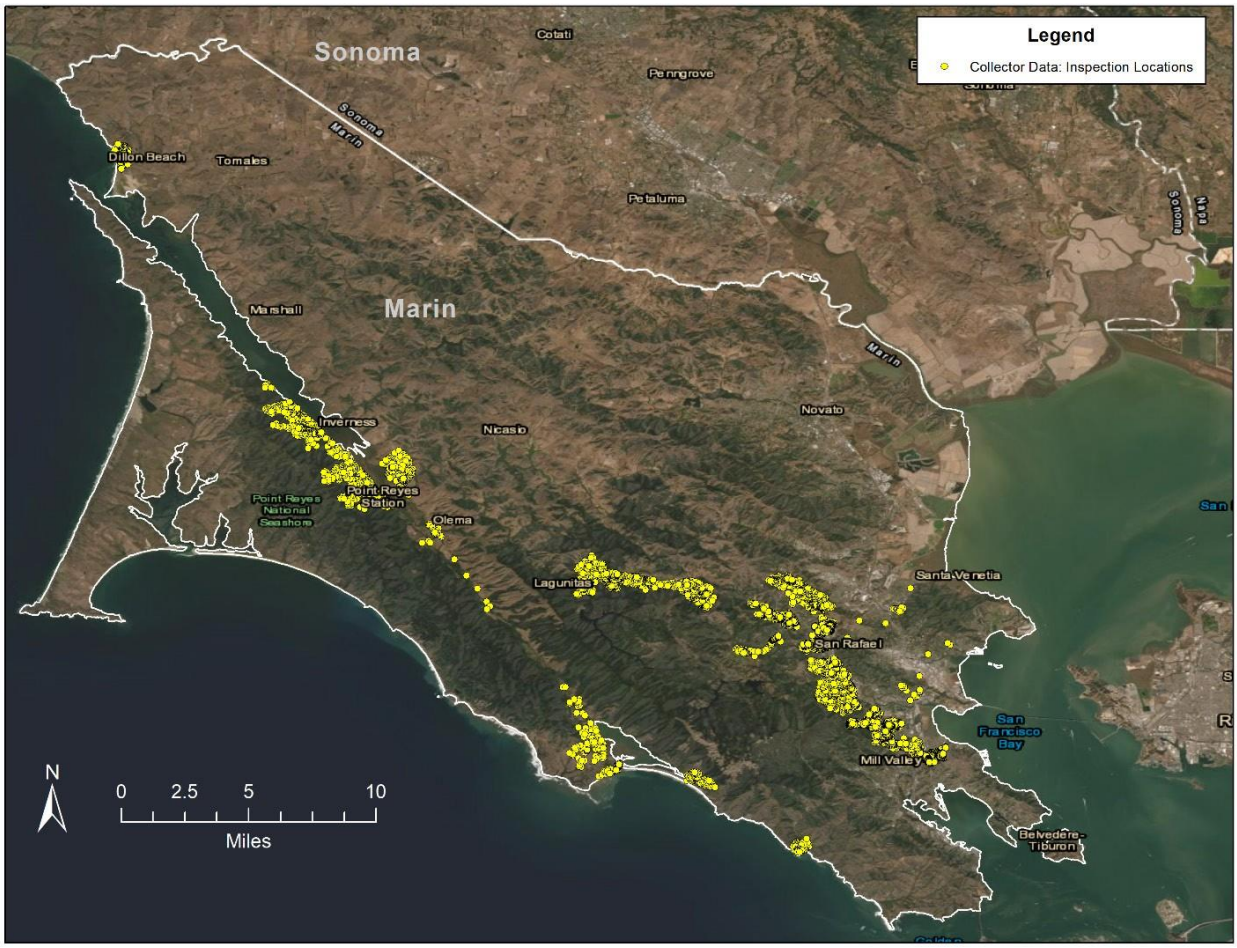


Figure 28. Locations of properties that have been inspected in the past two years.

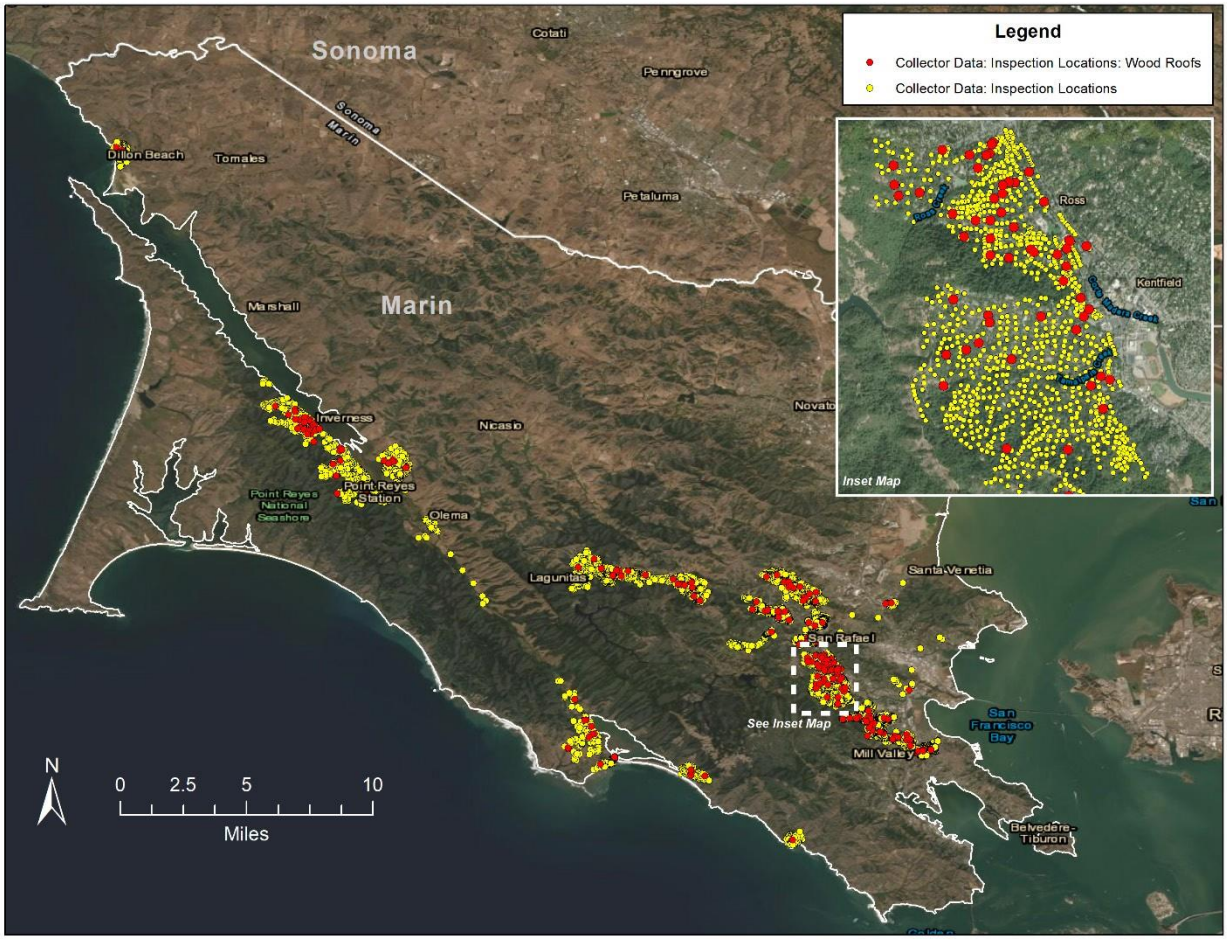


Figure 29. Locations of homes with wood roofing (shown in red).

Design, Construction, and Building Material Upgrades to Reduce Structural Ignitability

The building design and construction process provides one of the most cost-effective means of addressing wildfire risk (Schwab et al., 2005). The new construction and remodel process is governed by building codes, design criteria, architecture, and soils and landscaping considerations. Most often code criteria that support risk reduction apply only to new construction, substantial renovation, or renovation to change the type or use of the building. The construction process offers other opportunities to use fire-resistant building materials such as stone, tile, and stucco, and incorporate new technologies and design features to help homes resist and survive wildfires.

6.4 Defensible Space

Landscaping is particularly critical in areas of potential wildfires because vegetation close to structures can become fuel for a fire. Clearing, grading, and siting all have potential impacts to soil stability and erosion and can be included as part of a design or building permit review process. The use of “hardscape” features such as retaining walls and stone pathways can also be used to engineer an attractive landscape that helps structures survive wildfires and should be encouraged. FIRESafe MARIN recommends “firescaping" which is landscape design that reduces house and property vulnerability to wildfire. Individual homeowners are ultimately responsible for the protection of their homes from wildfire. In a severe wildfire event, the fire service cannot protect all homes at risk. Individual responsibility and preparation taken long before a wildfire starts is of paramount importance.

6.4.1 Improve Defensible Space Around All Structures

Defensible space of 100 feet is required by law (California Fire Code 4907.2, PRC 4291, Title 14 CCR). Residents and landowners must be encouraged to develop, enhance, and maintain defensible space annually. Property owners are ultimately responsible for maintaining defensible space; however, in some instances, rental contracts or lease agreements may subrogate responsibility for landscaping orbuilding maintenance. FIRESafe Marin recommends zones that make up the 100 feet of defensible space around a home. The most important zone is the 0-5 feet zone immediately surrounding a home. Vegetation, wood, and other materials in this 0-5 foot zone can ignite in a wildfire and pose a threat to homes. **Figures 30 and 31** illustrate and describe the zones that make up the 100 feet of defensible space required by law (Source: FIRESafe MARIN).[38]

There are opportunities to provide enhanced environmental conditions through defensible space actions. For example, through public education for residential defensible space the use of native and other pollinator friendly plants, guarding soil health, and retaining large trees and shrubs in a fire- smart manner ecological values can be improved. ESP is actively considering best practices in these areas. The recently revised state defensible space code (AB3074) requires CAL FIRE to develop guidelines that provide “regionally appropriate vegetation managementsuggestions that preserve and restore native species that are fire resistant or drought tolerant, or both, minimize erosion, minimize water consumption, and permit trees near homes for shade, aesthetics, and habitat.” Similar guidelines for Marin could be developed and included in public outreach materials.

[38] FIRESafe MARIN (**https://www.firesafemarin.org/defensible-space**).

Figure 30. The zones that make up the 100 feet of defensible space required by law (**https://www.firesafemarin.org/defensible-space**).

Figure 31. Description of the zones that make up the 100 feet of defensible space required bylaw (**https://www.firesafemarin.org/defensible-space**).

Field observations reveal that virtually no property in Marin is in strict compliance with defensible space requirements. Additionally, only structures built or substantially remodeled since 2008 are likely to meet current ignition resistance standards of Chapter 7A of the California Building Code. Many of the recommendations in other sections of this report overlap with defensible space recommendations. Additional fuel reduction space within 100-200 feet of a structure could be considered an improvement of defensible space. In this section, specific recommendations for the 0-100 foot defensible space zone are addressed.

Each fire agency is responsible for defensible space inspection and enforcement within its jurisdiction. In order to improve high compliance with defensible space requirements throughout theCounty, the following is recommended:

- Continue to provide community “Chipper Days” throughout the county
- Conduct annual inspections and provide hazard notifications for all parcels out of compliancethroughout the county
- Recommend enhanced defensible space up to 200 feet to property boundary
- Support removal of specific non-native, fire-hazardous species (i.e., juniper, Italian pampasgrass, bamboo) commonly found in residential landscaping
- Support maintenance of mature native trees in defensible space zones, and incentivizemaintenance and/or replacement of non-native, fire-hazardous trees

Community Chipper Days

All fire agencies and departments throughout the county should encourage and support communityChipper Days, especially in Firewise USA® sites. Community Chipper Days have been shown to promote community involvement and provide a highly accessible mechanism to dispose of large quantities of hazardous vegetation. Annual Chipper Days also help neighborhoods meet annual Firewise USA® recognition and renewal requirements.

Hazard Inspections and Notices

During the public meetings conducted in 2016, when the CWPP was last updated, there was (and continues to be) public concern about a lack of compliance and enforcement for defensible space and vegetation management. One of the goals of the MWPA is to allocate funds “to expand and enhance defensible space home evaluations to ensure homes meet fire and building codes, as well as education to reduce the vulnerability of a home.” Enforcement can be geared toward working with property owners to help make their properties and homes more resilient to wildfire.

Recommend Enhanced Defensible Space to 200 feet for BoundaryProperties

The parcel-level hazard assessment performed as part of this CWPP update shows that many properties in Marin fall into Category 2 (of three). Parcels adjacent to large parcels of open space (public or private) and large tracts of contiguous vegetation are at particular threat from wildfire.

Some properties at the boundary of large parcels of open space (private or public) should be encouraged to maintain up to 200 feet of fuel reduction.

Vegetation management in these areas may include cutting grass, thinning tree canopies, enhancingthe spacing of landscaping plants, and thinning native vegetation up to 200 feet from all structures on the side(s) facing contiguous vegetation.

Priority Parcels for Fire Hazard

Although many parcels in Marin meet the accepted definition of WUI, some parcels may be at particular threat from wildfire. The analysis fire hazard at the parcel-level (Section 5) shows that manyof the parcels in Marin fall into Category 2 (of three). Priority parcels for fire hazard reduction should focus on parcels in Categories 3 and 2 that are in high risk intermix areas and properties immediatelyon the interface boundaries aligned with the most severe fire behavior predictions. Priority should also be given to those parcels that have homes with wood roofing and/or overgrown vegetation.

Support Removal of Hazardous Plant and Tree Species

Some non-native plant and tree species common to residential landscaping share characteristics thatmake them more likely to ignite readily and burn intensely. During recent fires in northern California,firefighters have observed certain plants including juniper, cypress, pampas grass, broom, and bamboo (to name a few) igniting and burning in the defensible space zones near homes. For this reason, these plants are poor choices for landscaping. Local fire departments may require removal ofcertain plants within 30 -100 feet of structures. FSM maintains a list of hazardous plant and tree species; however, the list is not a substitute for the experience of a professional as it does not take into consideration the condition of each home, and property characteristics such as slope, aspect, moisture, or soils, which can all influence a plant's response to fire. Fire agencies throughout the county should work with residences to support the removal of hazardous plant and tree species.

Removal of live plants should focus on recognized fire-hazardous, non-native plants. To protect biodiversity, habitat, and native landscapes, native plant species present in the defensible space zones around structures should typically be maintained, rather than removed. Maintenance may consist of regular pruning to remove dead material, irrigation during the dry season to increase planthydration, and spacing and/or limbing to provide ground to canopy separation.

Resale Inspections to Enforce Defensible Space and VegetationManagement

Ross Valley Fire Department (RVFD) takes a novel approach to vegetation management enforcement through its “Resale Inspection” program. Resale Inspections are vegetation hazard inspections that occur whenever a property is (re)sold in the towns of San Anselmo, Fairfax, or Ross in central Marin County’s Ross Valley. Fire inspectors visit properties listed for sale to conduct vegetation hazard inspections prior to sale. Current vegetation management standards and codes are included with property sale disclosures, and the vegetation hazard and mitigation requirements become part of thelisted “disclosures” during the sale of the property. Mitigation actions and cost are shared by the seller and buyer and must be completed as outlined in the related fire and municipal codes.

Resale inspections provide valuable access to fire department inspectors and ensure that property owners and buyers understand the wildfire risk and conform to standards to reduce hazards on theirproperty. Fire departments throughout the county could adopt a local ordinance, modeled after the RVFD, to require Resale Inspections for real estate sales in their jurisdictions as a strategy to enforce defensible space and vegetation management.

As part of California’s efforts to address the wildfire threat to communities, the State Legislature recently passed AB 38. Summarizing, this law requires local re-sale inspections of residences located in High and Very-High fire hazard severity zones in SRA, and in Very-High zones and locally designated WUI zones in LRA.

Support for Firewise USA Recognition

The national Firewise USA® program grew out of a partnership between the United States Forest Service (USFS), the U.S. Department of the Interior (USDI), and the National Fire Protection Association (NFPA). In 1997, NFPA launched the Firewise USA® website with information on wildfire safety for homes (NFPA 2015). The Firewise USA® community recognition program started in 2002 and now includes over 1,500 communities across the country. Marin County is home to more Firewise USA® sites (more than 60 as of November 2020) than any other county in the United States. **Figure 32** shows a map of Marin’s Firewise USA® communities.

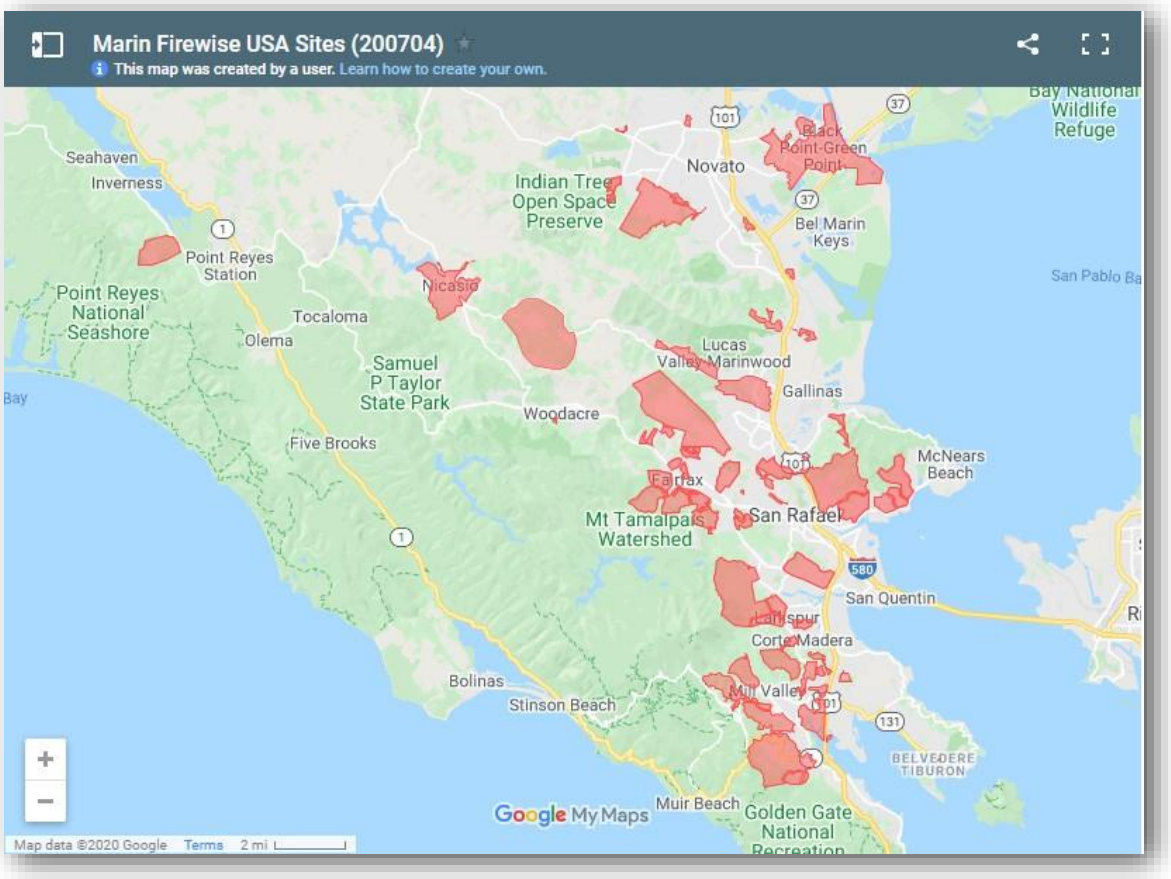


Figure 32. Map showing Marin County's Firewise USA® sites [Source: FIRESafe Marin:(**https://www.firesafemarin.org/firewise**)].

A similar movement started in California after the 1991 Oakland-Berkeley Hills Fire and developed into the fire-safe councils that now operate in over 100 California communities.[39] Fire-safe councils work to include local agencies and fire departments in planning to reduce fire hazard beyond the residents' mitigations on which the Firewise USA® program focuses. Many communities in Californiahave both a fire-safe council and Firewise USA® designation.

Firewise USA® incorporates many of the home mitigation and defensible space elements discussedin previous sections of this CWPP. Research and post-wildfire assessments have shown these mitigation measures to be successful. New research is beginning to assess the effect of Firewise

[39] California FireSafe Council (**https://cafiresafecouncil.org/**).

USA® practices on home survivability specifically. A careful analysis of 74 homes lost during the 2007 Witch Fire in San Diego, California, demonstrated that the majority of the Firewise USA® treatments evaluated appeared to be applicable even if individually they were not fully effective (Maranghides etal., 2013). More specifically, treatments such as having fire-resistant plants within 30 feet of the home,lawns, or gravel fuel breaks, pruning, removing overhanging branches, fire-resistant construction materials, clearing dead wood within 30 feet, and removing attached wood fences were all associatedwith reduced damage (Maranghides et al., 2013).

Firewise USA® recognition provides direct and indirect benefits to the community. Educational programs may improve awareness and individual accountability, and annual fuel mitigation efforts measurably reduce hazards. Financial benefits may include property insurance discounts, while FEMAgives Firewise USA® communities priority in consideration for pre-disaster mitigation planning and project grants.

6.5 Non-Residential Vegetation Management

This section provides information and recommendations for vegetation treatment goals and guidelines to be used when selecting and implementing fuel reduction actions for reducing wildfire hazards in Marin County's communities on non-residential land. It is important to recognize that fire agencies are not landowners and do not have the ability to conduct direct fuel modification treatments without landowner permission. All proposed fuel treatments on non-residential land should be achieved through a cooperative process with landowners or enforcement of existing (or proposed) regulations such as the adopted amendments to the WUI Code, California Fire Code, PRC4291, or Title 14 CCR.

After many years of fire suppression, ecosystems that rely on fire for health become strained and overgrown. Plants and trees become stressed by overcrowding and become more susceptible todisease; fire-dependent species disappear; and flammable fuels build up and become hazardous.Prescribed fire has many benefits, including:[40]

- reducing hazardous fuel loads;
- protecting communities from catastrophic fires;
- reducing the spread of plant and tree diseases and invasive species;
- encouraging the health of fire-dependent native vegetation and animal species;
- encouraging palatable and nutritious forage for domestic livestock in timbered and openrange;
- enhancing aesthetic value by increasing occurrence and visibility of flowering annuals andbiennials; and

[40] https://www.goodfires.org/.

- improving access to areas previously inaccessible because of thickets or dead and downwood.

Prescribed fires can be a very effective tool for hazard mitigation and ecosystem restoration. Conducting effective prescribed burns requires a burn plan that considers temperature, humidity, wind, moisture of the vegetation, and conditions for the dispersal of smoke.

6.5.1 Roadside Vegetation Management

Vegetation management along roadways and driveways is critical to safe access and egress during any emergency event. Narrow roads with unmaintained vegetation create considerable challenges forresponding fire apparatus. Under current vegetation conditions, some roads and areas in Marin are not safely accessible to fire emergency equipment and may create congestion for residents attempting to evacuate.

Roadside vegetation clearance is ultimately the responsibility of individual landowners when property lines extend to the edge of the right-of-way. In certain situations, right-of-way maintenance, such as annual mowing, drainage maintenance, and hazard tree removal, may fall on the local or county Departments of Public Works. For roads not maintained by the County, the adjacent property owner or local neighborhood association has responsibility for roadside vegetation management.

Funding for enhanced vegetation maintenance should be prioritized for the public right-of-way to reduce vegetation that may threaten evacuation or impede fire apparatus access. Because roadwayvegetation maintenance is largely the responsibility of individual landowners, the county could consider encouraging voluntary improvements through incentive programs such as hazard tree removal matching grants, hazard vegetation removal matching grants, and/or sponsorship of vegetation management/fuel crews to conduct vegetation removal in the highest hazard areas and adjacent to evacuation routes, with property owner permission.

6.5.2 Other Access/Egress Issues

Road Width and Turnouts

Road width and clearance is critical for allowing access/egress during an emergency or evacuationsituation. Many roads in Marin, especially in the WUI, are narrow and potentially interfere with fireengine access. Where roadways are narrower than 15 feet, paved turnouts are important to allow incoming fire apparatus and evacuating passenger vehicles to pass safely. Where turnouts are not available, vegetation clearance along roadways and driveways should be enhanced to reduce the threat of direct flame impingement upon the roadway and to improve visibility.

Fire Road Gate Access

Vegetation clearance near fire road gates is imperative for fire department access. Fuel treatments should be similar to those recommended for roadways but should extend a minimum of 30 feet from road edges near gates. Grasses should be cut annually near gates, ground fuels (i.e., fallen wood, brush) should be removed, and gates should be functionally inspected and maintained. Fire agencies should work with landowners (GGNRA; MMWD; MCOSD; private) to ensure gate clearanceis maintained and that gates are keyed and locked appropriately.

6.5.3 Open Space and Common Space Vegetation Management

Vegetation management on open space and common space should be a collaborative effort among fire agencies and landowners. Large landowners such as GGNRA, MMWD, and MCOSD all have vegetation management and fire hazard reduction programs in place. Fire agencies should work collaboratively with large landowners to help implement these plans when appropriate.

The ability of firefighters to operate safely and conduct fire suppression along ridgetop and mid-slope roads is critical to the rapid containment of wildfires. Maintaining or reducing fuels along fire roads in the Tiburon Ridge and Ring Mountain Preserves to levels that allow safe access for firefighters might make the difference between catastrophic wildfire or containment. Modeling confirms the value of these locations for fuel maintenance and minor modifications.

Work with Public and Private Landowners to Maintain Fuels

The presence of several large public and private parcels in strategic locations presents an opportunity for fuel reduction partnerships to achieve mutually beneficial goals and reduce community wildfire hazard. The parcel-level hazard assessment can be used to identify certain parcels where fuel treatment might provide the greatest benefit.

Engagement with landowners in strategic locations to coordinate fuel reduction projects that will benefit the community as a whole is critical. Appropriate treatment techniques should be used for the vegetation present, such as prescribed burns, reducing ground and ladder fuels, creating shaded fuel breaks, thinning canopies, maintaining existing grasslands, cutting annual grasses, and maintaining private fire roads. Cost sharing, matching grants, or direct funding are strategies that canresult in community-wide benefits.

Prescribed Fire to Reduce Fuels and Promote Healthy Ecosystems

As discussed in Section 3.4, Marin's native vegetation evolved with the presence of frequent wildfires. Native Americans used fire for protection, agriculture, and forest health. Low-intensity prescribed fires can be beneficial to the landscape and support biodiversity and productivity of chaparral and coastal scrub ecosystems (Sugihara et al., 2006). Prescribed

fires support the natural ecological processes in most plant communities, and therefore help to conserve biological diversity. Improving the health of the land and forests can also help sequester carbon.[41] Prescribed fires can also help reduce the catastrophic damage of wildfire on our lands and surrounding communities by reducing excessive amounts of brush, shrubs and trees and encouraging the new growth of native vegetation. Prescribed fire can be a very effective tool for preventing wildfires and managing the intensity and spread of wildfires and should be considered as a tool for mitigating fire hazard.[42]

Grazing to Reduce Fuels

Since 2016, herds of goats and sheep have been used to graze in open space areas as part of a large-scale fire hazard reduction project spearheaded by local landowners. The goat grazing program has been a collaborative effort to address key locations for fuel reduction to reduce the impact of wildfires in Marin communities. Over the past three years, this multi-agency project has successfully reduced hazardous fuels on hundreds of acres of high-hazard grassy woodlands throughout central Marin. Some grazing practices are known to import and/or expand non-native plant species.
Therefore, grazing practices should be monitored and managed to avoid potentially negative impacts to native plant diversity and other ecological attributes.

Maintain Existing Fire Roads and Conditions

Maintenance of existing fire roads that provide a strategic advantage for fire containment efforts andaccess for fire equipment, specifically, a 100-foot corridor of continuous grass along fire roads— provides safe working conditions for firefighters. With the support of firefighting aircraft, which are highly effective along ridgetop grasslands, containment of a fire in the first hour may be possible.
Fire agencies are encouraged to work with large landowners to ensure that conditions support safe working conditions for fire suppression and potential fire containment lines.

Fire for Invasive Species Control

Fire is also a tool used to manage ecosystems by removing vegetation. In some grassland areas, prescribed burning atprecise stages of native and non-native plant growth may reduce weedy, invasive plants and increase the range of native grasses. In other cases, burning may damage natives and create gaps for the establishment of invasive plants. Like all

Photo by Dana L. Brown[40]

[41] CAL FIRE (https://www.fire.ca.gov/programs/resource-management/resource-protection-improvement/landowner-assistance/forest-stewardship/carbon-sequestration-and-a-changing-climate).
[42] **https://smokeybear.com/en/about-wildland-fire/benefits-of-fire/prescribed-fires**
[43] "Hard work: the Fuels Crew is reducing wildfire risk while protecting biodiversity in partnership with the Marin County Fire Department and Marin Open Space District" (**https://www.flickr.com/photos/danalbrown/48135385571/**) by Dana L. Brown

other weed control practices such as herbicides, mowing, or tilling the soil, burning has to be utilizedproperly and should be integrated with other methods. In some cases, intentional fires can be incorporated with re-vegetation of native plants. Burning is also a good way to remove dead biomassand expose target plants to follow-up herbicide treatments. After a fire, the majority of plant materialis consumed, so access to the areas can be much easier. This can provide an opportunity to employ weed control for much less cost and effort (Bell et al., 2009).

6.6 Evacuation Planning and Preparation

Rapid and timely evacuation is critical to protect lives and property. Residents should be encouraged to evacuate as soon as possible after becoming aware there is a fire, since the presence of citizens in the fire zone only serves to slow firefighting efforts and puts lives at risk. Early evacuation increases the safety of evacuating residents, reduces the involvement of fire suppression personnel in evacuation (allowing firefighting resources to commit to fire suppression), and reduces the likelihoodthat evacuees might become trapped on roadways and subjected to reduced visibility, smoke, heat, or direct flame impingement.

FIRESafe MARIN provides evacuation guidelines and terminology for the public. The terms “voluntary” and “mandatory” are often incorrectly used to describe evacuations. In Marin, fire agencies and law enforcement will use the terms Evacuation Order, Evacuation Warning, and Shelter-In-Place to alert you to the significance of the danger and provide basic instructions. The following defines each term

- **Evacuation Order.** Leave now! Evacuate immediately, do not delay gathering belongings or prepare your home. Follow any directions provided in the evacuation order.
- **Evacuation Warning.** Evacuate as soon as possible. A short delay to gather valuables and prepare your home may be ok (see Evacuation Checklist) may be ok. Leave if you feel unsafe.
- **Shelter in Place.** Stay in your current location or the safest nearby building or unburnablearea. May be required when evacuation isn’t necessary or is too dangerous

The County of Marin, through the Sheriff’s Office of Emergency Services (Marin OES) and local fire agencies, has adopted a “Mutual Threat Zone Plan” with detailed evacuation maps intended for emergency managers and responders (**https://www.marincounty.org/depts/fr/divisions/operations/wildfire-evacuation-zones**). Marin public officials are considering incorporating the current evacuation maps with traffic control points to allow for more effective management of traffic during an emergency and to develop a model thatis consistent across the Bay Area.

6.6.1 Roadway Clearance and Roadside Vegetation

Roadway clearance and managing roadside vegetation is critically important to secure safe evacuation routes and provide access for firefighting resources. Vegetation within 10 feet of roadways should be maintained in the same manner as Defensible Space Zone 1 (5 feet to 30 feet). Additional vegetation clearance—from 10 feet to 30 feet or more—may be necessary to protect critical roadways, especially when terrain features such as steep slopes, drainages, or certain vegetation fuels might impact roadways with direct flames and/or radiant or convective heat.

Roadside vegetation management is a statutory responsibility for landowners under the CA Fire Code, as adopted by local agencies (in Marin, typically Sections 4907.2 and 4907.8) and other local ordinances; code enforcement is critical to achieving this recommendation. In locations where there is no responsible landowner under the fire code (some undeveloped parcels, CALTRANS right-of-way, some public right-of-way, and some tax-exempt parcels), fire agencies should develop plans to encourage vegetation maintenance and consider funding partnerships to execute those plans.

Vegetation management in the vicinity of roadways and driveways is critical to safe access and egress during a wildfire event. Narrow roads with unmaintained vegetation create considerable challenges for responding fire apparatus. Under current vegetation conditions, some roads and areas in Marin are not safely accessible to fire crews and may entrap residents attempting to evacuate.

Roadside Vegetation Clearance Responsibility

Roadside vegetation clearance is ultimately the responsibility of individual landowners when property lines extend to the edge the right-of-way. In certain situations, right-of-way maintenance, such as annual mowing, drainage maintenance, hazard tree removal, may fall on the local or county Departments of Public Works. For roads not maintained by the County, the adjacent property owner or local neighborhood association has this responsibility.

6.6.2 Promote Integrated Alert and Warning Systems and Procedures

Integrated alert and warning systems, well-defined protocols, and improved public information and pre-planning allow the public to better access and act on the most current information during an emergency. During an emergency, it is critical that the public (1) is prepared for evacuation, (2) knows how and where to evacuate, and (3) knows where to obtain current information during and after an event. The following should be implemented to prepare the public for a wildfire emergency:

6.6.2.1 Incorporate the public facing Marin County Emergency Portal website (**https://emergency.marincounty.org)** into alert and warning

message templates and protocols to allow the public to access the most current information during an emergency.

6.6.2.2 Conduct a comprehensive update of pre-planned evacuation zones, including a 'know your zone' component and accompanying public education and outreach, to inform the public about which mutual threat zone (MTZ) they live and/or work in and which evacuation routesto take.

6.6.2.3 Develop a public outreach strategy to inform the public on (1) how to sign up for *AlertMarin*(**www.alertmarin.com**), (2) how to determine which MTZ people live and/or work in, and (3)how to use the Marin County Emergency Portal website (**https://emergency.marincounty.org**) to obtain information during an emergency.

During Public Safety Power Shutoffs (PSPS), PG&E turns off power to help prevent wildfires and during wildfires, there can be a loss of electrical power due to damage to power poles and electrical distribution infrastructure. Cordless phones and phone recorders do not work if there is no electricity.Firefighters do their best to prevent the disruption of service; however, it is recommended that all homes keep at least one hard-wired telephone that will work without electricity or if no other device is registered to receive *AlertMarin* notices.

6.6.3 Increase Community Situational Awareness

Fire weather notifications and Red Flag Warnings are issued by the National Weather Service (NWS) to notify fire agencies and the in advance of critical weather patterns that may contribute to extremefire danger and/or extreme fire behavior. A Red Flag Warning is issued for weather events which maycontribute to extreme fire behavior and that will occur within 24 hours (or when these conditions arecurrently being observed). A Fire Weather Watch is issued when weather conditions could exist in thenext 12-72 hours. A Red Flag Warning is the highest alert. Red Flag Warnings help improve public awareness of fire weather conditions and encourage residents to be cautious and modify their behavior during these conditions.

Fire agencies and FIRESafe MARIN use various media channels including the FIRESafe MARIN website, social media, Red Flag Warning signage, emergency alerts, and PulsePoint to increase situational awareness during fire weather conditions.

6.6.4 Promote Adoption of NOAA Alerting Weather Radios

National Oceanic and Atmospheric Administration (NOAA) Weather Radios are excellent sources ofinformation during emergencies, especially when power and/or communications infrastructure is disabled. Prices vary depending on the model and start at $20. Many receivers have an alerting feature that will trigger audible and visual alarms when weather warnings, evacuation notices, or

other emergencies are transmitted. Most models are battery operated, and often have solar, hand crank, or other backup charging options.

In Marin, OES officials have established protocols to send an evacuation alert through the NOAA Weather Radio system. Local agencies may issue evacuation notices through this radio-based systemas well (using Marin OES as an intermediary), providing a backup notification system to homes that may be without power or out of cellular communication range and are unable to receive AlertMarin notices. Multiple NOAA evacuation alerts were successfully transmitted in Sonoma County during theOctober 2019 Kincade Fire. Fire agencies should encourage local adoption of these radios. FSM recently acquired several NOAA radios.

6.6.5 Long Range Acoustic Devices for Evacuation Alerts

There are potential benefits of installing Long Range Acoustic Device(s) (LRAD) for wildfire and disaster evacuation alerts. The LRAD is an acoustic hailing device developed to send voice messages and warning tones over long distances at high volume for alerting residents and visitors in at risk locations. When considering LRAD or other audible warning systems like “air-raid” sirens or horns, it’simportant to understand their limitations and use cases. These devices are typically audible outdoorsfor up to 1KM or more in ideal conditions (low ambient noise, calm air, clear skies). Testing shows that LRAD is audible indoors only within 100-300 meters of the transmitter. LRAD systems can provide an effective way to alert the public of an emergency event.

6.6.6 Create and Distribute Neighborhood-Scale EvacuationMaps

Two areas of Marin, Novato, and Fairfax, are developing neighborhood-scale evacuation maps. The “Fire Clear” evacuation preparedness program develops, prints, and distributes custom educational pamphlets outlining evacuation best practices; mapping evacuation routes for communities; and highlights evacuation steps recommended by FSM and neighboring agencies. The Fire Clear wildfireevacuation maps and brochures are 11 x 17 full-color brochure, bifold, printed on both sides on heavy paper with a UV laminate for durability. One side contains a full-color evacuation map of the target neighborhood (following MTZ evacuation zones), highlighting primary and secondary evacuation routes, direction of travel, potential safety zones, and community refuge areas. The otherside contains text information including evacuation checklists, and emergency contact numbers.

6.6.7 Evacuation Drills

To prepare the public for an evacuation situation, fire agencies throughout Marin have been conducting evacuation drills in cooperation with the Marin County Sheriff's Office and MCFD. Modeled around the multi-agency examples set in Mill Valley, Kentfield, and Novato, these drills haveproven to be an excellent education opportunity for both residents and fire service and law enforcement personnel. Marin Humane and the American Red Cross should be invited to attend and/or participate as well.

6.6.8 Designate Temporary/Community Refuge Areas

FSM and many Marin fire agencies, cities and towns, and other partners are working together to develop improved wildfire evacuation maps and messaging for residents in Marin's WUI communities. These "Fire Clear" maps, funded by fire agencies, cities and towns, and a grant from CAL FIRE, will be published as they are completed over the course of 2020. The maps currently available can be found on the FSM website (**https://www.firesafemarin.org/evacuation/maps**).

Temporary/Community Refuge Areas are locations where evacuating residents may seek temporary shelter during a wildfire if evacuation is not possible. In the unlikely event that the primary evacuation or secondary routes could be compromised during a wildfire, formal alternate safety zones should be established. Potential candidate locations for safety zones may include open, irrigated playing fields at local public and private schools, community centers, parks and open spaces, large parking lots, and other locations near a valley floor where residents may be able to shelter more than 100 feet from exposed vegetation or other combustibles.

6.6.9 Prepare for Animal Evacuation

Recent catastrophic fire events in rural areas where people are likely to have large animals or pets identified the need to provide animal evacuation and sheltering. During disasters, emergency managers have learned that many people refuse to leave their pets behind, and sometimes do not evacuate early (when conditions are safer) when they are unable to locate their animals or are not prepared for animal evacuation. Refusals or delays to evacuate may begin a chain of events that can seriously jeopardize or cause a total breakdown of an overall evacuation. Additionally, large numbers of pets and large animals (i.e., horses and livestock) are often left behind or otherwise become stray during wildfires. Minimizing the likelihood of animals becoming stray improves animal, public, and firefighter safety, and may facilitate a more rapid recovery following disasters.

During a wildland fire, local animal rescue organizations (primarily Marin Humane) will work with law enforcement and fire departments to rescue as many animals as they can. While fighting a wildfire, firefighters will attempt to protect animals, but they are not responsible for evacuating animals.

Firefighters may cut fences or open gates to free trapped animals. FSM provides information and guidelines for evacuating pets (**https://www.firesafemarin.org/evacuation/pets**) and large animals (**https://www.firesafemarin.org/evacuation/large-animals**).

[22] Property owners in mountainous areas, forest-covered lands or any land that is covered with flammable material must create at minimum a 100-foot defensible space (or to the property line) around their homes and other structures, as mandated by California Public Resources Code 4291.

[23] **http://www.marincounty.org/depts/fr/fire-detection-cameras**

7. Recommendations

This CWPP is intended to facilitate multi-agency collaboration and cooperation for fire protection and preparedness planning efforts in Marin County. This CWPP is considered a living document which will be reviewed and revised periodically as needed. The following recommendations were developed based on the mitigation objectives and strategies of Marin's fire agencies in coordinationwith FIRESafe MARIN and the MWPA for reducing wildland fire hazard. Since 2016, many of these actions have been implemented throughout the county and should continue to be encouraged andsupported.

7.1 Recommended Actions

The recommendations and action plan outlined below are aligned with the mitigation strategies described in Section 8.

1. **Continue to encourage and support public and community outreach** to educate landowners, residents, and business owners about the risks and personal responsibilities of living in the wildland, including applicable regulations, prevention measures, and preplanningactivities.
    - 1.1 Support and promote the efforts of FIRESafe MARIN and public outreach to achieveconsistency in messaging and awareness of wildfire preparedness
    - 1.2 Engage community members to work together and make their homes andneighborhoods more fire resilient
    - 1.3 Promote *Ready, Set, Go!* and Firewise USA® collaboration
    - 1.4 Support and promote efforts to educate the public on environmentally sound practicesand their implementation
2. **Improve and encourage actions to reduce structural ignitability** to make homes andstructures throughout the county more fire resilient.
    - 2.1 Develop an inventory of structures with wood/shake roofing and consider a roofmatching grant program for these structures
    - 2.2 Encourage fire-resistant building construction
3. **Continue to improve defensible space** to reduce fire hazard and threat to communities andhomes.
    - 3.1 Improve defensible space around all structures considering ecologically sound

practices

3.2 Continue to support and conduct Chipper Days to encourage and assist residents withremoving and disposing of flammable, dead and dying vegetation

3.3 Continue to identify and increase opportunities to assist landowners with green wastedisposal

3.4 Continue to conduct defensible space inspections and streamline enforcementprocesses

3.5 Encourage removal of hazardous plants within the 0-5 feet zone around structures

3.6 Enhance defensible space on priority parcels identified through inspections and theparcel-level hazard assessment

3.7 Support removal of hazardous plants and trees

3.8 Require resale inspections for defensible space requirements

3.9 Encourage and support Firewise USA® recognition

3.10 Develop a hazardous tree removal grant program

3.11 Encourage the use of native plants in landscapes in accordance with AB3074

4. **Continue to improve vegetation management practices** to reduce fire hazard and threat inand around non-residential areas.

4.1 Encourage and support roadside vegetation management

4.2 Collaborate with land management agencies to manage vegetation in open space andcommon space areas

4.3 Promote the use of prescribed fire as a way to reduce fuels and restore healthecosystems

4.4 Continue to encourage and support grazing to reduce fuels in appropriate areas

4.5 Continue to maintain fire roads

4.6 Continue to use fire as a means to control invasive plant species

4.7 Use ESPs in vegetation management activities as identified by the ESP partnership forMWPA.

4.8 Continue to improve management techniques to conserve Marin's valuable wildlifehabitats and ecosystem health while also reducing fire hazard

5. Continue to focus efforts on improving alert and warning systems and evacuationplanning

5.1 Improve roadway clearance and vegetation along evacuation routes

5.2 Promote *AlertMarin*

5.3 Promote the use of NOAA radios and AM/FM radio stations

5.4 Promote LRADs in areas that could benefit from the technology

5.5 Create neighborhood-scale evacuation maps and information

5.6 Conduct community evacuation drills

5.7 Designate temporary refuge areas

5.8 Provide guidance and support for evacuation of pets and large animals

5.9 Specific roadside treatment recommendations

- 5.9.1 Remove all dead trees and limbs that might obstruct roadways or impactutility lines
- 5.9.2 Remove all conifer stems 6 inches and smaller in diameter within 10” feethorizontally from road edges
- 5.9.3 Tree canopies extending over the roadway should be raised to a minimum of15 feet above the road surface to provide safe clearance for fire apparatus
- 5.9.4 Tree canopies on opposite sides of a road should not meet. Limbing orremoval of specific trees may be necessary to achieve discontinuity of canopies
- 5.9.5 Roadside trees should be limbed up, so the lowest point of lower limbs is atleast 10 feet above grade
- 5.9.6 Fine “ignition fuels” such as grass and weeds along road edges should beremoved annually, before June 1, or prior to the declared start of the fire season
- 5.9.7 Transition zones (from grass and weeds to shrubs and from low branches totree canopies) should be disrupted by mowing grass and herbs, removing brush, brambles (blackberries) and limbing up trees
- 5.9.8 Roadway turnouts should be mowed as necessary to prevent catalytic converter ignitions. Mowing may occur once or more per fire season, asneeded
- 5.9.9 Tree stands adjacent to roadways should be thinned to create crown separations. Always favor fire-resistant plants over fire-prone plants when thinning fuels (favor oaks, madrones, and redwoods versus bays, Montereypine, or Douglas fir)
- 5.9.10 Remove dead branches and clean up down and dead debris within 30 feet ofall roadways

5.9.11 When Applicable and Appropriate, Implement Environmentally Sound Practices and Climate Mitigation into Planning and Operations

5.9.12 Lower GHG emissions, sequester carbon

5.9.13 Support green resource management

5.9.14 Promote biomass recovery solutions

5.9.15 Conserve biological diversity

5.9.16 Decrease invasive non-native plants

5.9.17 Restore structure and diversity of native plant communities

5.9.18 Protect critical habitat and special status species

5.9.19 Prevent erosion and effects of actions on watersheds

7.2 Continue to Identify and Evaluate Wildland Fire Hazards

In addition to the recommendations and actions outlined above, efforts to collect data and state-of-the-science analyses should continue in order to continuously identify and evaluate wildland fire hazards. To facilitate planning for fire agencies and other jurisdictions implementing CWPP projects the mapping information used to evaluate wildfire risk will be available online. The data will include the map layers used to develop the county-level and parcel-level hazard maps (landscape data, structure density, etc.). This will help facilitate project evaluations. Specific actions include:

- Continue to collect, analyze, and maintain multi-agency hazard and resource GIS data.
- Maintain an accessible online GIS portal to store and share the ArcGIS Online (AGOL) maps and data developed throughout this CWPP and allow public and educational access as part of the process.
- Utilize the GIS information and modeling results presented in Sections 6 and 7 of this CWPP for pre-fire planning, and to collaboratively develop priorities for projects throughout the county.
- Consider ways to use drone technology for fire intelligence gathering.

7.3 Continue to Support the Collaborative Development and Implementation of Wildland Fire Protection Plans

Since 2016, several communities and fire districts have developed local fire hazard mitigation

plan and/or local-scale assessments including Sleepy Hollow, Southern Marin Fire Protection District, Novato Fire Protection District, and Ross Valley. These efforts should be continued and supported toaddress community-specific issues. Specific actions include:

- Work collaboratively with county, local, and regional agencies and landowners to develop fuel reduction priorities and strategies based on this CWPP, local plan, and/or other regionalplans.
- Support the development and implementation of local-scale fire hazard mitigation plans.
- Provide a collaboration mechanism between private property owners (and Homeowners Associations) and large landowners (i.e., MCOSD, MMWD, NPS).
- Consider the creation of transition zones (areas between developed residential areas and open space areas) where additional defensible space or additional vegetation clearance isneeded.

7.4 Plan Management

The fire agencies, land management agencies, and private landowners responsible for managingvegetation in Marin County are encouraged to submit project ideas that focus on reducing fire hazards in priority areas. Appendix B provides an initial list of priority projects but should be considered a starting point for continued collaboration and coordination.

To ensure continued collaboration and the long-term success of this CWPP effort, FSM—in collaboration with the MCFCA and the MWPA—will lead the effort to continue to evaluate, update, and maintain this CWPP as needed. The contents of the CWPP will be reviewed and evaluated everythree to five years and the action plan will be reviewed and updated annually. This plan will be updated with input from the community and local fire and land management agencies as necessary. Updates to the plan will be documented in Appendix A.

Appendix A: Identified Pre-Fire Projects

Agency & Project Name	SRA Threat LRA	Project Type	Status	Year Complete	Net Acres
TAM Community Service District	MRN	D Space	C	2016	2
MMWD BILL WILLIAMS FB	MRN	Fuel Break	M	Ongoing	4
MMWD DEER PARK RD	MRN	Road Maint	M	Ongoing	9
MMWD KNOB I	MRN	Fuel Break	M	Ongoing	48
MMWD KNOB II	MRN	Fuel Break	M	Ongoing	28
MMWD LAGUNITAS ROCK SPRING BREAK	MRN	Fuel Break	M	Ongoing	12
MMWD LOWER RAILROAD GRADE	MRN	Fuel Break	P	TBD	18
MMWD NATALIE COFFIN GREENE DIBBLEE	MRN	Fuel Break	M	Ongoing	8
MMWD PETERS DAM AND DSPACE	MRN	D space	M	Ongoing	10
MMWD PHOENIX DAM	MRN	Fuel Break	M	Ongoing	2
PHOENIX LAKE ROAD FB	MRN	Fuel Break	M	Ongoing	3
MMWD PINE MOUNTAIN FB	MRN	Fuel Break	M	Ongoing	13
MMWD PINE MOUNTAIN SOUTH GATE	MRN	VMP Burn	P	TBD	30
MMWD PORTEOUS FB	MRN	Fuel Break	P	Ongoing	19
MMWD RIDGECREST FB	MRN	Fuel Break	A	Ongoing	5
MMWD ROCK SPRING	MRN	VMP Burn	M	Ongoing	37
MMWD ROSS RESERVOIR BREAK	MRN	Fuel Break	M	Ongoing	17
MMWD SHAVER GRADE BREAK	MRN	Road Maint	M	Ongoing	8
MMWD SKY OAKS HEADQUARTERS	MRN	D Space	M	Ongoing	10
MMWD SKY OAKS MEADOW	MRN	VMP Burn	M	Ongoing	47
MMWD WORN SPRING MIDDLE	MRN	Fuel Break	M	Ongoing	16
MMWD WORN SPRING NORTH	MRN	Fuel Break	M	Ongoing	11
MMWD Middle Peak Dspace	MRN	D space	M	2016	1
MCP CITY SAN RAF Scettrini 1&2	THRT	Fuel Break	M	TBD	5
MCOSD Terra Linda/Sleepy Hollow Preserve	MRN	Defensible Space	O	TBD	49
MCOSD King Mountain Phases 1 & 2	MRN	FB maintenance	M	TBD	20
MCOSD Camino Alto Phase 1-5	MRN	Fuel Break	O	TBD	70
MCOSD Hillside Fuel Break	MRN	Fuelbreak	C	2019	5
MCSOD Middle Summit Fire Road	MRN	FB Maint	M	TBD	4

MCOSD Terra Linda Ridge	MRN	fb/ecu removal	P	TBD	40

MCOSD Old St Hillary's	MRN	Fuel Reduction	C	2019	3
MCOSD Baltimore Cyn/Ridgecrest/Crown	MRN	FB maint	P	TBD	31
MCOSD/MMWD/KNTFD-BWGulch/Indian FR	MRN	FB/Fire Road	P	TBD	TBD
MCOSD Cascade Canyon Fuel Break	MRN	Fuel Break	P	19-20	41
MCOSD/MCFD King MountainPhase 2	MRN	Fuel Break	C	2015	14
MCOSD/MVFD Mill Valley Fuel Break	MRN	Fuel Break	O	Ongoing	61
MCOSD Gary Giacomini Preserve	MRN	Defensible Space	P	2023	10
MCOSD Blithedale Ridge FB Area1,2,3	MRN	FB maintenance	O	TBD	15
MCOSD Corte Madera Ridge FuelBreak	MRN	FB maintenance	M	TBD	6
MVFD/MCOSD Corte Madera RidgeFuel Break	MRN	Fuel Break	M	TBD	32
RVFD/MCOSD Sleepy Hollow Community Defense	MRN	Fuel Reduction	C	2019-20	18
NPS Bolinas Stinson School Dspace	MRN	Fuel Reductio n	C	2020	8
NPS Smith Road Euc Thin	MRN	Thinning	P	2022	11
NPS Marin Drive Euc Thin	MRN	Thinning	P	2022	32
NPS Tam Valley WUI Fuel Reduction	MRN	Fuel Reductio n	C	10-20	6
NPS Inverness Ridge Mechanical FR	MRN	Mech fuelred	A	2015-2023	64
NPS Bolinas Ridge Thinning	MRN	Fuel Break	A	2018-2023	81
NPS Forest Wy WUI Fuel Reduction	MRN	Fuel Reductio n	P	TBD	5
NPS Lamintour Rx	MRN	Prescribed Fire	O	2021	128

NPS Mc Curdy Rx	MRN	Prescribed Fire	P	2021	127
NPS Strain Hill Rx	MRN	Prescribed Fire	P	2021	74
NPS Dogtown Rx	MRN	Prescribed Fire	P	2021	44
NPS Boundary FB Drakes View	MRN	Fuel Break	A	18-25	36

MCFD Shroyer Mtn FB	MRN	Fuel Break	M	2020	8
MCFD Triple C Ranch/Sleepy Hollow FB	MRN	Fuel Break	C	2020	16
MCFD Iron Spring Road Fuel Break	MRN	Fuel Break	O		22
MCFD Throckmorton Fire Road	MRN	Fuel Break	M	2019	3
MCFD/NVFD Rancho Santa Margarita – SRA Grant	MRN	Evac Route improvement	C	2017	6
MCFD Priority Fire Road Maintenance	MRN	Fire Rd Maint.	O		
MCFD/Novato Burnt Ridge FB Novato	MRN	Fuel Break	M	2015-2020	75
MCFD Skywalker Ranch	MRN	D Space	A	2021-2022	12
MCFD Countywide CWPP	MRN	Plan	C	2016	0
MCFD Tam Lookout Dspace	MRN	D space	C	2019	4
Status Guide:					
A= active					
P=planning					
C=complete					
O=ongoing/out year					
m= maintenance					

Appendix B: Unit Goals and Objectives

CAL FIRE identified seven goals in the 2010 Strategic Fire Plan for California. The goals, when implemented with the collaboration of local communities and groups, will enhance the protection oflives, property, and natural resources from wildland fire, as well as improve environmental resilience to wildland fire. Community protection includes promoting the safety of the public and emergency responders, as well as protection of property and other improvements and infrastructure.

The Marin Unit may work on any of the Fire Plan goals at any given time based on available fundingand other opportunities. The following are the Marin County Fire Department six goals and objectives concerning implementation of the Strategic Fire Plan/CWPP:

Goal 1: Improve wildland fire planning - Identify and evaluate wildland fire hazards and recognize life, property, and natural resource assets at risk, including watershed, habitat, social and other valuesof functioning ecosystems.
Objective: Collect, analyze, and maintain hazard and resource data in collaboration with state, localand federal partners.

Goal 2: Articulate and promote the concept of land use planning as it relates to fire risk andindividual landowner objectives and responsibilities.
Objective: Identify the minimum key elements necessary to achieve FIREWISE communities andincorporate these elements into community outreach and education while increasing FIREWISEcommunities one per year.

Goal 3: Support and continue to participate in the collaborative development and implementation ofwildland fire protection plans and other local, county, and regional plans that address fire protection and landowner objectives.

Objectives: Create and support venues in which individual community members can be actively involved in FIRESafe Marin, community emergency response teams, FIREWISE and other community-based efforts to develop readiness plans and educate landowners to mitigate the risks and effects ofwildland fire. Work with our land-owner cooperators/partners, fire agencies, and community partners to implement the Marin County Community Wildfire Protection Plan (CWPP) and track with an annual report of accomplishments for the Marin County Fire Chiefs Association.

Goal 4: Increase fire prevention awareness, knowledge and actions implemented by individuals andcommunities to reduce human loss and property damage from wildland fires, such as defensible space and other fuels reduction activities, fire prevention and fire safe building standards.

Objective: Educate landowners, residents and business owners about the risks and their incumbentresponsibilities of living in the wildland, including applicable regulations, prevention measures and preplanning activities, emphasizing personal responsibility, by conducting defensible space inspections and utilizing the READY, SET, GO program.

Goal 5: Integrate fire and fuels management practices with landowner priorities and multiple jurisdictional efforts within local, state, and federal responsibility areas.
Objective: Work to remove regulatory barriers that limit hazardous fuels reduction activities, whilebeing respectful and consistent with MCFD's land manager partner's priorities and challenges by collaborating on annual work plans.

Goal 6. Determine the level of resources necessary to effectively identify, plan and implement fireprevention using adaptive management strategies.
Objective: Seek additional staffing for implementing enhanced fire prevention activities, includingrelated natural resource management programs.

Goal 7: Determine the level of resources necessary to protect the values and assets at risk. Objective: Initiate and maintain cooperative fire protection agreements with local, state, and federal partners that value the importance of an integrated, cooperative, regional fire protection system anddeliver efficient and cost-effective emergency response capabilities beneficial to all stakeholders.

Goal 8: Implement post-fire assessments and programs for the protection of life, property, andnatural resource recovery.
Objective: Assist landowners and local government in the evaluation of the need to retain and utilizefeatures (e.g., roads, firelines, and water sources) developed during a fire suppression effort, taking into consideration those features identified in previous planning efforts.

In addition to the goals and objectives listed above, the following is the proposed workplan for the County as a whole for 2020-2021, through the MWPA:

MWPA Work Plans 2021		
Proposal Name	**Op Area**	**Proposal Category**
Defensible Space and Home Hardening Evaluation and Inspection Program	Central Marin	DSpace Evaluations
Defensible Space Evaluation and Inspection Software Development	Central Marin	DSpace Evaluations
Shaded Fuel Break Planning Project	Central Marin	Shaded/ Non-shaded Fuel Break
2021-2022 Evacuation Route Vegetation Management	Central Marin	Evacuation Routes
Defensible Space Inspection and Evaluation Program- Corte Madera	Central Marin	DSpace Evaluations
Defensible Space Inspection and Evaluation Program- Fairfax	Central Marin	DSpace Evaluations
Defensible Space Evaluation Program- Kentfield	Central Marin	DSpace Evaluations
Defensible Space Inspection and Evaluation Program- Larkspur	Central Marin	DSpace Evaluations

Defensible Space Inspection and Evaluation program- Ross	Central Marin	DSpace Evaluations
Defensible Space Inspection and Evaluation program- San Anselmo	Central Marin	DSpace Evaluations
Fairfax Defensible Space Grant Program	Central Marin	DSpace Grants Home Hardening
Fairfax Defensible Space Grant Program	Central Marin	DSpace Grants Fuel Management
San Anselmo Defensible Space Grant Program	Central Marin	DSpace Grants Fuel Management
Sleepy Hollow Defensible Space Grant Program	Central Marin	DSpace Grants Home Hardening
Sleepy Hollow Defensible Space Grant Program	Central Marin	DSpace Grants Home Hardening
CMD Defensible Space Grant Program	Central Marin	DSpace Grants Fuel Management
CMD Invasive Vegetation Treatment Program	Central Marin	Shaded/ Non-shaded Fuel Break
Fairfax Invasive Vegetation Treatment Program	Central Marin	Shaded/ Non-shaded Fuel Break
KNT Local Hazard Mitigation Grant Program	Central Marin	DSpace Grants Fuel Management
KNT Invasive Vegetation Treatment Program	Central Marin	Shaded/ Non-shaded Fuel Break
CMD Defensible Space Grant Program- Larkspur	Central Marin	DSpace Grants Fuel Management
CMD Invasive Vegetation Treatment Program	Central Marin	Shaded/ Non-shaded Fuel Break
Ross Invasive Vegetation Treatment Program	Central Marin	Shaded/ Non-shaded Fuel Break
San Anselmo Invasive Vegetation Treatment Program	Central Marin	Shaded/ Non-shaded Fuel Break
Monthly Webinar Series	Fire Safe Marin	Public Education
Community Wildfire Protection Workshops	Fire Safe Marin	Public Education
Wildfire Preparedness Festival	Fire Safe Marin	Public Education
Landscape Professionals Wildfire Education	Fire Safe Marin	Public Education
Home Hardening Workforce Development	Fire Safe Marin	Staffing
Prepare and Distribute Educational Materials	Fire Safe Marin	Public Education
Translation for Training and Educational Materials	Fire Safe Marin	Public Education
Partnership with Marin Center for Independent Living	Fire Safe Marin	Public Education
Provide Training to Marin Schools	Fire Safe Marin	Public Education
Support Firewise Sites	Fire Safe Marin	Public Education
Support Defensible Space Inspection Program	Fire Safe Marin	DSpace Evaluations
Maintain Comprehensive Website	Fire Safe Marin	Public Education
Timely Responses to Resident Inquiries	Fire Safe Marin	Public Education
Prepare Monthly Newsletter	Fire Safe Marin	Public Education
Coordinate Outreach/PR with MWPA and Partners	Fire Safe Marin	Public Education
Mobile Home Wildfire Safety Training	Fire Safe Marin	Public Education
Red Flag Safety Signs	Fire Safe Marin	Alerts/Notifications
Curbside Chipper Program	Fire Safe Marin	Chipper Days

Low-Income DSpace Grant Program	MWPA Admin	DSpace Grants Fuel Management
Home Hardening Matching Grant Program	MWPA Admin	DSpace Grants Home Hardening
UCCE/Marin Master Gardners	MWPA Admin	Public Education
Marin Valley Goat Grazing Evacuation Project	Novato	Shaded/ Non-shaded Fuel Break
Bahia HOA Defensible Space and Evacuation Routes	Novato	Shaded/ Non-shaded Fuel Break
Novato Roadside Evacuation Routes	Novato	Evacuation Routes
Black Point Evacuation Routes	Novato	Evacuation Routes
HOA D-Space/Chipper Program	Novato	Shaded/ Non-shaded Fuel Break
City of Novato Open Space/CEQA and Biological Services	Novato	DSpace Evaluations
Novato Chipper Days	Novato	Chipper Days
NFD Certified Wildfire Mitigation Specialist Program	Novato	DSpace Evaluations
Wildfire Ignition Resistance Home Hardening Initiative	Novato	DSpace Grants Fuel Management
Vegetation Management Matching Grant Program	Novato	DSpace Grants Home Hardening
Zone 0 NFD Fire Stations and Admin	Novato	Shaded/ Non-shaded Fuel Break
Fire Adaptive Community Awareness Campaign	Novato	Public Education
Fire Smart Demonstration Garden	San Rafael	Public Education
South San Pedro Mountain Fuel Reduction Zone	San Rafael	Shaded/ Non-shaded Fuel Break
North Lucas Valley Fuel Reduction Zone	San Rafael	Shaded/ Non-shaded Fuel Break
Fire Roads: Vegetation Removal and Enhancements	San Rafael	Shaded/ Non-shaded Fuel Break
Ridgewood Fuel Reduction Project	San Rafael	Shaded/ Non-shaded Fuel Break
Prescribed Herbivory on San Rafael Open Space	San Rafael	Shaded/ Non-shaded Fuel Break
Chipper Days (Additional)	San Rafael	Chipper Days
Evacuation Route Clearance	San Rafael	Evacuation Routes
Evacuation Information Outreach	San Rafael	Public Education
Informational and Warning Signage	San Rafael	Alerts/Notifications
Open Space Management Projects	San Rafael	Shaded/ Non-shaded Fuel Break
Direct Assistance Grant Program	San Rafael	DSpace Grants Home Hardening
Puerto Suello Fuel Reduction Project	San Rafael	Shaded/ Non-shaded Fuel Break
Air Curtain Burner for Debris Disposal	San Rafael	Equipment

Full Time Vegetation Management Staff	San Rafael	Staffing
Seasonal Inspection Staff	San Rafael	Staffing
Annual Defensible Space Notice	San Rafael	Public Education
Open Space Rangers	San Rafael	Staffing
Wildfire Mitigation and Preparedness Specialist Position	San Rafael	Staffing
Fire Mitigation Technician/Specialist	San Rafael	Staffing
Service Corps Direct Assistance	San Rafael	Staffing
Ignition Site Clean-up and Fuel Reduction	San Rafael	Shaded/ Non-shaded Fuel Break
MCFD Community Wide Evacuation Route Local Funds	San Rafael	Evacuation Routes
L.R.A.D Emergency Notification Network	Southern Marin	Alerts/Notifications
Mill Valley Sheltered Fuel Break	Southern Marin	Shaded/ Non-shaded Fuel Break
Regional Neighborhood Response Coordinator	Southern Marin	Staffing
Ridgecrest Fuel Reduction- Southern Marin	Southern Marin	Shaded/ Non-shaded Fuel Break
Tamalpais Valley/Homestead Fuel Break	Southern Marin	Shaded/ Non-shaded Fuel Break
Highway 1 Evacuation Corridor	Southern Marin	Evacuation Routes
Defensible Space Inspection and Evaluation Program	Southern Marin	DSpace Evaluations
Defensible Space Inspection and Evaluation Program	Southern Marin	DSpace Evaluations
MVFD Defensible Space Grant Program	Southern Marin	DSpace Grants Fuel Management
MVFD Evacuation Route Clearing	Southern Marin	Evacuation Routes
SMFD Evacuation Route Clearing	Southern Marin	Evacuation Routes
Southern Marin Fire District Fuel Break	Southern Marin	Shaded/ Non-shaded Fuel Break
Bolinas-Stinson Beach Resource Recovery Project	West Marin	Equipment
Defensible Space and Home Hardening Evaluation and Inspection Program	West Marin	DSpace Evaluations
West Marin DSpace and Home Hardening Grant Core 2021	West Marin	DSpace Grants Home Hardening
West Marin Evacuation Route Core 2021	West Marin	Evacuation Routes
MCFD Defensible Space Inspection and Evaluation Program 2021	West Marin	DSpace Evaluations
Bolinas Defensible Space Inspections	West Marin	DSpace Evaluations
Defensible Space Inspections- Inverness	West Marin	DSpace Evaluations
Defensible Space Inspections- Stinson Beach	West Marin	DSpace Evaluations
MCFD DSpace Grants Local Funds 2021	West Marin	DSpace Grants Home Hardening
MCFD Community Wide Evacuation Route Local Funds	West Marin	Evacuation Routes

Inverness Ridge Association Evacuation Clearance	West Marin	Evacuation Routes
Bolinas Defensible Space Inspections	West Marin	DSpace Evaluations
Perth to Highland Evacuation Route	West Marin	Shaded/ Non-shaded Fuel Break
Fire Break Improvement- Stinson Beach	West Marin	Shaded/ Non-shaded Fuel Break

Appendix C: Unit Report on Accomplishments

The Marin County Fire Department accomplished the following in 2018-2019 in support of our UnitFire Plan:

Goal 1.

- Funded and managed FEMA Grant for 2020 Refresh of CWPP with County HazardMitigation planning.
- Provided numerous consultations on vegetation management alternatives forprivate landowners to reduce fire hazard.
- Ongoing contract with STI to develop a parcel level structure ignitability assessmentfor Marin County.
- Collaboration with One Tam Partners and STI on acquiring LiDar vegetation data forre-analysis of fire behavior modeling for the Community Wildfire Protection Plan.
- Ongoing coordination with DPW on evacuation route vegetation management priorities.
- Made several presentations on fire preparedness and 2020 CWPP to various boards,councils and public entities.
- Member and participation on numerous Fire Environment working groups underMarin Conservation League.

Goal 2.

- MCFD Staff lead project to refresh/update Marin County Community WildfireProtection Plan with stakeholders.
- MCFD Staff coordinated and implemented the MWPA Defensible Space Program forMarin County Fire, Ross Valley Fire Dept, Kentfield and Central Marin Fire --- hired and interviewed defensible space inspectors/evaluator and a lead coordinator to run the program. Coordinated all logistical needs and support for the program.
- Inspected/evaluated 15,000 residences utilizing the Fireaside data collection software.
- Worked with neighboring fire districts and property managers to assess vegetationmanagement issues on county properties adjacent to open

space and private lands.

- Coordinated with PG&E and NPS on vegetation management issues along poles and powerlines.
- Consulting and supporting numerous non-profits, departments etc. on grant opportunities for fire hazard reduction and fire planning.
- Continued coordination of Public and Agency alerts & notification of Red Flag Warnings and Red Flag Watches – created a consistent message for all agencies to distribute.

Goal 3.

- MCFD fielded 2 Tam Fire/Fuels Crews – with funding support from the NPS, OSD, FIRESafe Marin. Crews completed fire hazard reduction projects for land management agencies and local large private landowners at Hill Ranch, Tam Valley TCSD, FSM Roadside Evac Routes, National Park Service – cut, pile, chip dead Bishop Pine in Inverness Paradise Ranch Estates on the NPS boundary, and fuel reduction behind communities bordering Parks and Open Space areas throughout the county.
- Conducted fire insurance hazard assessments for various homeowners in West Marin and Unincorporated areas. Managed and supported agencies and non-profits on submission and completion of multiple CAL FIRE Prevention Grant applications. Ongoing updates coordination of Marin Mutual Threat Zone mapping and FIRE Clear Evacuation Route Mapping for Marin County.
- Regularly attended and support for FIRESafe Marin Meetings, serving on their board as the Marin County Fire Department representative.
- MCFD support and membership of several MWPA committees.
- Conducted defensible space work around Cedars Adult Day Center with MWPA funds.
- Completed several environmental reviews on defensible space and hazardous fuel reduction projects.
- Developed project proposals for MWPA work planning efforts.

Goal 4.

- Hosted 3 Green Waste days in partnership with County of Marin and West Marin Compost.
- Conducted defensible space inspections including distribution of fire educational and preparedness materials on over 7000 properties in and adjacent to the SRA.
- Provided defensible space services to 15 senior property owners.
- Contacted numerous absentee/vacant lot property owners on defensible space requirements.
- Consulted with several neighborhoods on FIREWISE process,

defensible space and emergency procedures.
- Provided training on defensible space inspection process to department personnel.

Goal 5.
- Quarterly coordination meetings with Parks and Open Space on Road and Trail management plan for fire roads and fire access.
- Prioritization, inventory, evaluation, and clearance of primary evacuation routes and roads in Woodacre, San Geronimo, Lagunitas, Forest Knolls, Inverness.
- Cleared evacuation routes of excess vegetation in Inverness community in cooperation with Inverness PUD.
- Provided numerous senior homeowners with defensible space work to identified properties needing assistance.
- Partnering with DPW on improving evacuation route vegetation clearances on county-maintained roads.
- Coordinated CEQA virtual training sessions with County Environmental Planning Staff.
- Enhanced staffing and messaging during Red Flag Days.
- Provided services to NPS hazardous fuel reduction accomplishments - continued work on Inverness Ridge Shaded Fuel Break – chipped 105 burn piles versus burn.
- Vegetation clearance around the multiple radio repeater sites to improve defensible space to this critical communication site, defensible space around Stinson Bolinas School, and numerous park infrastructure.

Appendix D: Contract County Reporting Requirements

Date Required	Report	Responsibility	Comments
Monthly 10th of each month	Fire Prevention & LE Inspections, violations,citations, education	Station Captains Roll Up Fire Marshal &VMP Captain	Station data rolled into reporting table – **AOP says 13th of each month* mail to Patricia.Nakasone@fire.ca.gov
Monthly	JAC Report	B/C Training	Target Solutions export to CPF
Monthly 15th of each month	NFIRS Report	OPS BC 1511	NFIRS Export
Bi-Monthly	VMP projects update	VMP Fire Captain	Projects also in CalMAPPER
January /Annual DPAreview	SRA edits	Fire Chief BC/Fire Marshal	Protection area changes due tocity annexation To Regional Pre Fire Coordinator
February 15th	Fire perimeter & ignition data for Annual Fire Report from previous year	BC/Fire Marshal	To FRAP
March 1	Northern Region Training Needs Assessment	B/C Training	To Northern Region TO
April 15	FRAP - Community Planning Data Maintenance	VMP Fire Captain	Requires collaboration with local Fire Depts, FIRESafe Marin and CWPP, HOAs.
Monthly 25-5th of each month	CalMAPPER project data input	VMP Fire Captain	Include Treatments numbers in place of Incident numbers for each project activity
May 1 Annually	Unit Fire Plan to Region	VMP Fire Captain	
Monthly 25th	ACC spreadsheet of hours worked on fuel treatment projects in SRA	VMP Fire Captain	Coincides with treatments entered in CALMAPPER
May 15th Annually	Unit AOP Review	Fire Chief	AOP AppendicesIA Resources Lost Recovery RatesGrey Book Stations Communication Resource InvCapital Outlay
Quarterly Sept/Dec/Mar/June	Base Contract BillingGrey book	Admin. Services Mngr.	
120 days post incident control date	Billing invoices /ABH	Admin. Services Mngr.	
Rev SDA 5/8/21			

Appendix E: Ignition Management Plan

State Responsibility Area Description

Marin County is a mosaic of urban and rural residential areas, agricultural lands, municipal watersheds, and public lands. Each of these areas presents a variety of ignition sources that threaten State Responsibility Areas

Our records management system (RMS), Emergency Reporting System (ER) indicated that MCFD responded to 653 vegetation fires and 568 structure fires over the past 10 years. However, our records are incomplete when it comes to determining the cause of these fires.

The California Legislature directed the Board of Forestry, the California Department of Forestry and Fire Protection, and contract counties including Marin to deliver a fire-protection system that provides an equal level of protection for lands of similar type (Public Resources Code §4130). To evaluate this standard, MCFD used an analysis process that defines a level of service rating that is applied to the wildland areas. The rating is expressed as the percentage of fires that are successfully extinguished with initial-attack resources.

The level of service rating provides a powerful tool for setting program priorities and defining program benefits. The level of service rating also provides a way to evaluate the contribution of various program components (fire prevention, fuels management, engineering and suppression) toward the goal of keeping damage and cost within acceptable limits.

During the past 10 years, (1/1/2010-12/31/2020) MCFD responded to a total of 469 wildland fires. Of these fires 129 were undetermined/under investigation as to cause (13%). Of the remaining fires, causes identified: Equipment (17 fires, 4%), Act of Nature (13, 3%), “Intentional” (8, 2%), “Unintentional” (46, 10%), Power line (22 fires, 9%), and “misuse” of fire (11 fires, 4%) were the most common known/determined causes of fires. The remaining fires (223) did not have a cause entered in our RMS, were “lost in translation” when we transitioned from “Firehouse” to Emergency Reporting, or were fires that MCFD responded to as Mutual Aid (97). Fires ranged in size from small roadside spots to 159 acres, averaging less than 1.0 acre. Extended attack was required in all cases where fires burned more than 10 acres (19 fires); additional support in the form of a hand crew was also needed where fires burned in heavy fuels. Level of Service is calculated as follows:

Fires Extinguished by Initial Attack	450
Total State Responsibility Area Fires	469
Level of Service = ---x 100 =	**96%**

Ignition Summary

An analysis of MCFD's ignitions for the years (2003-2016) indicates that MCFD experiences on average approximately 25 structure fires per year. The 10 years of wildfire fire statistics (2005- 2016) shows MCFD responds to an average of approximately 80 vegetation fires per year. Of the vegetation fires, prevalent identifiable causes include tree branches contacting power lines (or someother power line associated failure) and fires caused by mechanical equipment (hot work, cutting, and agricultural equipment). A majority of these fires have been classified as undetermined/unknown due to the absence of identifiable ignition mechanisms.

Average Wildfire Statistics by Cause: 2005-2016

Wildfires	Acreage ac/year	Unk #/acres	Camp Fires #/acres	Debris #/acres	Equip Use #/acres	Vehicle #/acres	Electrica lpower #/acres	Misc #/acres
80/year	**114 ac**	**24/74**	**6/4**	**7 /1**	**4/11**	**8 /4**	**13/23**	**12/8**