



2020 SOUTHERN MARIN FIRE PROTECTION DISTRICT WUI WILDFIRE HAZARD & RISK ASSESSMENT



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EXECUTIVE SUMMARY

XMR Fire Consulting (XMR Fire) prepared this report to assist Southern Marin Fire Protection District (SMFPD, “the District”) of Mill Valley, CA, in assessing hazards within the wildland-urban interface (WUI) areas encompassed by the District. The purpose of the assessment is to identify specific hazards associated with wildfire and development in Southern Marin (as defined by the District boundaries).

This assessment’s goal is to provide SMFPD with a strategy to minimize the risk of catastrophic wildfire within the WUI while ensuring the protection and enhancement of economic and ecological values and resources within SMFPD’s jurisdiction. The intent is consistent with the mission of SMFPD and builds upon the District’s ongoing wildfire mitigation activities, as well as the 2016 Marin County Community Wildfire Protection Plan (CWPP), and other District plans and policies.

This assessment looks at current conditions and predicted trends and recommends sound, long-term strategies for reducing structural ignitability, managing and reducing vegetation fuel loads on public lands and private property, and improving wildfire response and suppression capabilities within the boundaries of SMFPD.

This document addresses potential hazards, natural and human-made, and assets that may be at risk if (and when) wildfires occur. Causes of existing and potential hazards include natural vegetation “fuels,” fire spread and topography, accessibility and road conditions, and human-related risks such as hazardous yard features. Fire environment, fire defensibility, and potential mitigation techniques are discussed, and impact avoidance and minimization measures are presented.

Using geographic information system (GIS) analyses, XMR Fire modeled the hazards associated with the boundaries of SMFPD. An evaluation of the application of GIS methods to modeling the risks within the WUI was based on a review of literature pertinent to these elements and is consistent with the techniques used in the 2016 Marin County CWPP. Adjacent communities were not assessed as part of the development of this report. As detailed in this report, some neighborhoods and streets within the District are at greater risk than others. Therefore, this report identifies the neighborhoods and infrastructure that are at greatest risk of being negatively influenced by wildfire and concludes with recommendations for specific measures to systematically reduce risk and mitigate hazards.

FUNDING MECHANISMS

Measure U

Measure U, the SMFPD Local Emergency Medical Response and Fire Protection Measure, is an annual \$200/single-family residence parcel tax measure adopted by voters in 2018 to protect and maintain the District's fire and emergency medical protection services. Measure U assesses a parcel tax for property other than single-family houses of \$200/unit for other residential property, \$150/parcel for undeveloped property, and \$0.18/square foot of developed building space for nonresidential property. Measure U is expected to generate approximately \$3 million in annual revenue for the District.

Measure U funding priorities adopted by the District's elected Board of Directors are:

1. Maintaining Local Emergency Medical Services
2. Attracting and Retaining Qualified Professional Paramedics
3. Maintaining High Cardiac and Stroke Survivability Standards
4. Maintaining Local fire Protection
5. Maintaining Current 9-1-1 fire response times and,
6. *Improving the District's ability to react to and contain wildland fires*

This report and assessment may be used to provide guidance and/or a framework for prioritizing, developing, and implementing the District's wildfire prevention and mitigation programs; prioritization of future allocation of funds; and identification of potential projects related to element #6 above, improving the District's ability to react to and contain wildland fires.

Marin Wildfire Prevention Authority: MWPA

SMFPD's Board of Directors voted to join the Marin Wildfire Prevention Authority (MWPA)¹ in October 2019. The authority will be funded by parcel tax "Measure C" approved by voters on the March 3, 2020 ballot, with a 10-year sunset provision.

Key elements of the MWPA initiative include:

- Improving emergency alert and warning systems to enhance early alert for organized evacuations
- Expanding coordinated efforts to reduce combustible plants and vegetation
- Improving evacuation routes and infrastructure to enhance traffic flow and promote safe evacuations
- Expanding and enhancing defensible space and home evaluations and educating homeowners about how to reduce the vulnerability of their home and neighborhood to wildfire

¹ <https://www.marinwildfire.org/>

- Providing grants and support to seniors, persons with disabilities, and low-income homeowners who need assistance maintaining a defensible space, making homes fire resistant, reducing combustible vegetation, and preparing for emergencies
- Creating and sustaining a coordinated local wildfire public safety and disaster preparedness program
- Supporting residents to establish Firewise USA programs in neighborhoods through ongoing public education

INTRODUCTION

Southern Marin Fire Protection District (SMFPD, “the District”), located at the southern end of Marin County, California, has undertaken an assessment of potential hazards in the wildland-urban interface (WUI) in and around the communities within its jurisdiction. The WUI is commonly described as the zone where structures and other human development meet and intermingle with undeveloped wildland or vegetative fuels. In WUI areas, urban “fuels” (homes and other structures) directly meet wildland “fuels” (vegetation). When wildfires occur in the WUI, they pose tremendous risks to life, property, and infrastructure and create one of the most dangerous and complicated situations firefighters face. This report provides an assessment of potential fire hazards and recommendations for pre-fire planning and mitigation strategies to help protect the communities of Southern Marin.

The District is an independent special district established by the Marin County Board of Supervisors in July 1999. The District was formed by the merger of the Alto-Richardson Fire Protection District and the Tamalpais Fire Protection District. In June 2012, the City of Sausalito Fire Department was annexed into the fire District. In October 2010, the District signed a contract with the National Park Service (NPS) to provide services to the Marin Headlands and Fort Baker areas of the Golden Gate National Recreation Area (GGNRA).

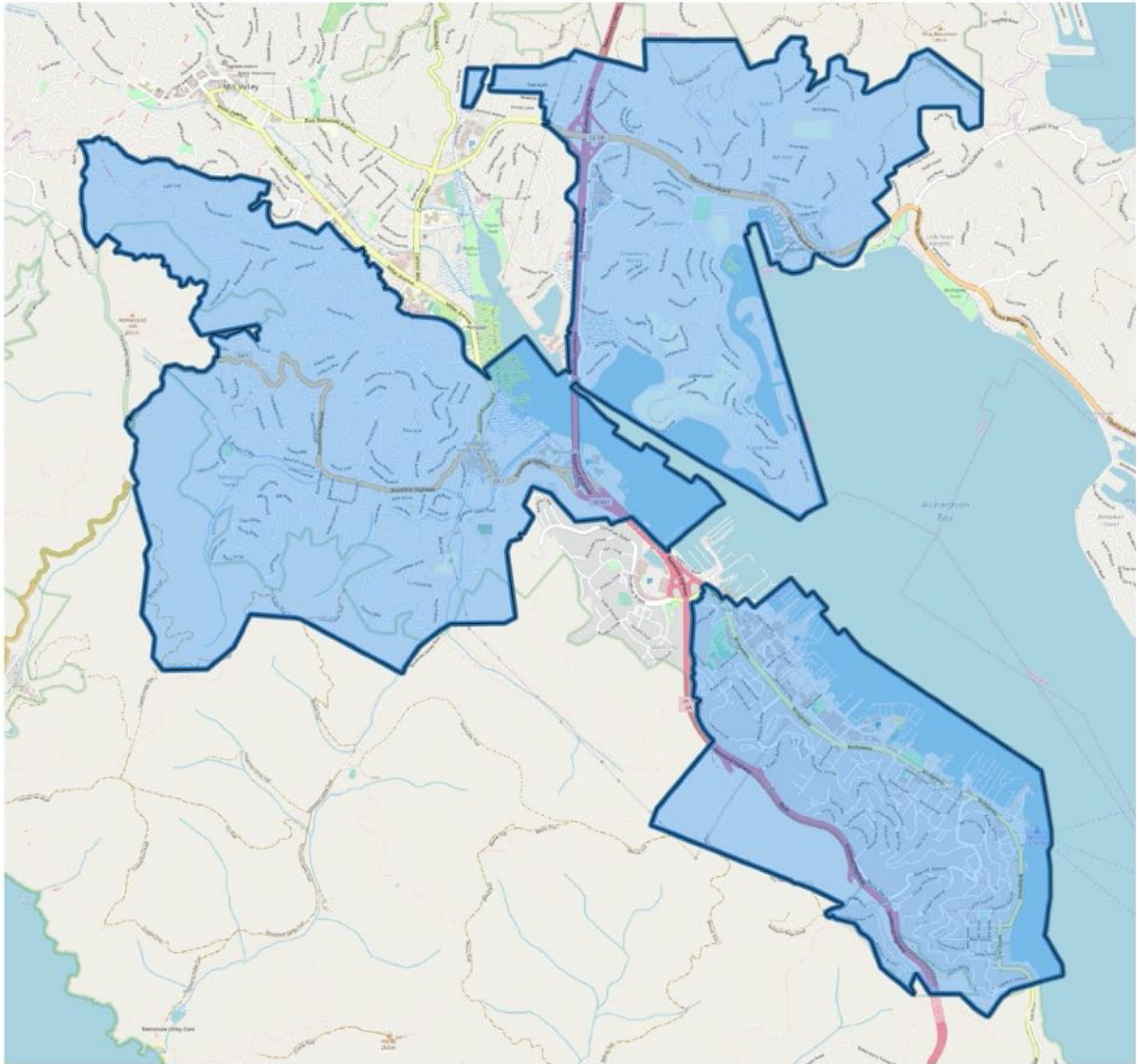
The District now serves the communities of Tamalpais Valley, Almonte, Homestead Valley, Strawberry-Alto, the City of Sausalito, a small portion of Tiburon, Fort Baker, and the Marin Headlands. The District covers over 20.5 square miles of Southern Marin County. Approximately 14 square miles are National Park property. The remaining 6 square miles are developed communities with a population of approximately 26,175 and over 14,100 homes and commercial properties.

In 2014 the Southern Marin Fire Protection District and City of Mill Valley Fire Department began exploring opportunities to share or consolidate services for the purposes of increasing efficiencies and reducing or avoiding un-needed costs. Both agencies had a single vacancy in their Battalion Chief groups and this became the catalyst for an earnest effort to consolidate some services. The Battalion Chief of the two agencies were combined into a single team informally in 2015 while the agreement was developed and ultimately executed in 2016.

The success of this initiative led to an expanded consolidation of the upper management team of both organizations, and both prevention divisions, into a single mid and upper management team, and a single prevention division. This was formalized in a two-year agreement in January 2020. While not a full merger, the steps in this process will allow for better collaboration. The arrangement allows firefighters, engineers and captains in Mill Valley and the fire district to work together seamlessly, respond to emergencies more efficiently and learn from each other.

For the purposes of the hazard assessment provided in this report, the communities within the District's jurisdiction have been defined as three general areas: 1) the Tamalpais and Homestead Valley area which includes Almonte; 2) the Strawberry-Alto area; and 3) the city of Sausalito. A map of the jurisdictional boundary of the District and the communities of Sausalito, Tamalpais Valley and Homestead Valley; and the Strawberry-Alto area is shown in Figure 1. Figure 2 shows a Google Earth image of the same area.

Assessment of the risks and hazards in parks and open space areas (for example Golden Gate National Recreation Area, GGNRA) are generally excluded from this report since there are limited structures and assets within those areas. Occasionally there will be mention of risks and hazards in these areas, especially where assets like residences and utility infrastructure exist.



■ SOM District Boundary

0 0.5 1 mi

Figure 1. Map of the District's jurisdictional response boundary (outlined in blue) and the communities of Sausalito; Tamalpais Valley and Homestead Valley; and the Strawberry-Alto area. The District provides initial attack and emergency medical response to GGNRA lands (outside of the District's tax boundary) accessed from Sausalito and Tennessee Valley under contract.



Figure 2. Google Earth image of the SMFPD RESPONSE boundary (in red) and the communities of Sausalito; Tamalpais Valley and Homestead Valley; and the Strawberry-Alto area.

The various fire protection agencies responsible for the protection of wildlands and communities within and around Southern Marin (primarily Southern Marin Fire Protection District, Marin County Fire Department, CAL FIRE) recognize the potential for catastrophic wildland fires that pose serious threats to people and infrastructure. The 2017 and 2018 California wildfire seasons were the deadliest and most destructive in recorded history. The fire season of 2017 brought 5 of the top 20 most destructive WUI fires including the Tubbs fire in nearby Napa and Sonoma counties. In 2018, northern California alone experienced several large, destructive fires including the Mendocino Complex, Carr, and Camp fires. As the number of acres burned and property/structure loss increase, more attention has been directed at pre-fire planning and public preparedness throughout California.



Fountaingrove, Santa Rosa, following the Tubbs Fire of October 2017.

Risk Factors

Much of SMFPD's service area is characterized by WUI and adjacent parklands and open spaces. These areas and the risk and hazard were analyzed and mapped for relative potential fire hazards, value, and risk assessment in the 2016 Marin County CWPP.

SMFPD has a long history of significant wildfires, including Marin's first known urban/wildland conflagration 100 years ago in September 1919 in the Wildwood Glen and Hurricane Gulch neighborhoods of Sausalito. The district experiences frequent wildfires, typically from 0.5 to 20 acres under "normal," prevailing weather conditions. Significant potential exists for larger, more destructive wildfires under extreme weather scenarios, and this report will analyze and identify that risk and present mitigation recommendations.

The risk created by the natural environment is compounded by certain physical constraints and limitations in the District, including:

1. **Evacuation Routes:** Limited and or constrained evacuation routes.
2. **Overhead Utilities:** Overhead utility lines and equipment line many of the key evacuation routes and present a potential ignition source for a wildfire.

3. **Constrained Ingress and Egress:** Many streets are narrow, dead-end, with one or two-lane egress routes which may restrict access by first responders and evacuation by residents.
4. **Older Structures:** A majority of structures within the District were built prior to the adoption of current WUI codes and standards. Chapter 7A of the CA Building Code, adopted in 2008, set a standard for building ignition resistance that makes structures built or substantially remodeled post-2008 much more likely to survive exposure to wildfires.²
5. **Visitors:** The District sees significant tourism, with at least 8 million visitors per year³ to Sausalito, GGNRA, and accessing Muir Woods National Monument via Highway 1 in Tam Valley. Tourism and nonresident visitors may complicate evacuation efforts and require planning to consider a much larger volume of evacuees than just the approximate 23,000 residents.

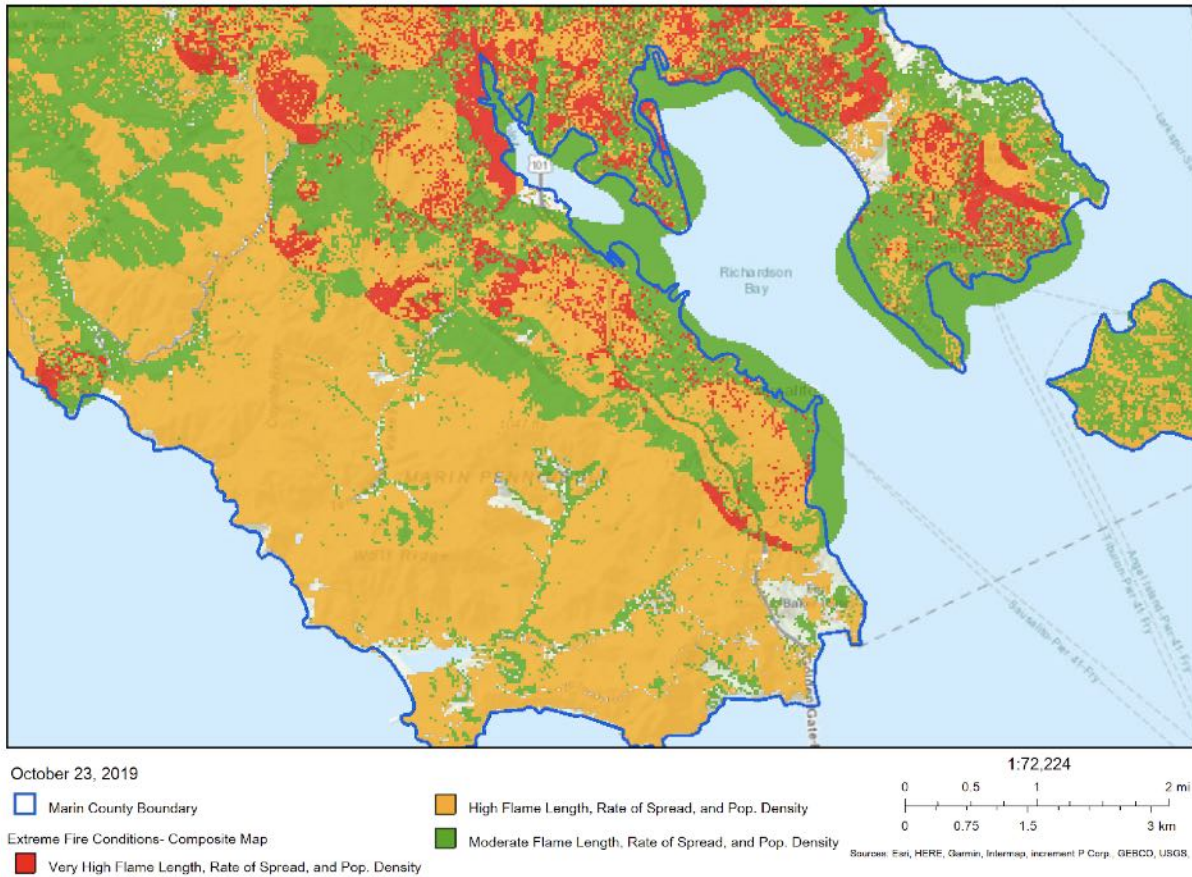
Many of the properties and structures within the District are in areas prone to wildfire. Much of Southern Marin is bordered by open space with a long history of wildfires igniting within or spreading from outside the community. The communities of Tamalpais-Homestead Valley, Strawberry-Alto, and Sausalito are identified as Communities at Risk in the California Fire Plan⁴, the 2016 Marin County CWPP, and the Marin County Unit Strategic Fire Plan. Most parcels fall into the "high" or "very high" WUI hazard rank as defined in the 2016 CWPP. The following areas were specifically identified in the CWPP as areas of high hazard rank: U.S. Route 101/Wolfback Ridge, Seminary, Edwards/Marion, Lattie Lane/Highway 1, Blackfield, Laguna/Forest, Cabin Drive, Homestead Valley, Ring Mountain Area, Aqua Hotel Hill, Highway 1 to Erica/Friars. In addition, on the boundaries of the District are several other Communities at Risk, specifically Corte Madera, Marin City, Mill Valley, and Tiburon.

² <https://www.sacbee.com/news/california/fires/article227665284.html>

³ <https://www.nps.gov/goga/learn/news/visitation-2018.htm>

⁴ http://osfm.fire.ca.gov/fireplan/fireplanning_communities_at_risk?filter_field=county_name&filter_text=Marin

Southern Marin Extreme Fire Conditions Composite Hazard/Risk Index



Many homes in Southern Marin are built with combustible materials adjacent to vegetation on steep terrain without adequate Defensible Space and are at risk from wildfire.

To complicate matters, drought conditions combined with widespread epidemics of Sudden Oak Death, pine bark beetles, and other tree disease throughout Marin County have: (1) increased fuel “laddering” potential and aerial fuel flammability; and (2) increased the potential for extreme fire behavior such as crown fire, blowups (sudden increases in fire intensity), and spotting (firebrands, or lofted burning embers, igniting flammable fuels ahead of the main fire).

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 Southern Marin and 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 along with vehicles parked tightly along narrow roadways especially through Tamalpais-Homestead Valley along Highway 1. Consideration of the tourist population flux is important for planning strategic fuels treatment projects, reducing potential ignition sources, and allocating emergency response personnel.

Purpose

In 2016, FIRESafe MARIN and the Marin County Fire Department (MCFD) published a county-level CWPP. The countywide CWPP provides a science-based assessment of wildfire threat in the WUI areas of Marin County and was developed through a collaborative process involving fire agencies; county officials; county, state, and federal land management agencies; and community members. The purpose of the county-level CWPP was to provide a framework that can be used to identify, prioritize, implement, and monitor hazard reduction activities throughout the county. It is intended to be a living document that will be updated periodically by FIRESafe MARIN and the MCFD in collaboration with a broader group of county stakeholders, including the District.

This report provides a more focused and local wildfire protection plan for Southern Marin based on the results of a field assessment and survey of the communities of Sausalito; Tamalpais and Homestead Valleys; and Strawberry-Alto performed between March 2019 and January 2020 by XMR Fire Consulting (XMR Fire). The assessment focused on the streets, neighborhoods, and public and private open space areas within the District. A variety of potential wildfire influences and hazards were measured or observed through field observation, geographic information systems (GIS) data, and aerial photography. The observed conditions were analyzed using GIS technology including QGIS and Google Earth Professional. Fire behavior modeling was performed using FLAMMAP. Based on the results of the analysis, XMR Fire developed recommendations for pre-fire mitigation strategies. The work performed and resulting recommendations are based on currently accepted best practices and the experience of the Consultant.

The information and recommendations contained in this report are intended to help prioritize and inform pre-fire planning and mitigation projects in Southern Marin which can be implemented and tracked as part of the larger, county-level CWPP framework.

Southern Marin Fire Protection District

Like most communities in Marin, the communities of Southern Marin are built at the boundary of large tracts of undeveloped open space. In addition to being surrounded to the north, west and south by this open space, relatively large lot sizes, the narrow, steep geography, and lack of infill development contribute to the proximity of most homes in Southern Marin to wild vegetation.

Wildfires represent a potential threat to both established and newly constructed communities within the WUI. Like most communities, local emergency services may be quickly overwhelmed by a fast-growing wildfire in its early stages. Municipal fire departments, like Southern Marin Fire Protection District, Mill Valley Fire Department, and Marin County Fire Department (the agencies with primary responsibility for wildfire suppression in and near Southern Marin) maintain equipment and daily staffing to quickly suppress small wildfires. As a fire grows, especially during extreme weather scenarios, additional firefighting resources must be drawn from increasingly far away, introducing a significant lag-time between the time when the fire impacts

a community and when firefighting resources arrive to suppress the fire or protect values and assets at risk. It is not financially feasible for communities to maintain enough ready firefighting resources to fight a large fire, and because of this, California has developed what may be the largest and best developed “mutual-aid” system in the world for fighting wildfires.

Because of this “lag-time” in firefighting response, and the often rapid growth of wildfires in California, communities cannot depend entirely on local firefighters to save their homes. To alleviate some of the hazards associated with living in the WUI, **residents must help protect their property and community by taking educated steps before and during the fire season to make their homes “hardened” and properties defensible from the threat of fire.**

Scientific research has shown the effectiveness and benefits of implementing wildfire mitigation concepts across individual property boundaries and throughout communities (Brenkert-Smith, 2011). It is important that members of a community work together so that the community as a whole is defensible.

The National Fire Protection Association’s (NFPA’s) Firewise USA® Program⁵ encourages homeowners to develop community-based solutions for protecting homes and properties from the risk of wildfire. The nationally recognized program provides resources to help homeowners learn how to adapt to living with wildfire while encouraging and empowering neighbors to work together to take action to reduce their wildfire risk and prevent losses. There are currently more than 1,500 recognized Firewise USA® communities throughout the country. Marin is the fastest growing Firewise USA® county in the nation with approximately 50 recognized Firewise USA® “sites,” (as of October 2019) three of which are located within the District: Tamalpais Valley, Homestead Valley, and Strawberry-Alto.

Geographic Setting

Sausalito

The community of Sausalito is a small coastal/bayfront town with most of the residential structures built on the hillsides from just above sea-level to the top of Wolfback Ridge which reaches up to about 1,120 feet. The WUI of Sausalito is located above the town at approximately 250 to 1,120 feet and consists of close proximity, high density, housing with irrigated landscaping. The WUI is intermixed with small stands of Eucalyptus with deep duff layers and Oak Woodlands with some Sudden Oak Death (SOD) fuel loading. Deep undeveloped canyon areas filled with Bay trees and large patches of coastal chaparrals extend from the 750 foot elevation line to the ridgetop at 1,120 feet. The City of Sausalito is bisected by the US Highway 101 that runs adjacent to the City of Sausalito boundary. The Wolfback Ridge Homeowners development is on the west side of the freeway and is unincorporated. The GGNRA headlands area lies to the south and west of Sausalito. Figure 3 shows an aerial view of Sausalito.

⁵ <https://www.nfpa.org/Public-Education/By-topic/Wildfire/Firewise-USA>

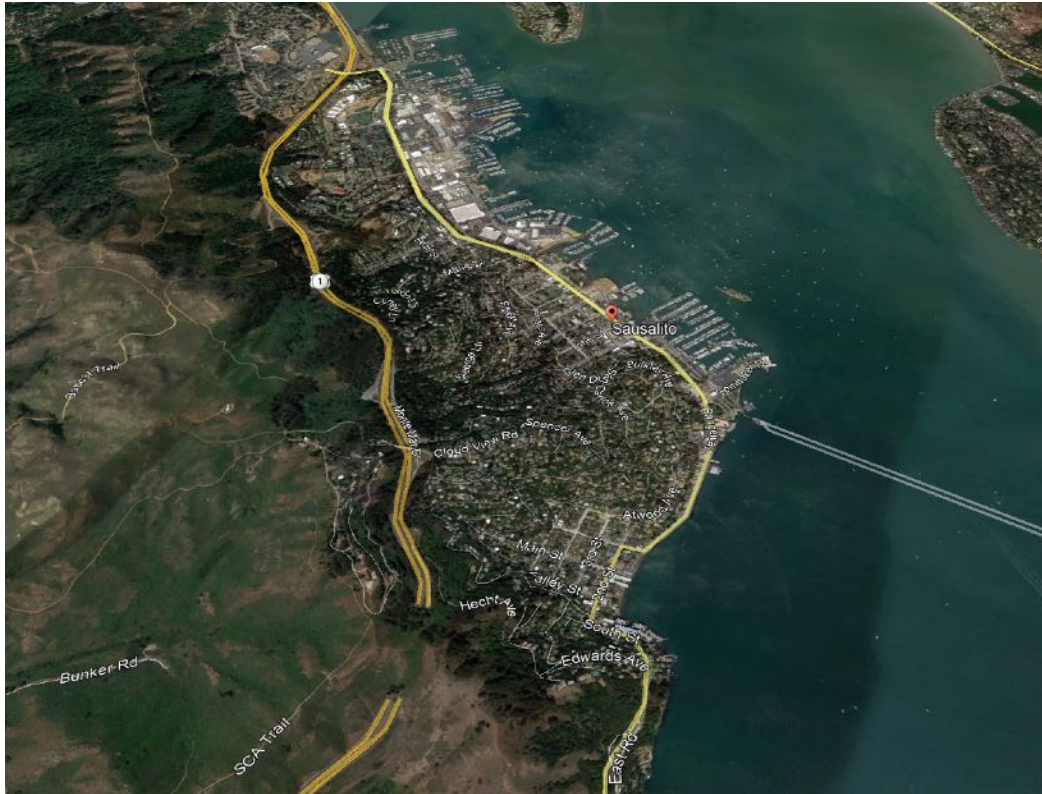


Figure 3. Map of Sausalito.

Tamalpais Valley and Homestead Valley

The areas of Tamalpais Valley and Homestead Valley are rural suburbs consisting of mostly single-family dwellings built in and upon the coastal mountain range. The division between the two valleys is a sharp mountain range running from west to east that divides the two communities. The area is built out with very large single-family dwellings and a few schools. A small commercial hub is located on the valley floor in Tamalpais Valley. The fuels in these areas are mostly Oak Woodland, Bay stands in deep canyons, Eucalyptus stands with heavy downed material, and sporadic pine trees with thick beds of needle cast (some of which is overgrown with black berry patches and annual grasses) as well as significant plantings of ornamental vegetation on developed property. The GGNRA borders these communities starting on the south and continuing to the west and mainly consists of coastal chaparrals and numerous stands of Eucalyptus that have not been maintained. Figure 4 shows a map of Tamalpais Valley and Homestead Valley.

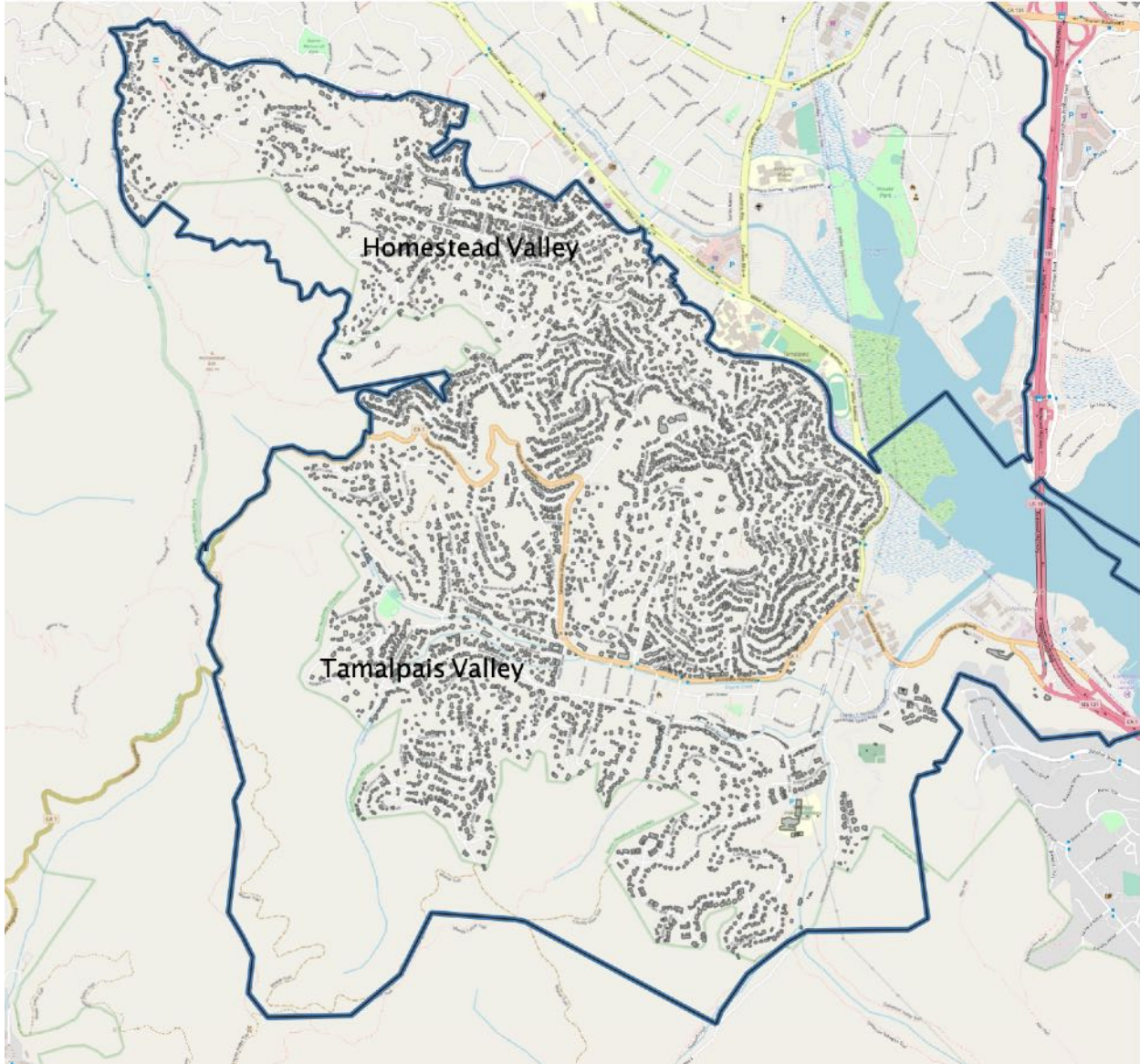


Figure 4. Map of Tamalpais Valley and Homestead Valley.

Strawberry-Alto

The area of Strawberry-Alto is a residential community consisting of the community of Strawberry, the Alto Bowl, and Blackfield. There is a large commercial hub in the community of Strawberry that runs parallel to US Highway 101. The commercial area has a variety of businesses such as Safeway Food Store, Porsche of Marin, Chevron and it also is the home of the 148-acre Golden Gate Baptist Seminary. Golden Gate Baptist Seminary land contains many residential and commercial buildings that are generally separated by large expanses of open grasslands intermixed with large, maintained Pine trees. The northeastern part of the Strawberry-Alto area is adjacent to the Ring Mountain Open Space area which is predominantly overgrown grass and chaparral lands that directly abut the residential area. A large portion of

this area is built on hillsides with streets that are relatively new and wide. Figure 5 shows a map of the Strawberry-Alto area.



Figure 5. Map of the Strawberry-Alto area.

Population and Housing

Table 1 provides population, housing, and tax assessor information for Sausalito, Tamalpais-Homestead Valley, and the Strawberry-Alto area. Population and housing data are from the 2010 U.S. Census American Fact Finder⁶ and median home value information is from the TownCharts website.⁷

Community	Population	Total Households	Average Household Size	2019 Median Home Value
Sausalito	7,061	4,112	1.71	\$1,163,500 ⁸
Tamalpais-Homestead Valley	10,735	4,447	2.41	\$1,119,700 ⁹
Strawberry-Alto	5,393	2,510	2.05	\$1,248,700 ¹⁰
<i>Totals (District Wide)</i>	<i>23,189</i>	<i>11,069</i>	<i>2.09</i>	<i>\$1,157,400</i>

Climate

Southern Marin Fire District’s climate is classified by the “Sunset New Western Garden Book” as zones 16 and 17. The North Coast Thermal Belt, zone 16, has more heat than Zone 17 and warmer winters than Zone 15. Summer afternoon winds are common, with strong drying spring winds observed from early April to late June, and generally slightly drier conditions than surrounding areas. Lowland valley areas such as Homestead Valley, and surrounding ridges and hilltops experience colder winters and may experience greater vegetation freeze kill. Average winter low temperatures are 36 – 19 degrees F on valley floors. Zone 17, primarily the coastal and bayfront areas of Sausalito, Marin Headlands, Tam Valley, and Strawberry, features mild, wet, almost frostless winters and cool summers with frequent fog or wind. On most days and in most places, the fog tends to come in high and fast, creating a cooling and humidifying blanket between the sun and the earth, reducing the intensity of the light and sunshine.

Southern Marin in general observes 36”-38” of annual rainfall. The mediterranean climate experiences summer drought, with typical rainfall measured between May 15 and October 15 at less than 0.25 inch, and experiencing lower relative humidity (RH) and lower overnight RH

⁶ <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>

⁷ <https://www.towncharts.com>

⁸ TownCharts data for Sausalito

(<http://www.towncharts.com/California/Housing/Sausalito-city-CA-Housing-data.html>)

⁹ TownCharts data for Tamalpais-Homestead Valley

(<http://www.towncharts.com/California/Housing/Tamalpais-Homestead-Valley-CDP-CA-Housing-data.html>)

¹⁰ TownCharts Data for Strawberry

(<http://www.towncharts.com/California/Housing/Tamalpais-Homestead-Valley-CDP-CA-Housing-data.html>)

recovery than nearby coastal valleys. These conditions may contribute to slight to moderate increases in expected fire behavior relative to surrounding areas.

Diablo Winds

In the late spring through early 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 overnight. 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. Occasionally in the summer and more often in the fall, the Pacific High moves inland and centers over Oregon and Idaho, while low pressure moves from the Central Valley of 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 (offshore winds). As the offshore winds move air from the Great Basin over the Sierra Nevada Mountains to the coastal areas of California, the air descends and compresses, which greatly warms and dries the air. Under these “Diablo” wind conditions, temperatures in Marin County can reach 100°F in the inland areas and 80°F at the coast, with relative humidities as low as 10%. Wind speeds can be high (20 to 40 mph) with stronger gusts, and are often much faster over the coastal mountains and ridge tops¹¹.

It is during these Diablo wind events that there is the greatest potential for large, wind-driven fires. Historically, Marin’s largest and most destructive fires have occurred during these conditions including the 1919 Sausalito, 1923 Novato to Bolinas Ridge fire, and 1995 Vision fire near Inverness. These conditions may contribute to dramatic increases in observed fire behavior relative to surrounding areas.

Increasing wildfire threat due to climate change

As urban development expands the WUI, large wildfires are simultaneously burning more acres and with greater severity. A study of wildfires in the western U.S. between 1984 and 2011 shows both the number of large fires and the acres burned increased significantly (Dennison et al. 2014). NIFC data¹² shows that this trend has continued in subsequent years through 2018. Several regional studies have documented an increase in burn severity in California and the western U.S. (Dillon et al. 2011, Miller and Safford 2012). These studies conclude that the increase in severity and acres burned by wildfires is likely to continue, particularly in the western U.S., due to climate change.

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

¹¹ <https://w2.weather.gov/climate/index.php?wfo=mtr>

¹² https://www.nifc.gov/fireInfo/fireInfo_statistics.html

longer, drier summer fire seasons (Westerling et al. 2006, IPCC 2007, Dominguez et al. 2010). The US Forest Service's Quadrennial Fire Review documents a lengthening fire season in the western U.S. and predicts near-future fire seasons of more than 300 days per year (Booz Allen Hamilton 2015).

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, Frechette and Meyer 2009); trends over the last few decades (Westerling et al. 2006); and predictive models (Westerling and Bryant 2008). Increased drought and heat are already beginning to cause an increase in tree mortality (Allen et al. 2010).

A warming and drying climate is also amplifying the risk of extreme fire behavior such as longer flame lengths, increased torching, crowning, faster rates of spread, and increased long range spotting (Brown et al. 2004, Booz Allen Hamilton 2015).

Current wildfire policy and management recognizes that fires are a natural disturbance in ecosystems across the United States, but the growing risks to human values creates difficult tradeoffs between long-term ecological health and the immediate need for protection of public safety, infrastructure, and assets at risk (Wilson, R., McCaffrey, S., and Toman, E. 2016).

Vegetation Communities

The WUI parcels in Southern Marin are home to a diverse vegetation community that includes a wide variety of non-native and urban varieties of ornamental plants and trees, while the surrounding hills and ridgelines are home to an equally diverse landscape of native oak, bay forests, eucalyptus, grasslands, and coastal chaparral.

Since the arrival of European ranchers in Southern Marin in the mid-19th century, the native vegetation has been substantially altered by human activities. Livestock grazing, road and trail construction, residential development, introduction of non-native species (notably non-native grasses, eucalyptus, and Monterey pine), and suppressing wildfires dramatically changed plant life in Southern Marin.

Early settlers introduced non-native grasses, shrubs, eucalyptus, Monterey cypress and pine, French and Scotch broom (to name only a few) to Southern Marin as early as the 1850s. As the non-native tree species have grown and aged, many have begun to fail as they reach the end of their lifespan or are attacked by insect pests or disease (e.g., bark beetles and pine pitch canker). As



Colden Gate NRA Park and Silva Est. by James de Valley. Photo Collection, CCGA 19510.

more trees are affected by these ailments, “fuel loads” in many locations are increased.

The Marin County Open Space District (MCOSD), in the 2015 Draft Vegetation and Biodiversity Management Plan, identifies plant communities, natural resources, and vegetation challenges on the three Open Space Preserves within the SMFPD jurisdiction: *Bothin Marsh, Tiburon Ridge, and Ring Mountain* (Figures 6 and 7).

The plant communities found in the Tiburon Ridge and Ring Mountain Preserves are generally indicative of the vegetation found in the Strawberry-Alto area. The plant communities found in the Bothin Marsh Preserve are generally indicative of marshlands in Marin. Tiburon Ridge is a relatively small preserve of approximately 15 acres with an approximate 1-mile perimeter. Little information is available for the Tiburon Ridge Preserve in the Vegetation and Biodiversity Management Plan; however, the primary invasive plant species in the Preserve is French broom. A summary of MCOSD’s findings for the Ring Mountain and the Bothin Marsh Preserves is included below:

<p>Ring Mountain</p> <ul style="list-style-type: none"> • Area = 367.2 acres • Perimeter = 6.1 miles <p>Sensitive Natural Resources Sensitive Vegetation Type(s):</p> <ul style="list-style-type: none"> • Cliffs, rock outcrops • Mesic trending chaparral • Purple needlegrass perennial grasslands • Rocky serpentine grasses • Sedge, rush, wet graminoids meadow • Serpentine grassland • Temporarily flooded or saturated meadow edge • Upland serpentine grassland • Valley oak, coast live oak • Wetland serpentine grassland <p>Special-Status and Locally Rare Species Special-Status Plants:</p> <ul style="list-style-type: none"> • <i>Calochortus tiburonensis</i> (Tiburon mariposa lily) • <i>Calochortus umbellatus</i> (Oakland star-tulip) • <i>Castilleja affinis</i> ssp. <i>neglecta</i> (Tiburon indian paintbrush) • <i>Eriogonum luteolum</i> var. <i>caninum</i> (Tiburon buckwheat) • <i>Hesperolinon congestum</i> (Marin dwarf flax) • <i>Trifolium amoenum</i> (showy Indian clover) • <i>Trifolium buckwestiorum</i> (Santa Cruz clover) <p>Locally Rare Species:</p> <ul style="list-style-type: none"> • <i>Allium lacunosum</i> (pitted onion) • <i>Calamagrostis ophitidis</i> (serpentine reed grass) • <i>Triteleia peduncularis</i> (long-rayed brodiaea) <p>Management Challenges Important invasive plants include:</p>	<p>Bothin Marsh</p> <ul style="list-style-type: none"> • Area = 105.9 acres • Perimeter = 3.1 miles <p>Sensitive Natural Resources Wetlands:</p> <ul style="list-style-type: none"> • Salt marsh (high, intermediate, low marsh) • Brackish marsh • Seasonal wetlands <p>Special-Status and Locally Rare Species Special-Status Plants:</p> <ul style="list-style-type: none"> • <i>Cordylanthus maritimus</i> ssp. <i>palustris</i> (Point Reyes bird’s beak) • <i>Plagiobothrys glaber</i> (hairless popcorn-flower): plants presumed extinct in California, last confirmed in 1954 <p>Management Challenges Important invasive plants include:</p> <ul style="list-style-type: none"> • <i>Foeniculum vulgare</i> (fennel) • <i>Carpobrotus edulis</i> (iceplant) • <i>Acacia dealbata</i> (silver wattle) • <i>Salsola soda</i> (glasswort) • <i>Genista monspessulana</i> (French broom) <p>History and Local Setting</p> <ul style="list-style-type: none"> • North and South Basins are essentially man made marshes. The 1851 map shows tidal marshes extending to the base of the hills. Dikes built in the 1950s and 1960s. Shellmound in North Basin. Filling and building in the 1970s. Acquired in 1976. Pathway (old railroad right of way) acquired in 1981 through Rails to Trails Program. <p>Vegetation Management and Maintenance</p> <ul style="list-style-type: none"> • 2008 grant-funded restoration project with Save The Bay removed invasive plants and replanted natives.
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- *Genista monspessulana* (French broom)
- *Centaurea solstitialis* (yellow starthistle)
- *Elytrigia pontica* (tall wheatgrass)
- *Maytenus boaria* (mayten)
- *Centaurea calcitrapa* (purple starthistle)
- *Cortaderia jubata* (pampas grass)

History and Local Setting

- Earliest Miwok village dated to 370 BC. Part of Reed Ranch for 130 years until 1965. The Army installed guns on summit in the 1950s, deactivated in the 1960s. Management turned over to MCOSD in 1995 from Nature Conservancy.

Vegetation Management and Maintenance

Staff has worked with volunteers to treat a long list of invasive plant species at several sites across the preserve. These ongoing efforts have been very successful.



Figure 6. Map of the Marin County Parks Bothin Marsh Open Space Preserve. ¹³

¹³

<https://www.marincountyparks.org/-/media/images/sites/marincountyparks/parkspreserves/preserves/bothin-marsh/map-5bothin073114.pdf>



Figure 7. Map of the Marin County Parks Tiburon Ridge and Ring Mountain Open Space Preserves.¹⁴

Like most plant species in California, native vegetation in Southern Marin is adapted to wildfire. Most plants found here thrive when subjected to periodic wildfires, and some require fire to survive. Many of the non-native species present are adapted to wildfire as well (eucalyptus, broom, etc.), and contribute to overall fuel loads. Lack of fire, primarily due to rapid fire suppression since the mid-20th century, resulted in a loss of biodiversity, an excess of dead and down vegetation material on forest floors, and infill and loss of meadows and grasslands.

The GGNRA is located in the southernmost area of Southern Marin, just north of the Golden Gate Bridge. The climate of the GGNRA is considered a harsh coastal climate and as a result, the plants of the GGNRA are hardy. GGNRA's Mediterranean climate with mild, wet winters and extended, dry summers encourage plants to adapt to long seasons without rain. GGNRA is

¹⁴

<https://www.marincountyparks.org/-/media/images/sites/marincountyparks/parkspreserves/preserves/tiburon-ridge/tiburonridge-121314w.pdf>

located in the center of the California Floristic Province, one of only five regions in the world with this kind of Mediterranean climate, creating an area with high floral diversity.¹⁵

GGNRA's habitats are dominated by evergreen shrubs and patchy grasslands (commonly referred to as coastal scrub and coastal prairie). Coastal scrub plants are usually low-growing, thick-leaved shrubs with a variety of adaptations for temperature regulation and water retention. GGNRA also supports wetland habitat and several forest types including redwood and mixed evergreen forest, oak woodlands and riparian forests. Urban development and the stresses of habitat destruction and introduced species have threatened a number of the region's plant species. GGNRA serves as a refuge for over forty-five rare or special status plant species, with at least ten of those listed as federally threatened or endangered.¹⁰

Fire History

Understanding fire history is important when attempting to predict potential fire frequency, fire behavior, significant ignition sources, and vulnerable areas and communities. The historical record shows that many large, damaging wildfires (greater than 500 acres) have occurred in Marin since 1850. Many more frequent and smaller fires burned in Marin and Southern Marin, and this knowledge helps us understand the likely processes, scenarios, and locations for future fires.

Southern 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 a mosaic 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 grasslands and increasing biodiversity and productivity of chaparral and coastal scrub ecosystems (Sughara et al, 2006).

The most frequently burned landscapes in California prior to 1850 were ignited, often on a nearly annual basis, by Native Americans (Lewis 1993, Keter 1995) and were generally near villages or where vegetation was cultured for food and basketry materials, such as grasslands and oak woodlands. Vegetation adjacent to areas used by Native American experienced more frequent fire than would be found in the same vegetation type farther away (Vale 2002). In general, the most frequent fires occurred in grasslands 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 was less than 7 years prior to the arrival of Europeans (Stephens et al, 2007, Jacobs et al, 1985).

As Southern Marin's vegetation ages and land is no longer grazed or burned by prescribed fire, it becomes increasingly difficult to manage vegetation to reduce wildfire hazards in a

¹⁵ National Park Service GGNRA (<https://www.nps.gov/goga/learn/nature/plants.htm>)

cost-effective manner. Fire records for Marin are incomplete, but historic newspaper articles and old fire planning studies document an active and dangerous fire history for the area going back to the early 20th century.



In 1919 a fire began in the Wildwood Glen area of Sausalito. The fire was initially a smoldering outdoor burn pile when heavy winds fanned the flames and the fire spread to South Sausalito destroying twelve homes, five businesses, and a church hall.¹⁶ In 1953 Sausalito experienced a notable 75-acre wildfire near Fort Baker.

Sausalito Wildfire, 1919. Source: Marin County Fire History website.

¹⁶ <https://www.marinfirehistory.org/1919-sausalito-hills.html>

Transportation and Road Networks

Many homes in Marin County are located on hillsides and ridges with narrow and winding roads providing the only access routes. In many cases, these roads are also lined with dense vegetation making access even more problematic.



An article in the Marin Independent Journal (August 23, 2019) discussed how many communities in Marin could face major traffic during a disaster. The article specifically identifies Sausalito as one of these areas.

The Marin IJ article is based on research by StreetLight Data Inc. (StreetLight, 2019¹⁷), that was inspired in part by the gridlock residents of Paradise faced during the Camp Fire in 2018. Researchers looked at communities of 40,000 residents or fewer across the country, showing how traffic would flow during an emergency and pointing out potential bottlenecks. Researchers gave scores, referred to as exit loads, to cities across the country based on the total population of the town, the number of roadway exits out of town, and the average number of cars each exit route carries on a typical day, assuming residents would choose familiar routes in an emergency. Of the 30,000 communities analyzed, around 800 had scores that were three or more times the national average, including 107 in California, indicating that residents in California have fewer options 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.¹⁸

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 to be shared equitably by the landowners benefiting from these roads.¹⁹

Sausalito

Sausalito is bordered to the west by Highway 101 and to the east by Bridgeway. Bridgeway is Sausalito's primary access road which runs north to south along the waterfront. Bridgeway is accessed from Highway 101 at its north and south ends. Highway 101 is located along the

¹⁷ <https://www.streetlightdata.com/limited-evacuation-routes-map/#emergency-map-response>

¹⁸ Marin Independent Journal, August 23, 2019. Available online at (<https://www.marinij.com/2019/08/23/marin-communities-could-face-major-traffic-jams-during-an-emergency/>)

¹⁹ County of Marin (<https://www.marincounty.org/depts/pw/faqs#roads>)

western border of Sausalito. Many smaller, neighborhood roads provide access to the homes in the neighborhoods between Highway 101 and Bridgeway, adjoining Bridgeway. Bridgeway is a wide, four-lane road with wide shoulders, and serves as the primary ingress/egress and evacuation route from Sausalito. The StreetLight Data report ranks Sausalito's exit load at 61% with 7 exit routes (StreetLight, 2019).

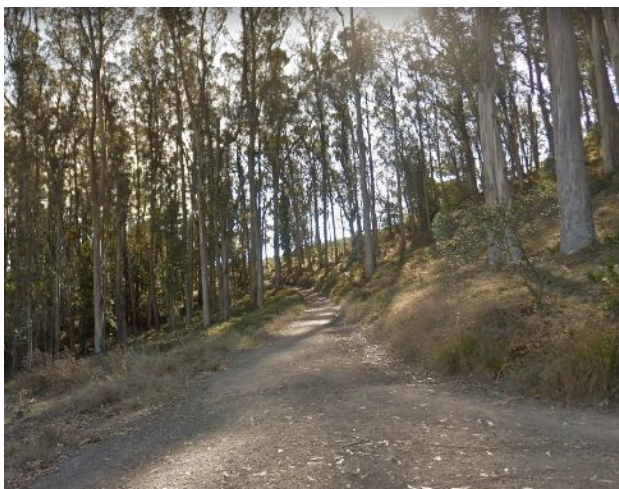
Strawberry-Alto

Strawberry-Alto is bordered to the west by Highway 101 with several roadways connecting from Highway 101 to the north and south. In the northern area of Strawberry-Alto, Tiburon Blvd. provides primary access to Highway 101 in the east-west direction. Tiburon Blvd. is the main road into and out of Tiburon and experiences frequent congestion. In the southern areas of Strawberry-Alto, several main roads provide access to the east-west and to the north-south. The main roads providing access to the east-west are Belvedere Drive, Ricardo Road, and Seminary Drive. Seminary Drive also provides south-north access as it runs along the western side of southern Strawberry and adjoins East Strawberry Drive along the eastern side of Strawberry. East Strawberry Drive, Richardson Drive, and several smaller roads provide north-south access in Strawberry.

Tamalpais-Homestead Valley

The Tamalpais-Homestead Valley area lies to the west of Highway 101 at the base of Mt. Tamalpais. The main access road through Tamalpais-Homestead Valley is Highway 1 which runs east-west from Highway 101 to the coast. Highway 1 is a narrow, two lane road serving as the main access road to many destination points on Mt. Tamalpais and the coast including Muir Woods, the Mountain Play Theatre, and Stinson Beach. Congestion on Highway 1 can be extreme, especially on the weekends as tourists from outside of Marin flock to Mt. Tamalpais to recreate. In addition, many people park their cars along Highway 1, sometimes illegally, compounding the congestion issue.

Fire Roads



A network of unpaved Fire Access Roads ("Fire Roads") exist in the open space and common areas of Southern Marin. These fire roads are in various states of repair, with some fire roads showing signs of regular maintenance, and other locations unpassable in a vehicle due to vegetation overgrowth, washouts, or other unsafe surface conditions. In general, access to the fire roads is limited to high-clearance off-road vehicles and fire apparatus. Four-wheel drive vehicles are recommended. All fire roads in Southern Marin are closed to public motor vehicle access.

5.7 miles of strategic fire roads were identified as part of this assessment within the boundaries of SMFPD. These roads were mapped to help identify potential wildfire response and emergency access issues, and to consider implications for evacuation during an emergency incident. Fire roads primarily include those roadways and trails on adjacent open space lands including unpaved roads and trails as well as some paved roads that connect and pass through open space areas.

Fire Roads (miles) in SMFPD WUI Area

Sausalito	Strawberry-Alto	Tamalpais/Homestead Valley
3.23	1.32	1.15

Fire Stations and Emergency Services

Primary, initial attack fire protection for both structural and wildland fires is provided by the District. The District maintains a daily staffing level of 16 personnel. The District's fire suppression personnel are divided into three platoons, A, B, and C. Each platoon is commanded by a Battalion Chief who is responsible for 3 stations located in Sausalito (Station 1), Tamalpais Valley (Station 4), and Strawberry (Station 9). Personnel are deployed in 3 engines, 1 ladder truck, and 1 rescue squad. These crews perform fire suppression operations, medical/rescue services, and other hazard mitigation activities.



The District operates a fleet of modern firefighting apparatus. Station 1 has one Type 1 engine, one advanced life support (ALS) ambulance, one inflatable rescue boat (IRB), one dive team tender, and one 40' fire boat (Liberty). Station 4 has one Type 1 engine, one ladder truck, one Type 3 wildfire engine, and one ALS ambulance. Station 9 has two Type 1 engines, one medium duty rescue, one command unit, and fire rescue watercraft (RWC).

The District is responsible for providing fire and emergency medical service for its constituents in the District. The three engines, one ladder truck, one rescue squad, and two ambulances (listed above) respond from the District's three fire stations. The personnel responding on these units are either a Paramedic (advanced life support) or Emergency Medical Technicians (EMT).

Operational guidelines are provided by the Southern Marin Emergency Medical Paramedic System (SMEMPS), a Joint Powers Agency (JPA) in which other fire agencies in the area participate. Emergency medical care is managed through a number of programs including standard operating procedures, standing orders, in-service training, and various other methods.

A four-wheel-drive, Type-3 wildland fire engine, "Engine 604" is available at Fire Station 4 in Tamalpais Valley. Availability of this fire engine for wildfire response may be limited due to the

“cross-staffing” with a Type-1 (structural) fire engine - only one engine can be operated at any given time by the three on-duty firefighters. The National Interagency Fire Center, NIFC, states that three-person staffing should be the minimum for Type-3 engine companies responding to wildfires.²⁰

Community Infrastructure

Wildfires frequently damage infrastructure, including roadways, communication facilities, above-ground utility lines, and water delivery systems. Restoring basic services following a fire is a top priority, and many agencies and organizations responsible for infrastructure incur significant restoration costs after a fire. Efforts to restore roads and highways post-fire include the costs of maintenance and damage assessment teams, field data collection, and replacement or repair of roads, guardrails, signage, electrical supply, culverts, and landscaping. Direct impacts to water supplies may occur through contamination of ash and debris during the fire, destruction of above-ground delivery lines, and soil erosion or debris deposits after the fire.

Natural Gas, Electrical, and Wired Communications

The most significant infrastructure identified in Southern Marin at risk from wildfire is overhead utility lines, including residential power lines, landline voice and data lines, and cable television/data distribution lines. Above ground utility poles are particularly vulnerable to wildfire, and frequently fall during fires when wooden pole bases burn. These fallen poles and lines present several challenges: ingress/egress routes may be blocked to evacuating residents and responding fire apparatus; communications can be cut off, including access to landline and VOIP 911 systems, and fallen power lines create a significant electrical hazard to firefighters and the public during the fire event. Undergrounding utilities are typically extremely expensive and done primarily to mitigate visual impacts.

PG&E provides natural gas distribution in Marin county. According to PG&E’s natural gas transmission pipeline map there are no major natural gas *transmission* lines located within the Southern Marin Fire Protection District. In residential areas, smaller, local lines are low pressure, 2”-4”, underground, and are not likely to be impacted by wildfire. Wildfire may threaten individual residential natural gas services, with above ground meters and interior residential gas line exposed if a structure ignites. Figure 8 shows a map of PG&E’s natural gas transmission lines (blue lines on map) in Southern Marin.²¹

Highway 101, the main Highway providing north-south access through northern California, runs through Southern Marin and could be susceptible to fire damage. Following a fire, utility,

²⁰ Interagency Standards for Fire and Fire Aviation Operations. NIFC. 2017.

²¹ PG&E Interactive Map of Natural Gas Transmission Lines (https://www.pge.com/en_US/safety/how-the-system-works/natural-gas-system-overview/gas-transmission-pipeline/gas-transmission-pipelines.page).

communications, and road repairs are necessary, with the cost of repair sometimes exceeding the cost of fighting the fire.

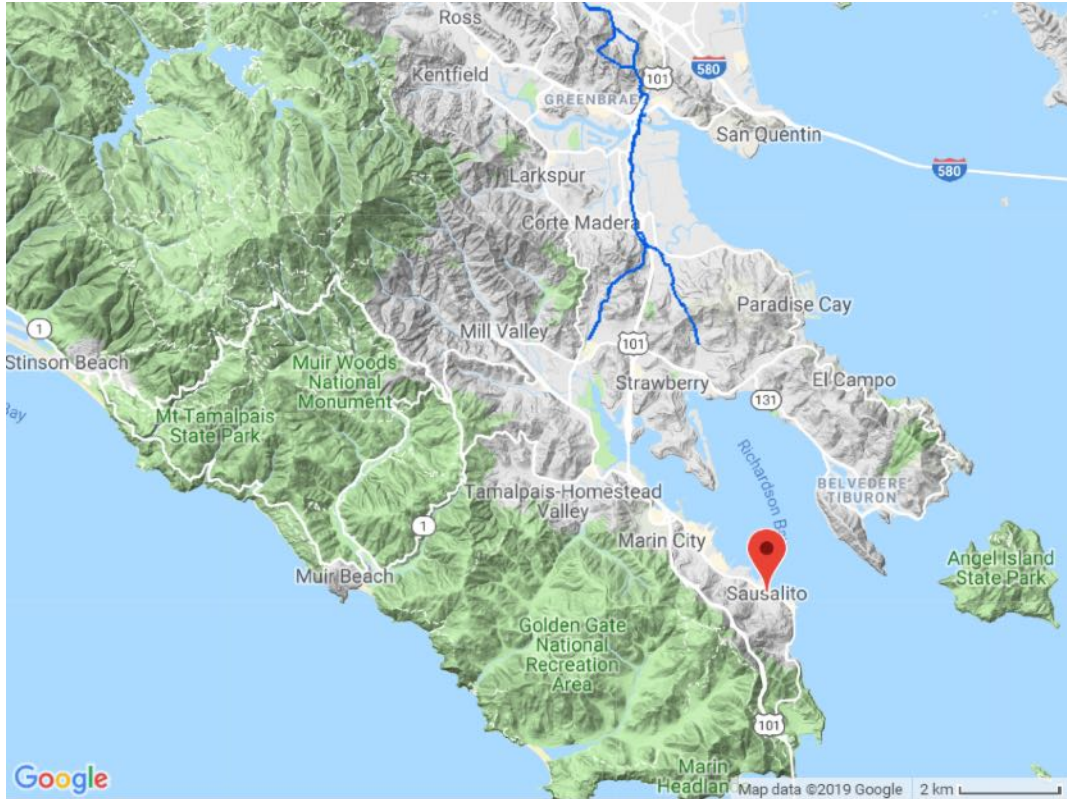


Figure 8. Map showing the locations of PG&E’s natural gas transmission lines (blue lines on map) in Marin County.

Cellular Communications

Cellular communications are an increasingly important tool for the public and fire managers alike. Adoption of systems like the *AlertMarin* disaster and evacuation notice system by the Marin County Office of Emergency Services (OES) depend on cellular voice and data transmission to communicate emergency information and evacuation to the public.

Although the dominant local cellular carriers (AT&T, Verizon Wireless, and Sprint) each indicate in their public GIS coverage data that Southern Marin has 100% coverage, on-the-ground field work in the development of this plan found that many areas of Southern Marin lack reliable wireless voice and data connectivity. The “crowd-sourced” signal map available from www.opensignal.com (Figure 9 below) generally shows good cellular connectivity along major roadways; however, areas of Sausalito, Tamalpais Valley and Homestead Valley, and areas of the Marin Headlands shows poor cellular connectivity for all carriers within the District boundaries.

Cellular Connectivity and PSPS

During unplanned or intentional power outages (such as PG&E's Public Safety Power Shutdowns (PSPS), cellular service may be impacted. Following the October 26-30 PSPS which affected most of Marin, the following information was gathered which may inform future power outage events.

T-Mobile confirmed that most of its sites in Marin lost power during the outage. It said, in part: "only a small number of sites down in some of the areas affected by the power shut off."

Sprint acknowledged power outages occurred at its cell sites but did not specifically say if any cellular outages had occurred.

Verizon said none of its towers had a service disruption caused by the shutoff.

All of the companies said they were either deploying additional generators or monitoring their generators to ensure cell coverage.

Yet at the end of the multi-day PSPS in late October 2019, reports for Marin County indicated that almost one-half of the cell towers were not functional due to lack of power.

Here are statements from the companies reported in local media²²:

AT&T: "We're closely monitoring and are deploying resources from other states to support our customers and public safety, including staging hundreds of additional generators and equipment. We are actively refueling generators and preparing additional assets for quick deployment in the state."

T-Mobile: "Our network is holding up well, with only a small number of sites down in some of the areas affected by the power shut off. Our priority is to keep our customers connected and we continue to work closely with the local utilities to monitor the situation and respond where needed. In addition to backup power – as noted in our newsroom post – we have a fleet of temporary generators that our emergency response teams can deploy if needed to get sites back up and running."

Verizon: "We have generators and backup batteries at the majority of our cell sites (towers) and all of our switch locations (network nerve center) to keep our network up and running if commercial power is lost. And we are able to refuel our generators to keep them running. Having this backup to our backup plan is critical to our strategy. This ensures our network can continue serving customers indefinitely until commercial power is restored."

²² <https://www.nbcbayarea.com/news/local/mobile-phone-providers-prepare-for-power-outages/1961777/>

Sprint: “Sprint continues to coordinate closely with these local power companies and local governments to try to minimize wireless network interruptions in impacted areas.

Future, planned network upgrades to “5G” technology may negatively impact system reliability during power outages, since the decentralized cell sites are more difficult to backup with generator power.

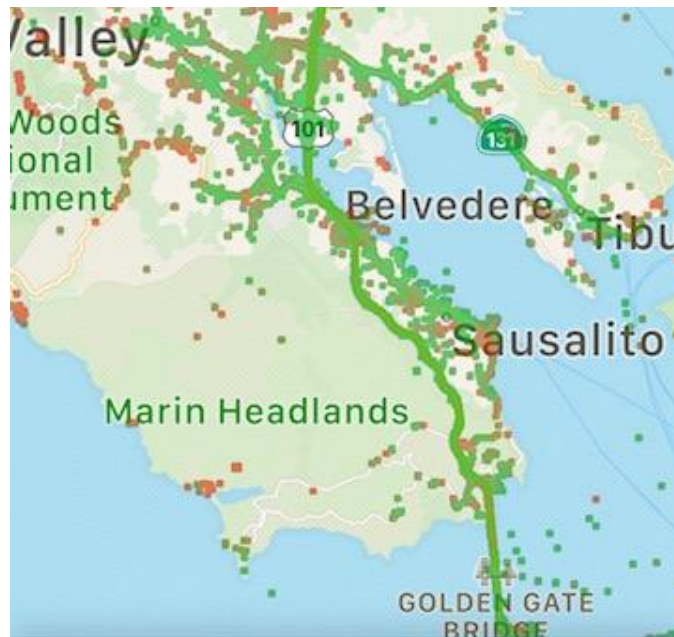


Figure 9. “Crowd-sourced” cellular and data signal strength map from www.opensignal.com generally shows good cellular connectivity in populated areas along major roadways; however, some areas in Sausalito, Tamalpais and Homestead Valley, and the Marin Headlands confirms field observations of poor or no reception. Red points indicate weak signals, green are stronger.

SMFPD Relationship to Existing Plans and Reports

Marin County Community Wildfire Protection Plan

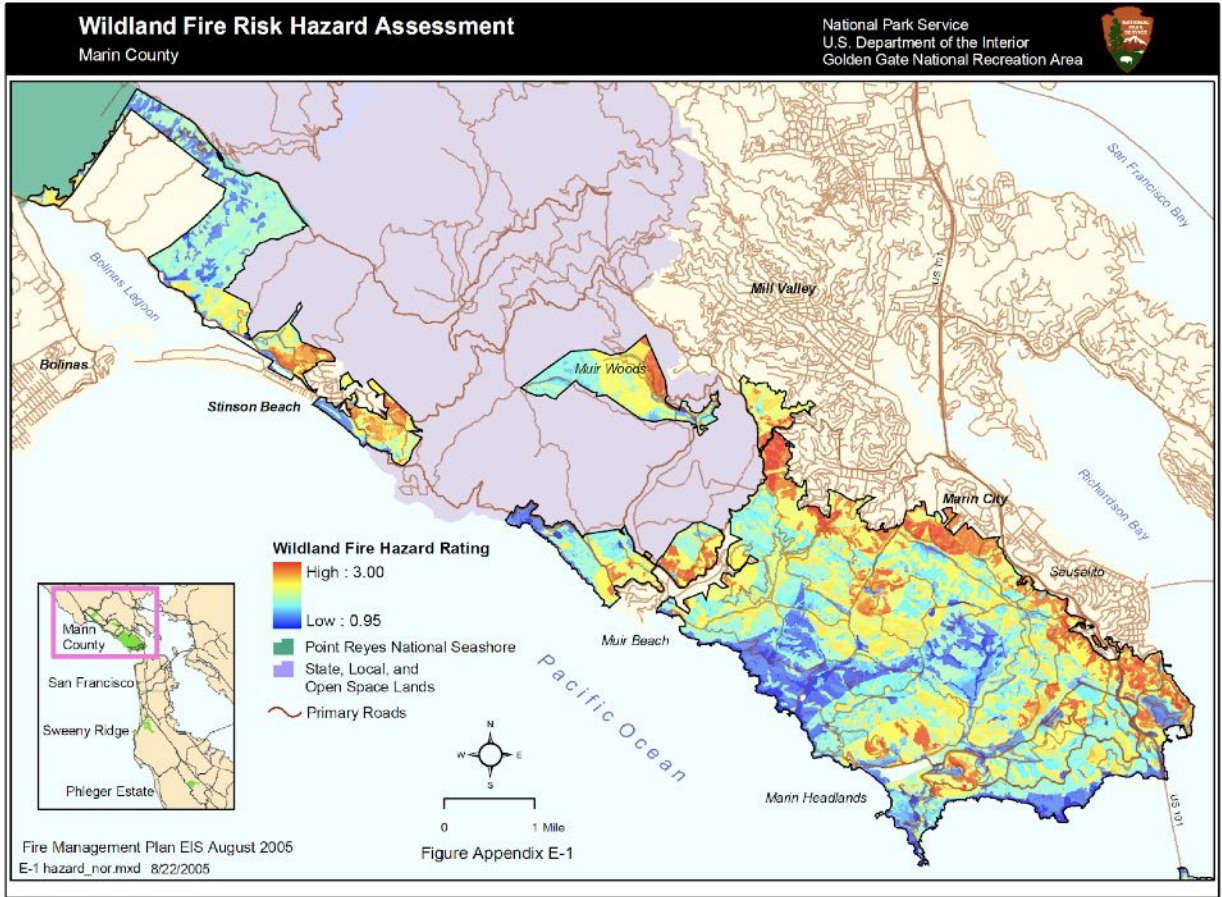
The 2016 Marin countywide CWPP provides a science-based assessment of wildfire threat in the WUI areas of Marin County and was developed through a collaborative process involving fire agencies; county officials; county, state, and federal land management agencies; and community members. The purpose of the county-level CWPP is to provide a framework that can be used to identify, prioritize, implement, and monitor hazard reduction activities throughout the county. This report provides a more focused, community-specific assessment and wildfire protection plan for Southern Marin based on the results of a field assessment and survey of the communities of Sausalito; Tamalpais and Homestead Valleys; and Strawberry-Alto performed between March 2019 and April 2020 by XMR Fire Consulting (XMR Fire)

Golden Gate National Recreation Area Fire Management Plan

The Fire Management Plan (FMP) for Golden Gate National Recreation Area (GGNRA) is an operational manual containing the standards, practices and guidelines in use by the Fire Management Branch of the Law Enforcement Division of GGNRA for conducting actions within the 15,700 acres of primary jurisdiction. The FMP is organized to present the current strategies and tactics for the range of actions undertaken by the GGNRA Fire Management Branch. Program operations addressed include preparedness, prevention, suppression, fuels management, rehabilitation, fire communication and education, monitoring and fire and fuels research. The FMP is written to be used as a reference by GGNRA staff as they plan and implement fuel reduction, resource protection and rehabilitation projects and strategize for and conduct suppression actions.

The GGNRA Fire Hazard Model defines fire hazard as areas where steep slopes, south-facing aspects, and high-danger fuels exist in close proximity to urban or developed areas. The analysis was conducted to help visualize and differentiate parklands in terms of wildland fire hazard. The model takes into consideration potential fire behavior should a fire start (fuels and topography) and values at risk (wildland urban interface). The model was conducted using a GIS analysis with input from fire management, natural resource, and cultural resource experts.

Several iterations of analysis were conducted with input variables weighted differently before park staff settled on the final process that resulted in distinguishable hazard differences. The final analysis relies heavily on the hazard created by fuel types and proximity to the wildland urban interface. It comes as no surprise that areas along the park boundary rank high in terms of fire hazard due to their close proximity to development and the fact that many of these areas contain heavy fuels, nonnative forest, and hilly terrain



The FMP divides GGNRA into three Fire Management Units (FMUs) in 3 counties, and the FMUs are further broken down into a total of project areas “to allow a finer level of understanding of existing resource values, vegetation and fire management conditions, treatment options, and management objectives specific to the referenced park area.” These project areas then form the framework for planning implementation programs within the GGNRA.

The following are descriptions of the 7 project areas immediately adjacent to SMFPD and which might impact District residents, resources, and programs.



Alta Project Area FMU

The Alta Project Area FMU is entirely within the WUI. The Alta Project Area is bordered on the northeast by Marin City and Sausalito, on the southwest by the Alta Trail, and on the southeast by the Wolfback Project Area. Vegetation types include coastal scrub/chaparral, native hardwood forest, and nonnative evergreen forest (primarily eucalyptus). The project area has mission blue butterfly habitat. The fire management issues in this project area include: 1) large stands of nonnative evergreen forest adjacent to residential areas in Marin City and Tamalpais Valley, and 2) needed fuel reduction on fire roads, eliminating stands of broom and other nonnative vegetation and fostering the conversion to grassland and native scrub.

Homestead Valley Project Area FMU

The Homestead Valley Project Area FMU is entirely within the WUI. The project area is bordered by Panoramic Highway to the west, Shoreline Highway to the south, and the Homestead Valley neighborhood to the north and east. Vegetation types in this project area include coastal scrub, grassland, native hardwood forest, and nonnative evergreen forests (eucalyptus and Monterey cypress). The Douglas fir/redwood forest in the north part of the project area provides habitat for the northern spotted owl. The fire management issues in this project area include buildup of hazardous fuels in close proximity to residential areas of Homestead Valley and Tamalpais Valley.

Marin Headlands Project Area FMU

The Marin Headlands Project Area FMU is in the Park Interior except Fort Barry and Fort Cronkhite which are in the WUI. The project area extends from the Gerbode Valley and Rodeo Valley watersheds bordered by the Fort Baker Project Area and the City of Sausalito to the east, the Tennessee Valley Project Area to the northwest, and the Pacific Ocean to the west and south. Vegetation is dominated by coastal scrub and grasslands, with herbaceous wetlands and riparian scrub in the low-lying areas. Nonnative stands of eucalyptus and Monterey pine are present in some of the developed areas, and native hardwood forest is present in Gerbode Valley. A large portion of the land along the Pacific Ocean is unvegetated rocky slopes.

The larger clusters of development from the past military occupation include Fort Barry, Fort Cronkhite, a former Nike missile site, historic coastal fortifications, and the Marine Mammal Center area. The project area supports habitat for several plant and animal species listed under the Endangered Species Act, including the threatened California red-legged frog, the endangered tidewater goby and endangered mission blue butterfly. Two species of bats that are federal species of concern use buildings in this project area. The fire management issues in this project area include: 1) buildup of hazardous fuels adjacent to historic structures, 2) nearby residential communities, and 3) the draw of popular visitor destinations within the project area served by roads that could limit access by emergency responders.

Oakwood Valley Project Area FMU

The Oakwood Valley Project Area FMU is in the Park Interior and the WUI. The project area is bordered by the Alta Fire Road to the northeast, Tennessee Valley Road to the northwest, and the Miwok Trail to the south. The Oakwood Valley and Marinview residential communities are adjacent to this project area. Vegetation types include native hardwood forests (oaks), coastal scrub, and some grassland. Riparian forests, as well as nonnative eucalyptus, are present in the drainages. The fire management issues in this project area include maintaining low fuel conditions and adequate fire road access/egress particularly along the residential community interface.

Tamalpais Valley Project Area FMU

The Tamalpais Valley Project Area is entirely in the WUI. The project area is bounded by the Miwok Trail on the south and west, Tennessee Valley Road to the southeast, and the unincorporated community of Tamalpais Valley to the northeast. The Homestead Valley Project Area lies due north, the Tennessee Valley Project Area to the south, Muir Beach Project Area to the west southwest and Oakwood Valley Project Area to the southeast. Vegetation types include coastal scrub, grassland, and native hardwood forest, with some large stands of eucalyptus and a riparian forest corridor along Tennessee Valley Road. Tennessee Valley Creek provides habitat for the California red legged frog. Fire management issues in this area include the need to reduce fuel loads between the park and adjacent communities and to provide for safe fire road access and egress routes.

Tennessee Valley Project Area FMU

The Tennessee Valley Project Area FMU is entirely within the Park Interior. The project area is bounded by the Pacific Ocean to the southwest, Coyote Ridge to the northwest, the Miwok Trail to the northeast, and the Hill 88 Ridge to the south. Vegetation consists mainly of coastal scrub with roughly a fifth of the acreage in grassland. Herbaceous wetlands, riparian scrub, and nonnative evergreen forests are present in the drainages. Disturbed lands and remnant landscape is found in and around the Miwok riding stables and the old farmhouse. Much of the coastline is unvegetated rock outcrops. This project area is home to the California red-legged frogs. The fire management issues in this project area include maintaining adequate fire road access and reducing roadside fuel loading to this area with heavily visited trails.

Wolfback Ridge/Sausalito Project Area FMU

The Wolfback Ridge/Sausalito Project Area is entirely within the WUI. The project area extends from Highway 101 and Sausalito to the east, the Marin Headlands Project Area to the west and south, the Oakwood Valley Project Area on the northwest, and the Alta Project Area to the north. Lands lie to the west and east of the Wolfback Ridge neighborhood. Vegetation types include coastal scrub and grassland, native hardwood forest, riparian forest, and nonnative evergreen forest (mostly eucalyptus). There are areas of mission blue butterfly habitat north of Fort Baker. The fire management issues in this project area include reducing the density of the eucalyptus forest west and east of the Wolfback Ridge neighborhood.

FEIS²³

The Final Environmental Impact Statement (FEIS) for the FMP described a range of alternative strategies for directing wildland fire management actions in GGNRA, Muir Woods and Fort Point Historic Site. Potential environmental effects of each alternative were assessed in the FEIS and mitigation measures developed that would avoid or minimize potential impacts of wildland fire management actions. FEIS appendices include the record of NPS consultations with other federal agencies charged with administering federal environmental regulations as well as the public comments received on the Draft EIS and NPS responses to the comments. The FMP NEPA process for the GGNRA FMP concluded with the signing of a Record of Decision (ROD) by the Pacific West Region Deputy Director on February 24, 2006.

²³ <https://parkplanning.nps.gov/document.cfm?parkID=303&projectId=13822&documentID=13599>

HAZARDS

Fire Risk vs. Fire Hazard

The concept of risk versus hazard can be confusing, as these terms are often used interchangeably.

A “risk” is the chance, high or low, that any “hazard” will cause harm.

Examples of fire hazards may include the presence chaparral, brush, or dry grass, stands of dead or diseased trees or other fuels prone to wildfire, electrical distribution and power lines, vehicle exhaust systems, areas that attract homeless encampments, and concentrations of homes that do not meet current wildfire building codes and standards.

In the context of technical risk assessments, the term “risk” considers not only the probability of an event, but also includes values and expected losses. Within the fire community, risk also refers to the probability of ignition (both human and lightning-caused) (Hardy, 2005). The fire risk (vulnerability) of Southern Marin and surrounding areas varies based on daily conditions (weather and dead fuel moisture) and longer term trends (climate and vegetation community health and distribution) within the local environment.

‘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 purpose of this report is to assist the community in developing collaborative methods of reducing the fire ‘risk’ within Southern Marin by employing strategies and tactics that will reduce or mitigate one or more distinct fire ‘hazards.’ Successful implementation of the recommendations in this report may result in meaningful reduction of the fire risk in the District through the identification and subsequent mitigation of specific hazards.

Wildfire Hazard Assessment

Wildfire is a hazard wherever people and residential developments meet wildlands. The degree of hazard and the required amount of fire safety preparation varies from area to area, even on a community scale. Identifying areas and neighborhoods of differing severity provides for the application of reasonable standards and mitigation strategies based on the actual threat and allows agencies and property owners to allocate resources more effectively.

A baseline of fire prevention and fire-safety activities should be measured to ensure a basic level of protection. Land use planning agencies and the fire service require identification and

classification of areas of varying fire hazard severity in order to specify the conditions under which development and use of these areas can occur safely. In Marin, the basic identification of the WUI meets this standard. Fire agencies continuously assess their protection responsibilities for applying appropriate fire prevention programs and targeting critical areas for special programs. Insurance companies have also shown a significant interest in wildland fire hazard assessment in recent years.

To take effective action, SMFPD Directors and District residents must understand the elements and factors that contribute to the problem. This hazard assessment, in conjunction with the District's desire to implement recommended mitigation strategies, presents a unique opportunity to treat risk at the landscape scale.

Information in this report is based on several available data sources, including the 2016 Marin County CWPP GIS database augmented by information collected during the planning process, the wildfire hazard assessment, three public meetings held in 2019, site reconnaissance visits conducted in 2019, meetings with District staff, published reports, and the professional knowledge of the consultant.

Each section provides detailed information concerning the methods used to assess wildfire hazards, a description of the identified hazards, and the process used to determine the recommended treatment areas discussed throughout the report and upon which the hazard mitigation recommendations are focused.

GIS

GIS data and maps are crucial for pre-fire mitigation and preparation for wildfires, offering a valuable tool for better understanding fire risk through:

- Review of a fire's potential behavior and intensity.
- Analysis of potential benefits of mitigation work.
- Identification of possible evacuation routes.
- Analysis of potential spatial changes over time.

The analysis elements of this document uses GIS data gathered from a number of sources.

As part of the development of the 2016 Marin County CWPP, a base map of the County was assembled using GIS data layers acquired primarily from Marin County's MarinMap GIS portal (www.marinmap.org). The base map includes map layers of political boundaries, fire districts, land ownership, census data, infrastructure, building footprints, a parcel map, WUI boundaries, sensitive habitats, and areas of concern, merged into multiple GIS map layers. The 2016 CWPP base map and corresponding map layers are available for viewing through an ESRI ArcOnline website (URL available to agency representatives) and was utilized for some analyses in this report.

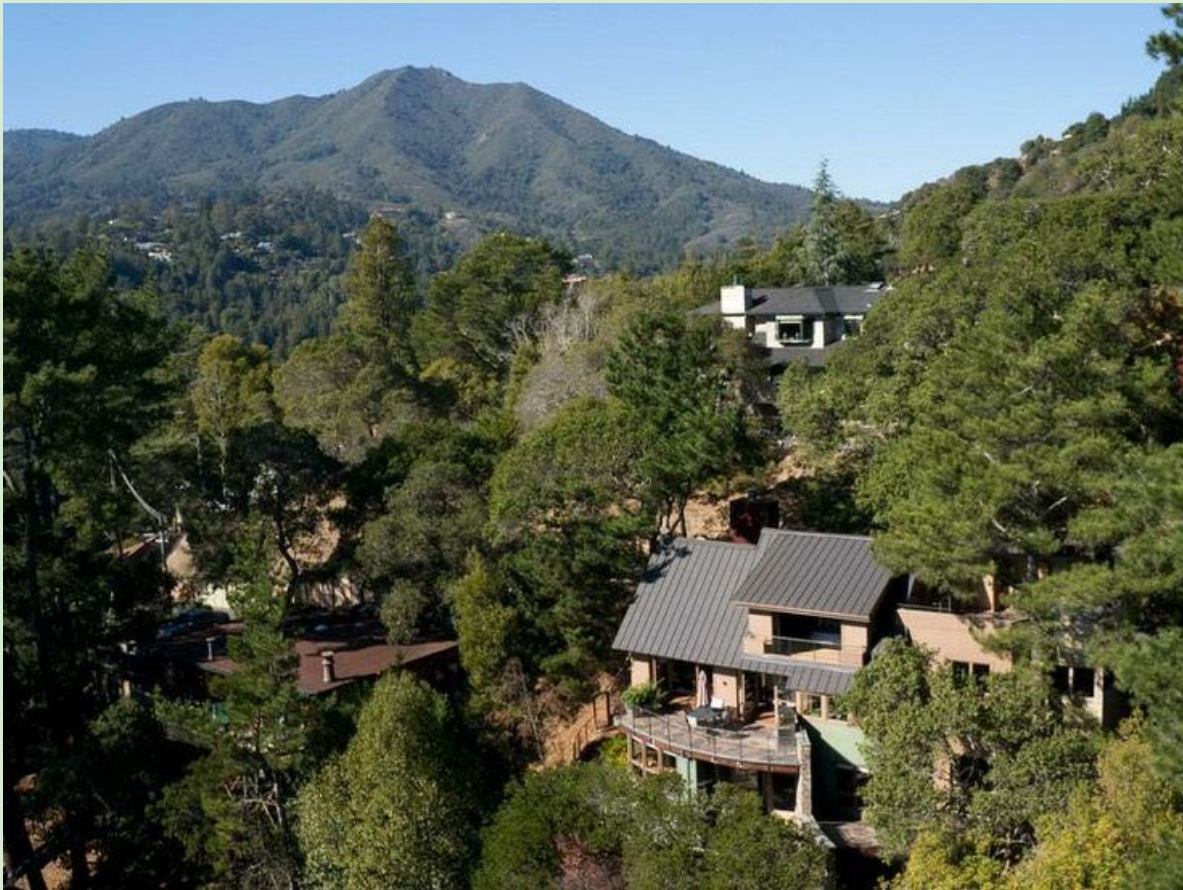
GIS data available from the MarinMap portal was used extensively for the analysis presented in this report, including special district boundaries, WUI boundaries, parcel data, fire hydrant locations, and census data.

QGIS Open Source Geographic Information System software was used to visualize, analyze, edit, and publish all geospatial information utilized in this report.

Fuel Models

Vegetation inventories and field assessments were conducted to identify existing fuels in Southern Marin and to serve as the basis for identifying potential treatment areas and recommending fuel reduction and vegetation management goals. As part of the wildfire hazard assessment process, existing fuel model data sets were reviewed and corrected to create an improved fuel map and model for SMFPD and surrounding areas. Using the 5-meter and 30-meter resolution fuel maps and associated models created for the 2016 Marin County CWPP (5-meter) and 2016 Landfire (30-meter) fuel data, selected vegetation fuel-model pixels were corrected based on hyper-local “ground truthing” of actual conditions observed during site reconnaissance visits in SMFPD’s WUI and a review of current aerial photography.

The 2016 CWPP high-resolution (5-meter) gridded vegetation map was developed using a combination of vegetation data provided by local land management agencies and LIDAR measurements. The 5-meter data was aggregated to 30-meter data for the purpose of fire behavior modeling in this report using FlamMap and the LANDFIRE data within the Interagency Fuel Treatment Decision Support System (IFTDSS). For consistency, fuel conditions for the modeling presented in this report are similar to the conditions used in the assessments contained in the 2016 CWPP.



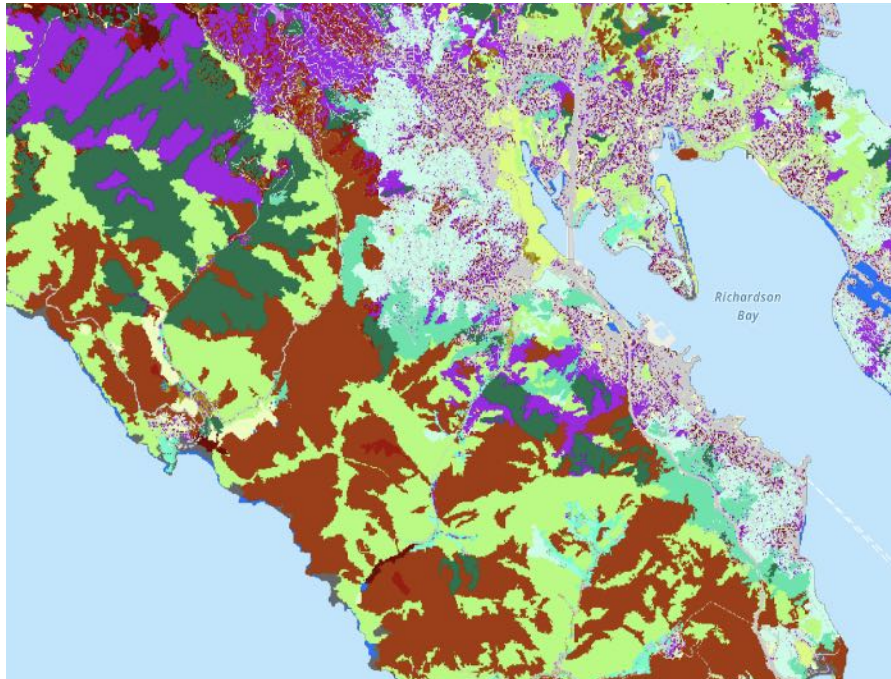
Fuel Modeling and WUI Fires

“Modeling WUI fires has all the challenges associated with wildland fire modeling with additional challenges due to the relatively more complex fuels environment. The WUI landscape contains wildland and residential vegetative fuels, a variety of fuel break types (e.g., roads, sidewalks, and lawns), as well as a range of structural fuels (e.g., siding, roofing, and decking materials) and building assemblies (eaves, decks, and various roofs). Current operational wildland fire models were developed for fire spread through solely vegetative fuels that are contiguous.” (Mell, et al. 2011)

Recognizing current limitations of modeling wildfire in the WUI, a similar fuel model was utilized to represent structures in the WUI as the analysis conducted for the 2016 Marin County CWPP.

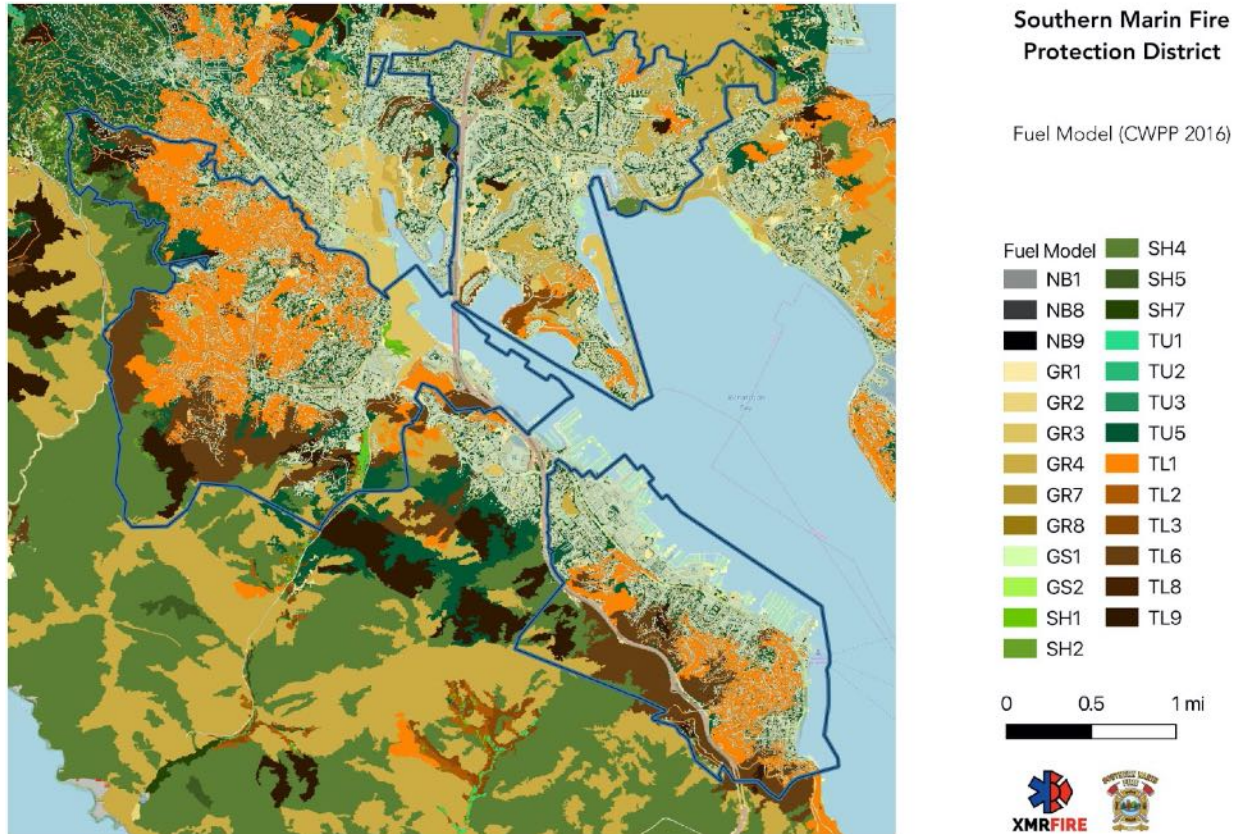
Marin County CWPP 2016 Fuel Model for Southern Marin

Vegetation data published as part of the Marin County CWPP 2016 was used as the basis for modeling fuels in Southern Marin. Corrections and updates were made based on field observations of actual, current fuel conditions.



- 101 Short, Sparse, Dry Climate Grass
- 102 Low Load, Dry Climate Grass
- 103 Low Load, Very Coarse, Humid Climate Grass
- 104 Moderate Load, Dry Climate Grass
- 107 High Load, Dry Climate Grass
- 108 High Load, Very Coarse, Humid Climate Grass
- 121 Low Load, Dry Climate Grass-Shrub
- 122 Moderate Load, Dry Climate Grass-Shrub
- 141 Low Load Dry Climate Shrub
- 142 Moderate Load Dry Climate Shrub
- 144 Low Load, Humid Climate Timber-Shrub
- 145 High Load, Dry Climate Shrub
- 147 Very High Load, Dry Climate Shrub
- 161 Low Load Dry Climate Timber-Grass-Shrub
- 162 Moderate Load, Humid Climate Timber-Shrub
- 163 Moderate Load, Humid Climate Timber-Grass-Shrub
- 165 Very High Load, Dry Climate Timber-Shrub
- 181 Low Load Compact Conifer Litter
- 182 Low Load Broadleaf Litter
- 183 Moderate Load Conifer Litter
- 186 Moderate Load Broadleaf Litter
- 188 Long-Needle Litter
- 189 Very High Load Broadleaf Litter
- 91 Urban/developed
- 98 Open Water
- 99 Bare Ground

Updated 2019 Fuel Model for Southern Marin



Local corrections based on observations in the field were applied to the CWPP 2016 Fuel Model, specifically to address modeling in and near WUI areas where large portions of SMFPD are classified as “unburnable” in the CWPP fuel model. Additionally, the extent of eucalyptus distribution was updated using 2018 aerial imagery.

Wildfire Modeling

The FlamMap fire behavior prediction model and IFTDSS were used to identify hazards according to predicted flame length, spotting potential, and rate of spread. As part of this assessment, fire behavior was modeled under a variety of weather and fuel conditions. For the purpose of this report and the final analysis, fire behavior predictions were assumed to be under late-season fuel conditions, northwest winds, and hot, dry weather to assess worst-case hazards.

Specifically, the following areas were given greater emphasis in assessing wildfire hazards due to the need to protect life and property and the elevated hazard potential resulting from these factors:

- Undeveloped public and private open space within 200 feet of homes and other structures.
- Areas of vegetation with the potential to produce greater than 8-foot flame lengths.
- Areas containing fuels prone to torching and ember production.

In general, modeling scenarios produced similar results to those obtained and published in the 2016 CWPP. The fuel moisture and weather values shown in [Table 13](#) were used for the extreme fire conditions modeling scenarios. Based on recent observations and experience, wind speed and direction were updated from the values used in the 2016 CWPP modeling to better match those observed during 2017 and 2019 Diablo wind events. Fuel conditions are unchanged.

Parameter (units)	Extreme Fire Conditions
1-hour fuel moisture	3%
10-hour fuel moisture	4%
1,000-hour fuel moisture	6%
Herbaceous fuel moisture	40%
Live wood fuel moisture	65%
Wind speed	15 mph 20MPH
Wind direction	206° 34°

Wildfire modeling attempts to predict fire behavior, such as how quickly a fire might spread, how much heat it might generate, and in which direction it might move. Most fire behavior models require three key inputs: (1) fuel model information, (2) fuel moisture, and (3) weather. Fire behavior modeling can provide an indication of how difficult a fire might be to suppress and the likelihood of fire transition from the ground to the tree canopy, which can help identify areas where extreme fire behavior may occur.

The FlamMap fire behavior model was used to model flame length and rate of spread. Flame length is commonly used as a gauge of fire potential because it provides an indicator of possible fire behavior from a suppression perspective. Table 14 shows the fire suppression interpretations of flame length; fires with lower flame lengths are typically easier to suppress while fires with higher flame lengths are much more difficult.

Table 14. Fire suppression interpretations of flame length and fire line intensity.

Flame Length (feet)	Fire Intensity (btu/ft/sec)	Interpretation
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 can be 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 weather scenario identified in Table 13 using the custom fuel model data developed for Marin County (see Figure 5 in Section 2.2) and topographical data (slope, aspect, and elevation).

CWPP Areas of Concern and Hazard Ranking

The 2016 Marin County CWPP finds that the overall results of the hazard, value, risk assessment for both the average and extreme fire condition scenarios throughout Marin produce similar results. All areas identified in the CWPP as “areas of concern” should be considered for hazard reduction efforts, however, based on the CWPP modeling results, the following areas ranked the highest (top 10%) and could be considered high priority:

Five areas are identified as “very high” priority locations in SMFPD’s area due to predicted fire hazard under both average and extreme conditions.

1. Meda project
2. Milland
3. Ricardo open space
4. So. Morning Sun/Tennessee
5. Hawk Hill, Autumn Lane

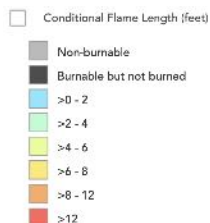
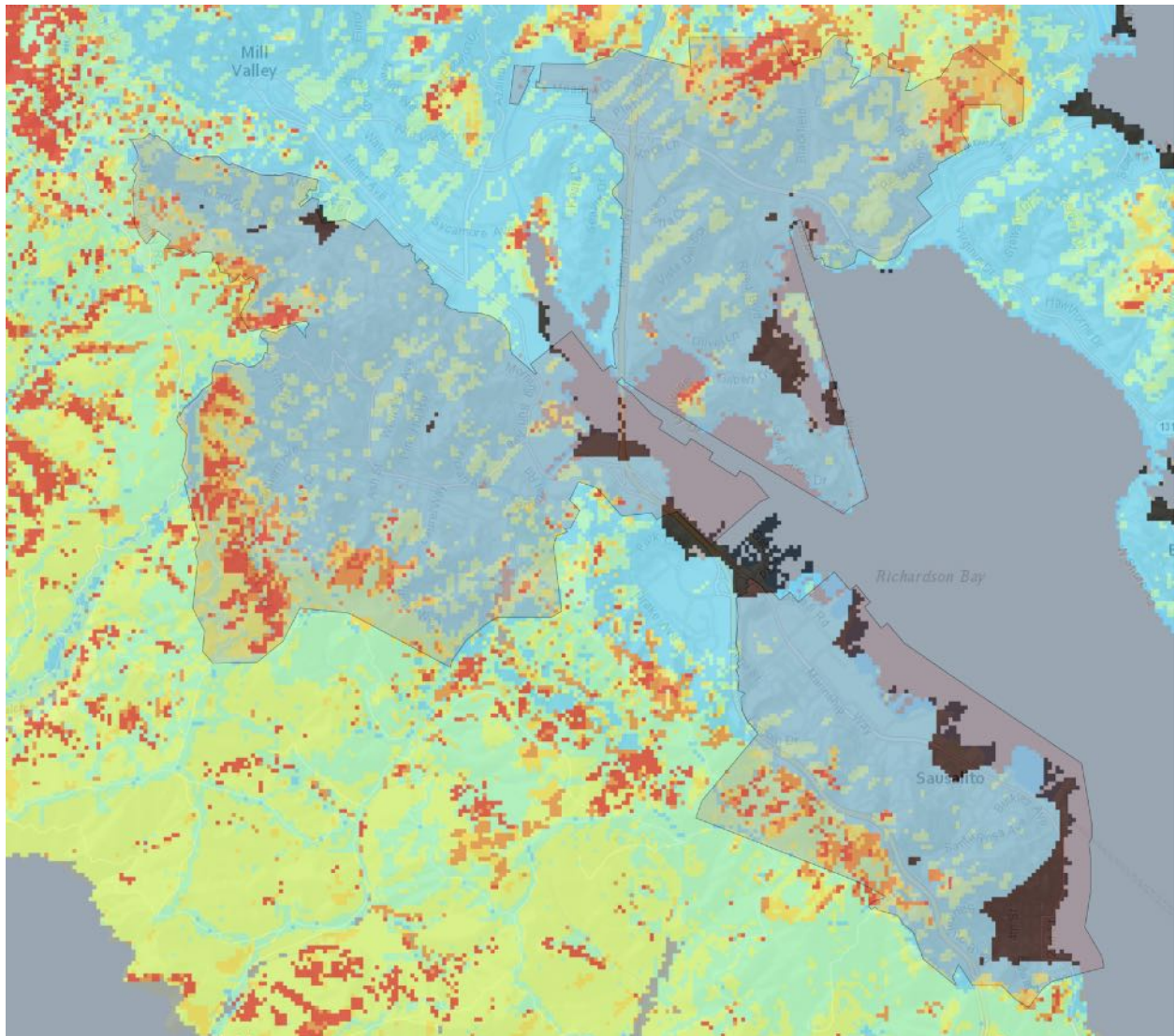
Twelve areas are identified as “high” priority locations in SMFPD’s area due to predicted fire hazard under both average and extreme conditions.

1. Rodeo water tank
2. U.S. Route 101/Wolfback Ridge
3. Seminary
4. Edwards/Marion
5. Lattie Lane/Highway 1
6. Blackfield
7. Laguna/Forest
8. Cabin Drive
9. Homestead Valley
10. Fairview Ring Mountain Area
11. Aqua Hotel Hill
12. Highway 1 to Erica/Friars

As observed in the fire history data for Marin (Marin County CWPP 2016), land ownership and fuel type strongly influence the location and frequency of burning in the landscape. The relative fire threat of an area may be influenced by a number of variables such as fuel types and age, topography, and the presence of ignition sources. When adjacent to urban development, large swaths of open space, whether public or private, presents a potential risk to adjacent communities due to continuous fuel beds, Marin’s relatively steep topography, and limited access. For example, wildfires originating on or burning through the Point Reyes National Seashore, Mt Tamalpais watershed, and Marin’s State Parks have posed a significant risk to communities in Marin.

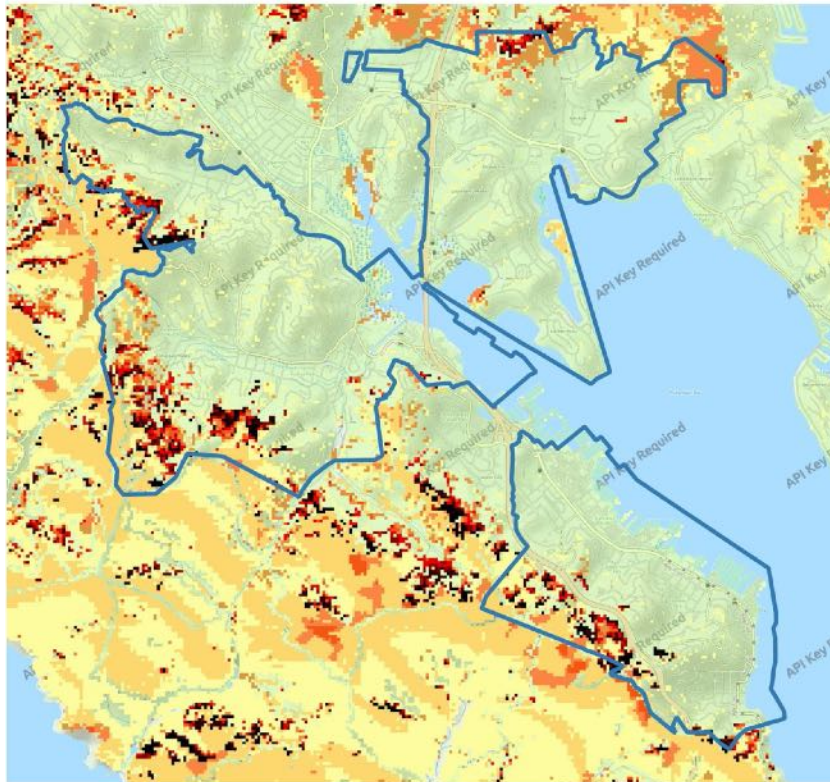
Prevailing wind patterns are a dominant factor affecting wildfire risk. In Southern Marin (and much of Marin) onshore winds blowing from the northwest routinely pick up in the early afternoon, increasing the risk that fires will be driven in a southeast direction if not extinguished before the onset of the winds. Hotter, drier winds from the north or northeast are common during the fall months, especially at higher elevations. The well-known “Diablo” winds (similar to the “Santa Ana” winds of southern California or the “Chinook” winds of the Rocky Mountains) blow from the east, or “offshore.” These winds contributed to many large, historical fires in the East Bay hills and Marin, often in the fall when fuels are extremely dry from months of summer drought.

Predicted Flame Lengths, Extreme Weather Scenario

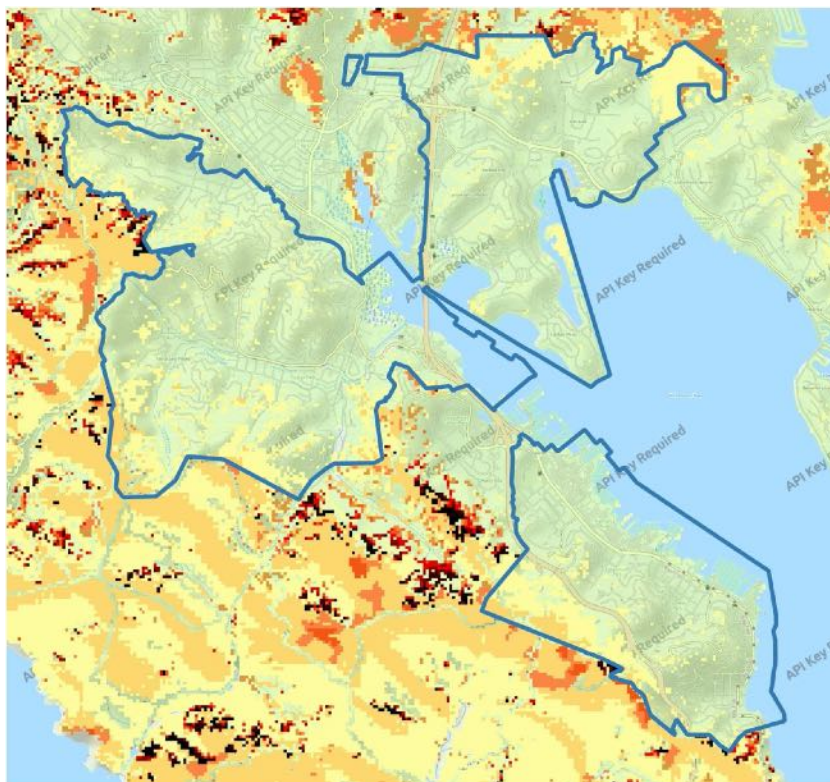


IFTDSS FlamMap modeling conducted using locally corrected fuel models specific to this report produced this hazard map showing predicted flame lengths (in feet) for SMFPD (outlined in black) and surrounding areas.

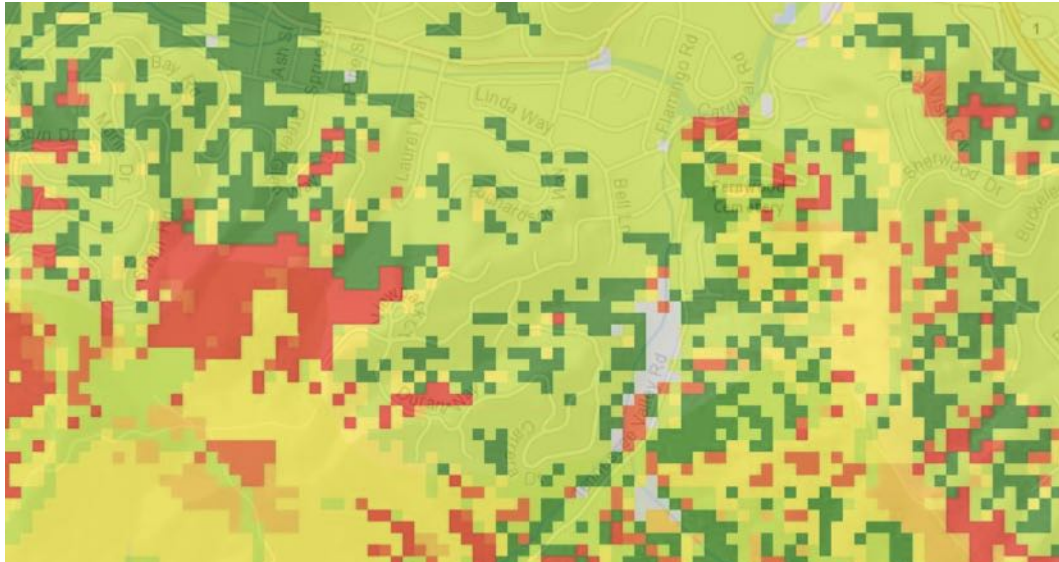
Model: Untreated Vegetation Fuels



Model: Treated (modified) Vegetation Fuels

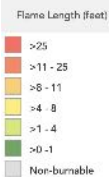
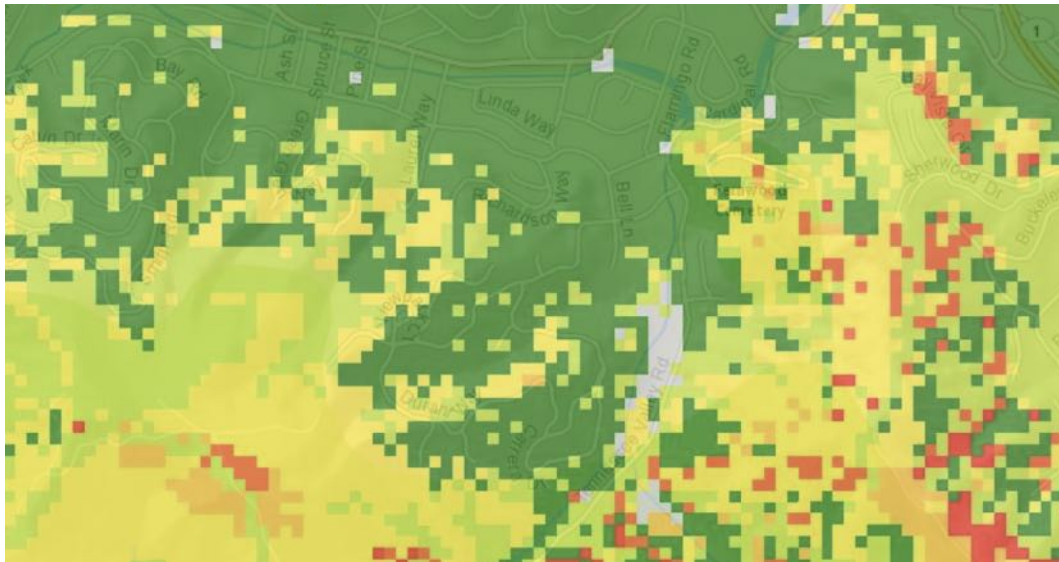


Model: Untreated Vegetation Fuels



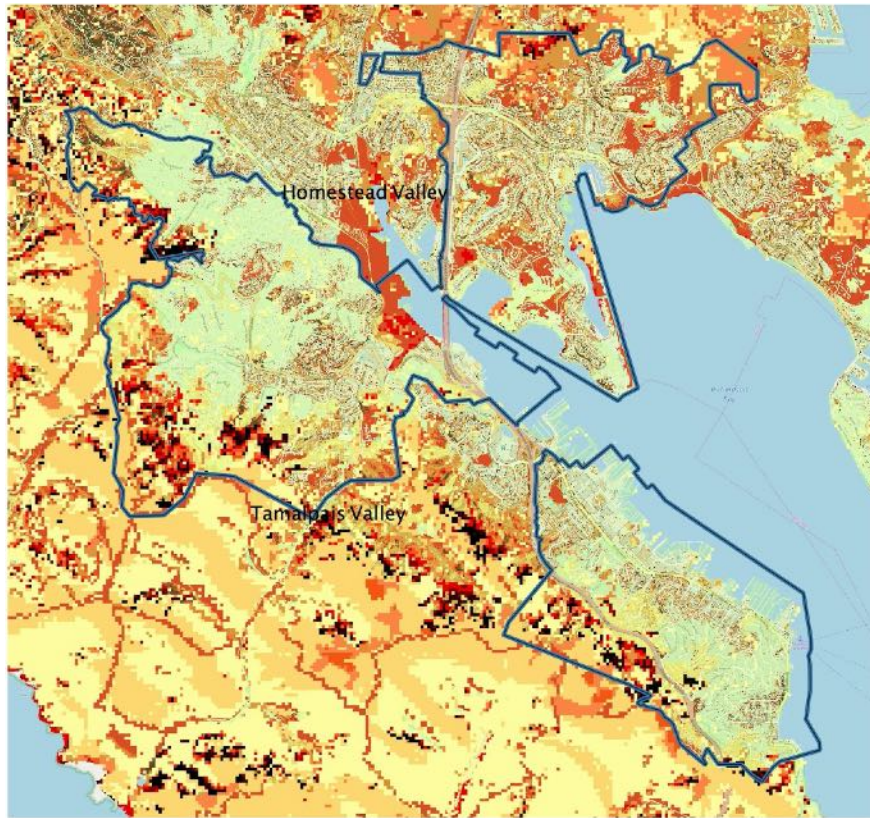
Modeling considered a variety of weather and fuel conditions. Flame length is one of the best predictors of the difficulty to control a fire at a given location, an important factor when evaluating wildfire hazard. The top image shows predicted flame lengths under current fuel conditions in Tam Valley.

Model: Treated (modified) Vegetation Fuels



Vegetation management through understory vegetation treatment, defensible space maintenance, and thinning of fire-prone vegetation in open spaces and undeveloped parcels may reduce the hazard near homes in the WUI by contributing to reduced flame length and energy release during a wildfire.

IFTDSS FlamMap modeling shows predicted flame lengths for the same location near Tam Valley, both pre- and post-treatment. This modeling run assumes 100% Defensible Space compliance on private property, and understory thinning in eucalyptus and native vegetation within 200' of structures on public and private undeveloped lands.



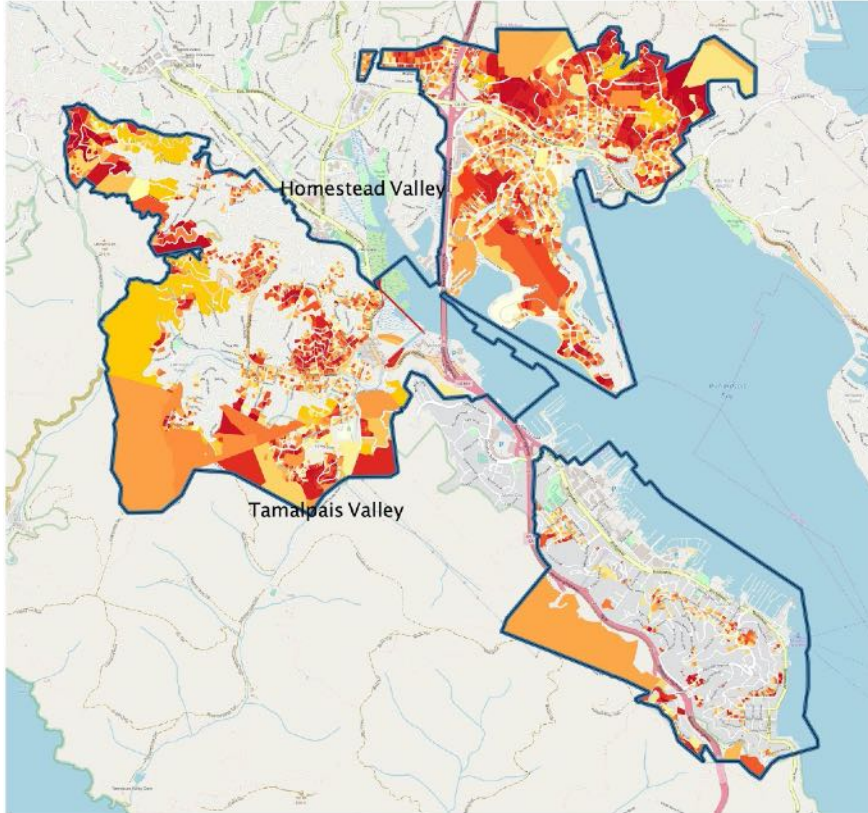
Southern Marin Fire Protection District

Flame Length, Composite
(97th & 99th Percentile)

- SOM Boundary
- Building Footprints SOM
- Flame Length (CWPP Extreme)
- 0
- 1
- 2
- 4
- 6
- 8
- 11
- 16
- 20
- 20 - 25
- 25 - 50














0 2500 5000 ft





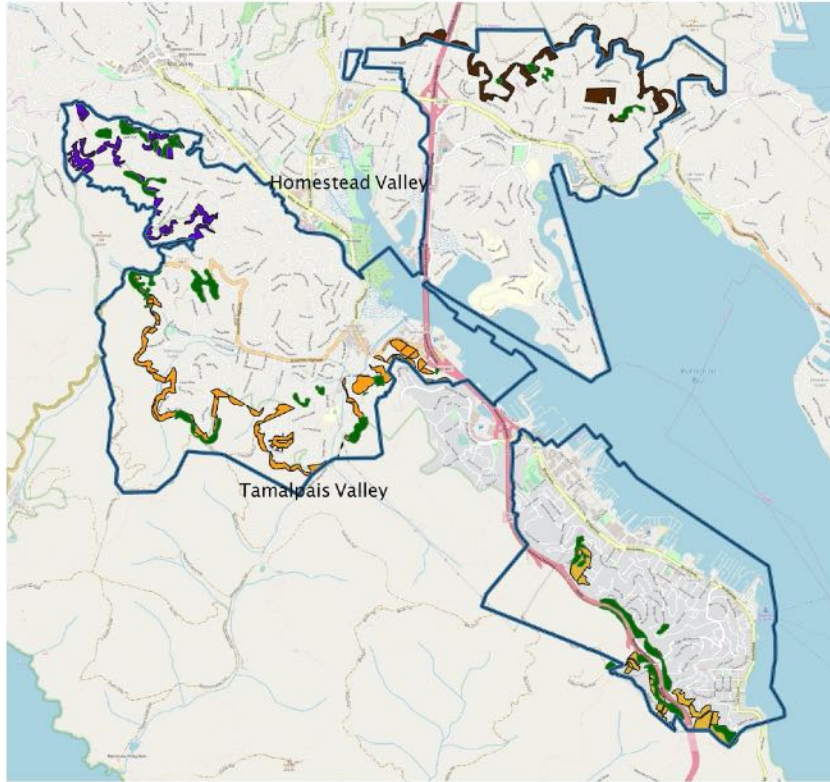
Southern Marin Fire Protection District

Flame Length, Composite
(97th & 99th Percentile)

-  SOM Boundary
 -  Building Footprints SOM
- Flame Length (CWPP Extreme)
-  0
 -  1
 -  2
 -  4
 -  6
 -  8
 -  11
 -  16
 -  20
 -  20 - 25
 -  25 - 50

0 2500 5000 ft



Southern Marin Fire Protection District

Treatment Areas, Including Eucalyptus

-  SOM Boundary
-  Tam Valley
-  Sausalito
-  Homestead Valley
-  Alto/Tiburon
-  Eucalyptus



Ignition Hazards

Wildfires are the result of an ignition source, fuels, and conditions that allow a fire to grow. Ignition sources are broadly divided into natural causes (primarily lightning) and human causes, including both accidentally and intentionally ignited (arson) fires. Ignition, in this report, refers only to the initial ignition source of a wildfire.

Too little ignition data exists for the SMFPD study area to accurately predict future ignition sources and types specific to this location. Ignition data for the entirety of Marin was analyzed in the 2016 CWPP, and in general, may reflect expected ignitions in SMFPD's area.

The CWPP analyzes ignition data for Marin county's SRA areas to evaluate ignition trends and problems within the county. The data set included 414 wildfire ignition points. The table below presents the ignition history for SRA areas between 1974 and 2015, classified by ignition cause.

Ignition statistics, 1974-2015 (2016 Marin CWPP)

Ignition Cause	Number	Percentage
Arson	24	6%
Campfire	7	2%
Debris Burning	15	4%
Electrical Power	6	1%
Equipment Use	12	3%
Lightning	2	0%
Misc.	186	45%
Smoking	4	1%
Undetermined	104	25%
Vehicle	18	4%
Other	36	9%

The ignition history identifies the majority of ignition causes as miscellaneous and undetermined. Arson, electrical, and vehicles also emerge as significant ignition sources. (2016 Marin CWPP)

To address the accidental and intentional ignition sources, agencies have a few key management options—wildfire prevention education, fuels management, and law enforcement.

Structural Hazards

Large, wildland urban interface (WUI) fires damaging a large number of homes are possible in SMFPD's area when extreme fire weather conditions exist. Extreme conditions include periods of low humidity and high winds, representing less than 5% of daily weather conditions during fire season²⁴.

A risk analysis that considers more typical conditions with moderate humidity and winds shows that the more likely scenario for damage to structures in Southern Marin involves small (1-10 acre) fires.

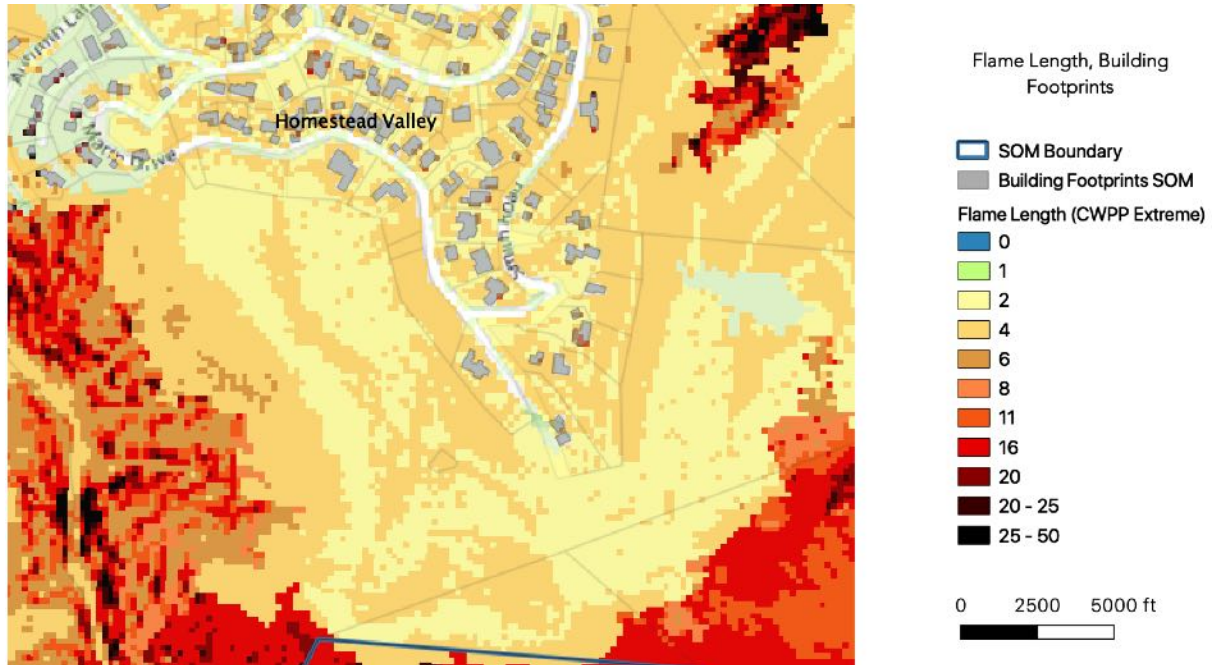


These smaller fires, with a moderate rate of spread in grass or medium fuels, are more likely to impact one or more structures in the time between ignition and arrival of initial attack firefighting resources. It is imperative that property owners prepare their properties with adequate Defensible Space and fire-resistant construction to prevent, or lengthen the time between exposure and structural ignition, in these fire scenarios. **The ignition of even a single structure increases the likelihood that other structures nearby will ignite, largely due to the production of a large number of embers** (Cohen, Quarles).

The current state-of-the-art in computer wildfire modeling is not adequate to accurately predict fire growth, spread, or structural ignitions in the WUI when housing density is high. Modeling can, however, help predict the location, travel paths, and intensity of fire in areas where structures are likely to be impacted by the flaming front of a vegetation fire.

With this in mind, **modeling indicates that larger fires (10-50+ acres) spreading from neighboring open-space into Southern Marin from the west, northwest, or east (under strong wind conditions) could potentially impact a large number of structures simultaneously.** Under worst case weather conditions, due to the large numbers of homes impacted by fire simultaneously on the periphery of Southern Marin, an urban conflagration similar to the Valley Fire (Lake County, 2015) or Tunnel Fire (Oakland/Berkeley Hills, 1991) is possible. Hundreds of homes might be impacted and damaged or destroyed in these conditions.

²⁴ www.weatherunderground.com



Structural Hazard Analysis considered building footprints and relation to flame lengths in continuous vegetation fuels. Building construction type and materials data does not currently exist. Collection and integration of this data is recommended in the Mitigation/Structural Ignition section.

Structural hazards can't be adequately addressed without considering other factors such as building construction, Defensible Space, and neighboring structures²⁵. These issues are discussed as separate (but connected) issues in the [Structural Ignitability](#), [Parcel Inspection](#), and [Defensible Space](#) sections under the Hazard Analysis and Mitigation Strategy headings.

²⁵ Syphard; Brennan; Keeley. 2014.

Assets and Facilities at Risk

Assets at risk are defined as structures and resources that can be damaged or destroyed by wildfire (Marin CWPP 2016). In addition to providing a framework for protecting citizens and providing for firefighter safety, the 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.

Assets in Southern Marin include real estate (homes and businesses), schools, water distribution, utilities and electrical distribution infrastructure, communications networks and facilities, transportation infrastructure, watersheds, protected open-space, recreation areas, and agricultural lands.

This report examined “facilities at risk” that were then evaluated as part of the wildfire hazard assessment and included, as necessary in recommended treatment areas. For the purposes of this report, facilities at risk are primarily schools and public safety infrastructure.

Schools

The following Schools were identified in SMFPD’s area:

- Bel Aire Elementary School, Tiburon
- Ross Academy Montessori School, Alto/Tiburon
- Mill Valley Nursery School, Mill Valley
- Strawberry Point School, Strawberry
- Strawberry Preschool, Strawberry
- The Seminary at Strawberry, Strawberry
- Mill Valley Montessori, Homestead Valley
- Mount Tam School, Homestead Valley
- Marin Horizon School, Homestead Valley
- Tamalpais Valley Elementary School, Tamalpais Valley
- Bright Horizons EDS Tam Valley, Tamalpais Valley
- Kumara School, Tamalpais Valley
- North Bay Elementary School, Sausalito
- The New Village School, Sausalito (Private K-12)
- Lycée Français de San Francisco, Sausalito
- Bayside Elementary School (Willow Creek Academy), Sausalito
- Sausalito Nursery School, Sausalito

Facility benefits: Playing fields present near schools may be a suitable Community or Temporary Refuge Area (CRA/TRA) or serve as Landing Zones (LZ) for rotor wing aircraft during wildfires.

Challenges: Schools may present a unique wildfire evacuation challenge - evacuating students during a daytime fire may be impossible due to lack of adequate transportation. Schools must be prepared to shelter students in-place, and communicate wildfire preparedness plans with parents to help them understand that picking up students may not be possible during a wildfire if an evacuation has been ordered in the area (since law enforcement tasked with traffic control is unlikely to allow parents into the area).

Schools should consider creating enhanced defensible space. A 200' buffer is recommended around all school facilities, and care should be taken to maintain combustible free zones around all school structures to limit potential ember ignitions.

Backup communication and power should be prioritized, and annual wildfire drills should test facilities and plans, including parent communications.

Vegetation

Vegetation in Southern Marin includes a variety of native and nonnative landscaping vegetation, native plant communities, and urban forest. The native plant communities, including oak woodlands, bay forest, coastal scrub, chaparral, and grasslands are naturally adapted to fire, and may depend on fire for regeneration, soil health, and paradoxically, protection from fire (by consuming dead material with frequent low intensity fires, the risk of high intensity fire is reduced).

Landscaping Plants

The County of Marin and Southern Marin Fire Protection District require a Vegetation Management Plan for new construction and substantial remodels. SMFPD Fire Standard 220 contains language nearly identical County of Marin requirements, and lists specific species which are not authorized in landscaping within the urban-wildland interface. A walkthrough of Southern Marin Fire District's area reveals the presence of many fire-hazardous plant species within the landscaping of a majority of homes.

The presence of certain species, particularly juniper which is present alongside roadways, driveways, and paths of approximately 20% of Southern Marin homes, is a significant concern.



JUNIPER is a coniferous, fire-prone shrub or tree that grows easily and well in most environments. There are many species, some low shrubs and some growing into trees. Juniper is often used as a quick ground cover, since it grows fast, acts as a visual screen, and is easily cared for. Its berries attract birds and mammals. Juniper develops significant volumes of dead litter underneath, and even green foliage is highly flammable. No juniper should be planted within 30' of a structure, roadway, or driveway. Removal of existing juniper is recommended for all properties in SMFPD's area.

Specific recommendations for juniper removal are covered in the Mitigation section.



Juniper bushes, commonly planted along driveways and entry paths, are a significant issue noted during field assessments of roadside fuels in the community. More popular in the 1960s and 1970s (and rarely planted with new construction due to vegetation management ordinances that discourage its planting since the early 1990s), many of the existing bushes

are 30-50 years old, poorly maintained, often with large amounts of accumulated dead material. These bushes present a significant hazard, with extremely high heat output often concentrated along critical driveways and access routes to homes where firefighters must work and park apparatus during wildfires.

A local (Novato FPD) firefighter died in 2003 while fighting a wildfire when juniper bushes ignited, impeding his escape route into the home his crew was protecting²⁶.

Fire-Hazardous Plants

All plants can burn, but the ease of ignition, rate of consumption, and generation of heat may be vastly different between species of vegetation. Fire-hazardous plants include species that ignite readily and burn intensely, and typically share certain characteristics²⁷:

- They are usually blade-leaf or needle-leaf evergreens.
- They have stiff, woody, small or finer lacy leaves.
- Their leaves and wood usually contain volatile waxes, fats, terpenes or oils (easily identified, since crushed leaves have strong odors).
- Their sap is usually gummy, resinous, and has a strong odor.
- They usually contain plentiful fine, twiggy, dry, or dead materials.
- They may have pubescent (hair covered) leaves.
- They may have loose or papery bark.
- These plants flame (not smolder) when preheated and ignited with a match.
- The condition of a plant is as important as its species when considering fire. Even some fire-hazardous specimens can be fire-resistant if properly maintained.
- Depending on its growth form and access to water, the same species may be fire resistant in one environment and fire-prone in another. Water-stressed plants that are in poor condition are more fire-prone.
- Many fire-prone species become explosively flammable when poorly maintained. South-facing slopes, windy areas, sites with poor soils, and urban landscapes are more stressful for plants, and enhance any plant's ability to burn.

Fire safety organizations such as FIREsafe MARIN and the NFPA's Firewise USA® program publish lists of common native and landscaping plants that are often labeled either "good" or "bad" from a fire standpoint. The lists are not all-inclusive, and may not identify invasive or uncommon plants that readily burn. The lists vary regionally and should address microclimates, irrigation needs, and soil conditions that contribute to plant health. It is best to think of these as "preferred" plant species rather than "fire-resistant" or "fire-safe."

²⁶

<https://www.wildfirelessons.net/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=266dcaf8-ff12-40bc-aaa5-e4e5e0165caf&forceDialog=1>

²⁷ Moritz, R.; Svihra, P. 1998.

In some instances, a “fire safe plant list” may give property owners a false sense of security. Homeowners who believe that their properties are “fire safe” due to the species they’ve selected may, incorrectly, be less worried about maintaining their landscapes.

Just as important as species selection is maintenance. Many preferred plants will readily burn when poorly irrigated, diseased, or when twiggy dead wood, fallen leaves, or other organic matter is allowed to accumulate.

In Marin, the best current source of information on local fire-prone and fire resistant landscape plant species is FIRESafe MARIN, which has curated lists of fire-hazardous and preferred landscaping plants since 1995. Working with a variety of organizations and experts, the list and descriptions of plant characteristics have been extensively updated in 2019 and early 2020.

Trees and Forests

Note: This assessment recognizes that SMFPD is not a landowner and is not obligated to engage in tree removal or large scale vegetation management projects. Where appropriate, these recommendations should be used to inform decisions about directing existing and future funding sources, and to encourage partnerships with public and private landowners to reduce wildfire risk and hazard within the District.

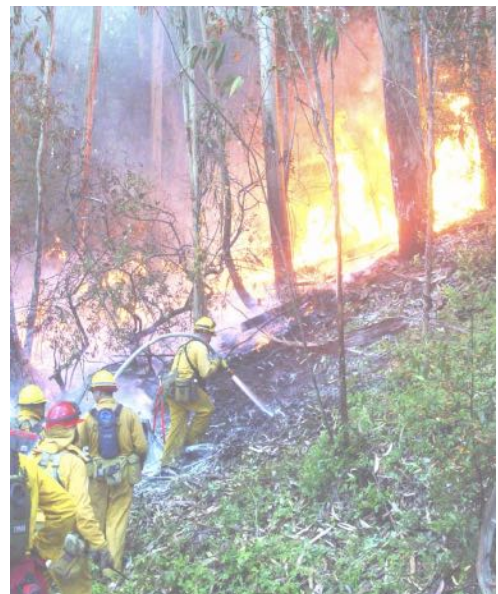
Tree species and forest communities in Southern Marin have changed dramatically since the 1850s. Planting of non-native species such as eucalyptus and Monterey pine have altered the landscape by introducing some of the most fire-prone trees on earth. Suppression of fires and loss of grazing since the 1980s has resulted in a reduction of grasslands, with native forests encroaching, often in an unhealthy state to the accumulation of woody debris and understory vegetation - also largely a result of fire suppression.

Eucalyptus

During interviews with residents, District representatives, and at public meetings, significant concern regarding the presence of eucalyptus (primarily *eucalyptus globulus*) was voiced.

Blue gum (*eucalyptus globulus*) is a tall (150-180 foot), aromatic, straight-growing tree, with bark that sheds in long strips, leaving contrasting smooth surface areas.

Within groves, biological diversity is lost due to displacement of native plant communities and corresponding wildlife habitat. Abundance and diversity of understory vegetation is dependent on stand density. Understory establishment is inhibited by the production of allelopathic chemicals and by the physical barrier formed by high volumes of forest debris consisting of bark strips,



limbs, and branches. The fuel complex formed by this debris is extremely flammable, and under severe weather conditions could produce drifting burning material with the potential to ignite numerous spot fires. Because stringy bark and leaves may be carried away while burning, eucalyptus forests are known for spreading spot fires. Wildfires, once established in eucalyptus stands, may be both intense and difficult to control, presenting dangers to firefighters from falling trees and limbs. Individual trees growing near structures or in public use areas are hazardous because of the potential for branch failure. Stature and growth form are distinctive and unlike native tree species, which compromises the visual quality of natural landscapes.²⁸

Field observations found eucalyptus present as single specimens and in stands up to 69 acres. GIS analysis followed by ground-truthing in August 2019 identified 27 stands of eucalyptus globulus within the boundary of SMFPD greater than .5 acres and of varying age classes. Within the stands, DBH observations ranged from 3” to greater than 74”. Numerous single specimens and smaller groupings of 2-10 individual trees were observed outside of the identified stands.

Location	Stands	Acres
Alto/Tiburon	4	7.24
Homestead Valley	5	22.51
Sausalito	9	92.72
Strawberry	2	11.10
Tam Valley	7	121.28





Wholesale eucalyptus stand removal is usually not a cost-effective mitigation strategy. Most eucalyptus globulus stands can be maintained in a relatively fire-resistant state through a thinning-from-below fuel treatment strategy, removing understory growth (including immature trees), fallen leaf litter and debris, and annual removal of shredded bark. Native habitat restoration (with mature tree removal) can be effective at reducing wildfire hazard and risk at the edges of stands closest to development. These areas should be treated to remove exotic fire-prone and invasive species (eg., eucalyptus, pine, and French broom) to reduce fire hazard, and decrease the continuity and flammability of the fuel bed by developing a mosaic of vegetation types. Conversion to oak-bay woodland, currently present in the understory, should be encouraged. Estimates for eucalyptus removal in mature stands run from \$150,000 to \$750,000 per acre, while native habitat restoration and/or thinning and understory treatment may cost \$10,000-\$25,000 per acre with retreatment every 3-10 years.

Eucalyptus treatment should be considered within 300’ of structures. In the 300’ zone around structures, native habitat restoration is preferred to thinning due to the reduced need for follow-up treatment. Understory thinning and/or stand removal more than 300’ from structures or assets-at-risk may help achieve other ecological goals, but is less likely to contribute to increased structural survival during a wildfire.

²⁸ <https://www.cal-ipc.org/resources/library/publications/ipcw/report48/>

Due to the potential height of the fuel (blue gum eucalyptus may commonly reach 150' in California²⁹), a eucalyptus maintenance zone of 300' around structures is recommended. Although 262 acres of eucalyptus were identified, only 109 acres are within 300' of structures.



-  SOM Boundary
-  Building Footprints (SOM WUI)
-  Eucalyptus Stand > 0.5 acres
-  Recommended for Treatment

Map of eucalyptus stand extent vs treatment area. In this 23 acre stand, only 8 acres is within 300' of structures and requires restoration (or treatment and routine maintenance) to provide protection to nearby structures.



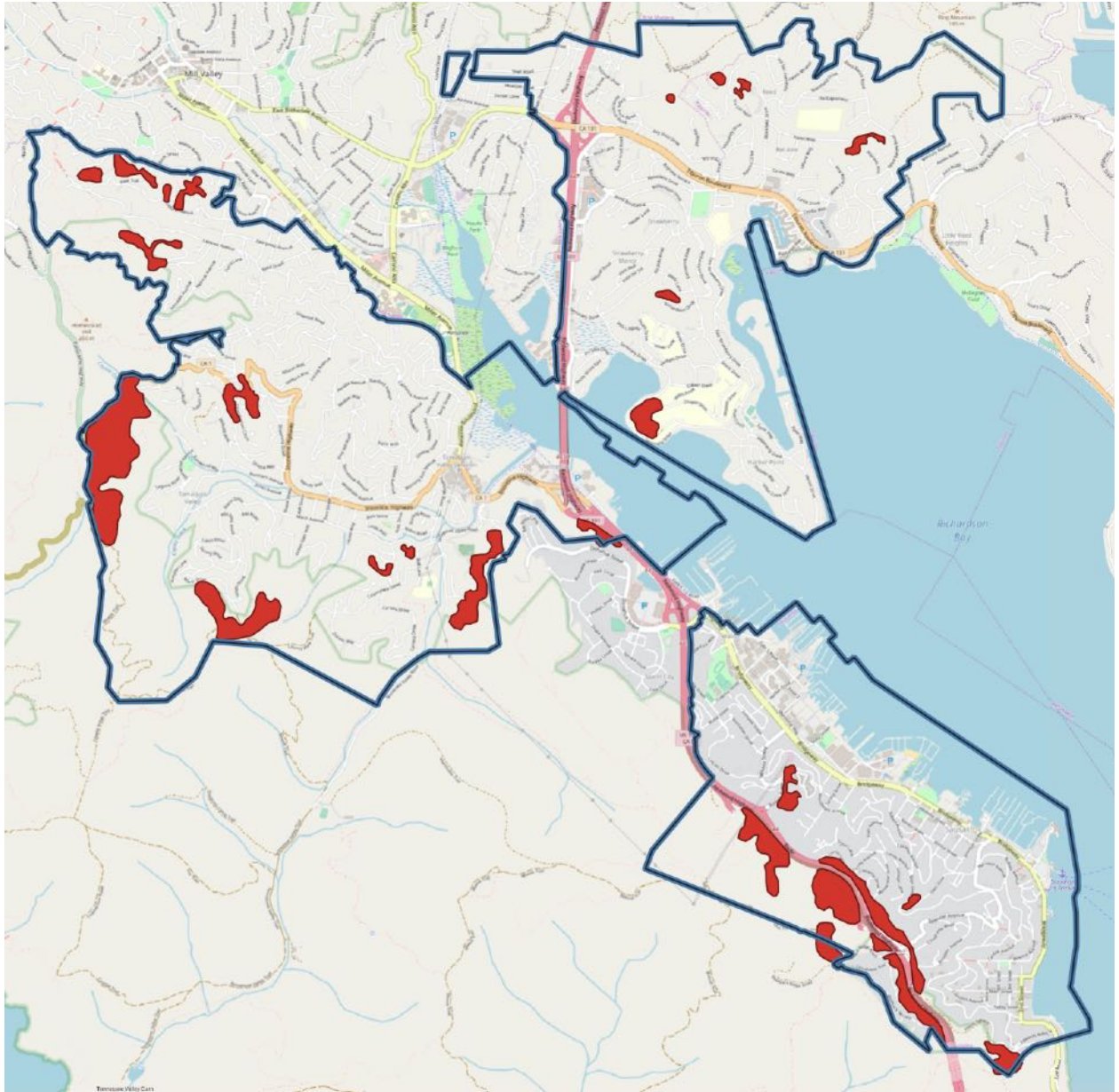
Eucalyptus treatment should focus on removal of ladder fuels, dead vegetation, and accumulated litter. When ground fuels are sparse, and ladder fuels thinned, a ground fire is unlikely to reach the tall canopies.




²⁹ <https://selectree.calpoly.edu/tree-detail/eucalyptus-globulus>



Within 300' of structures, native oak woodland restoration should be encouraged, to reduce follow-up maintenance requirements and further reduce the intensity of wildfires near structures.

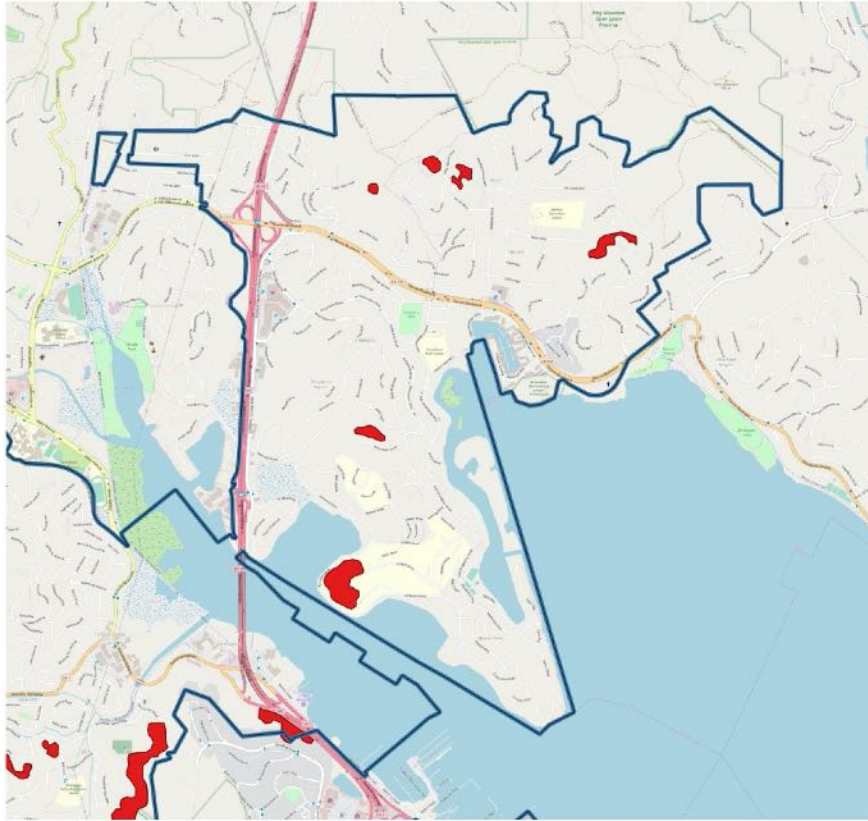
Eucalyptus Distribution: SMFPD



-  District Boundary
-  WUI Boundary
-  Eucalyptus stand >.5 acres

Eucalyptus distribution: stands greater than .5 acres within the boundary of SMFPD.

Eucalyptus Distribution: Alto/Tiburon/Strawberry



**Southern Marin Fire
Protection District**

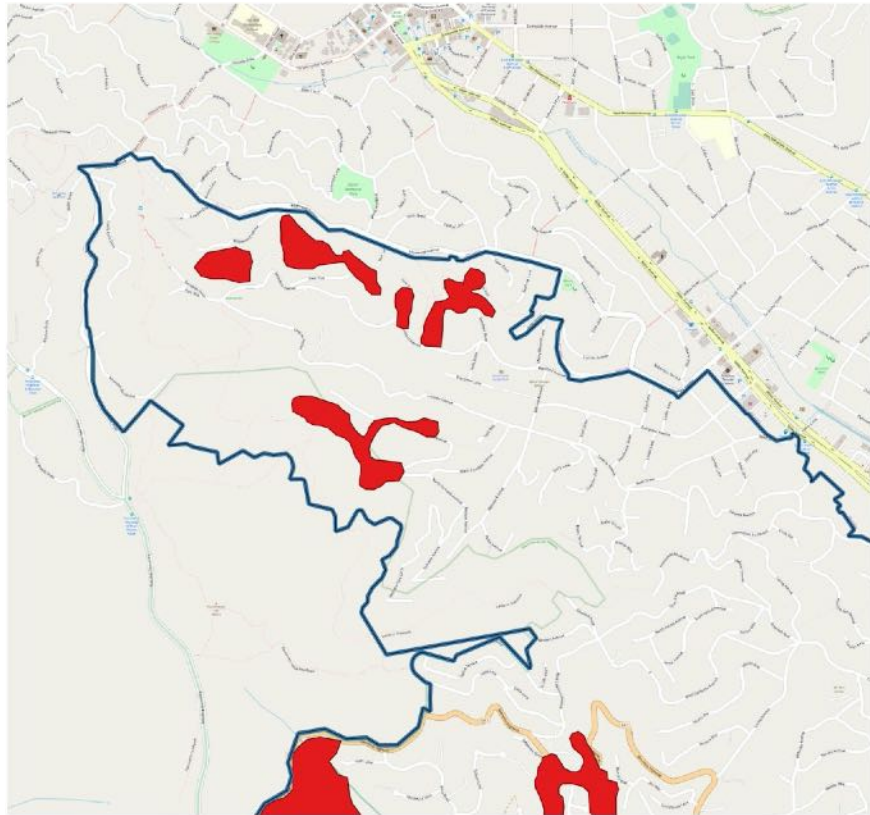
Eucalyptus Distribution
eucalyptus globulus

- District Boundary
- WUI Boundary
- Eucalyptus stand >.5 acres

0 0.5 1 mi






Eucalyptus Distribution: Homestead Valley



Southern Marin Fire Protection District

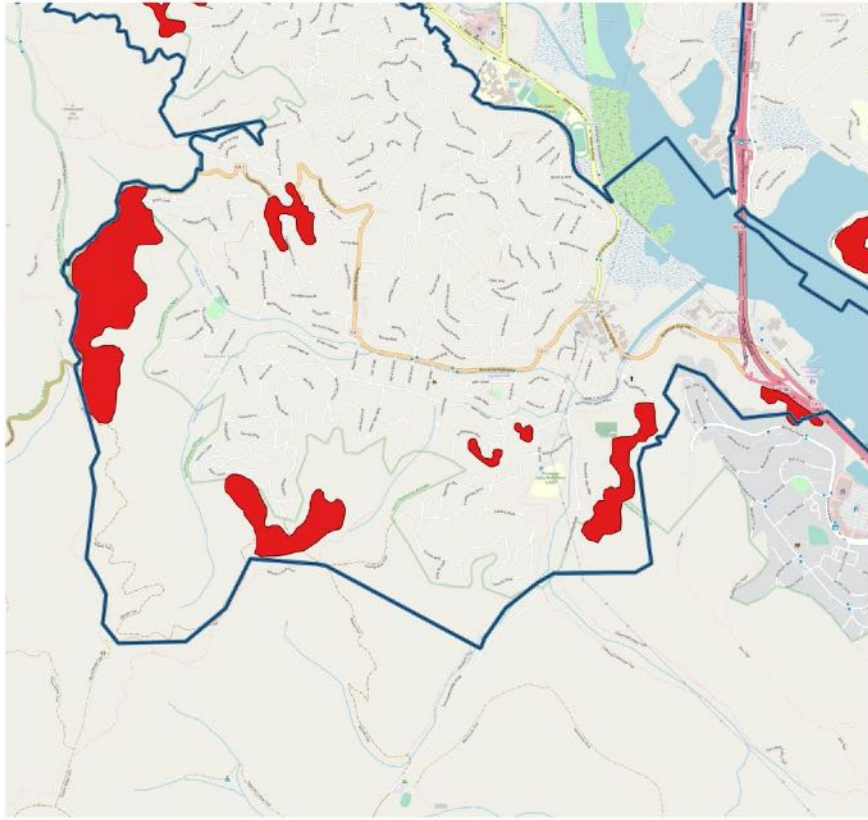
Eucalyptus Distribution
eucalyptus globulus

-  District Boundary
-  WUI Boundary
-  Eucalyptus stand >.5 acres

0 750 1500 ft




Eucalyptus Distribution: Tamalpais Valley



Southern Marin Fire Protection District

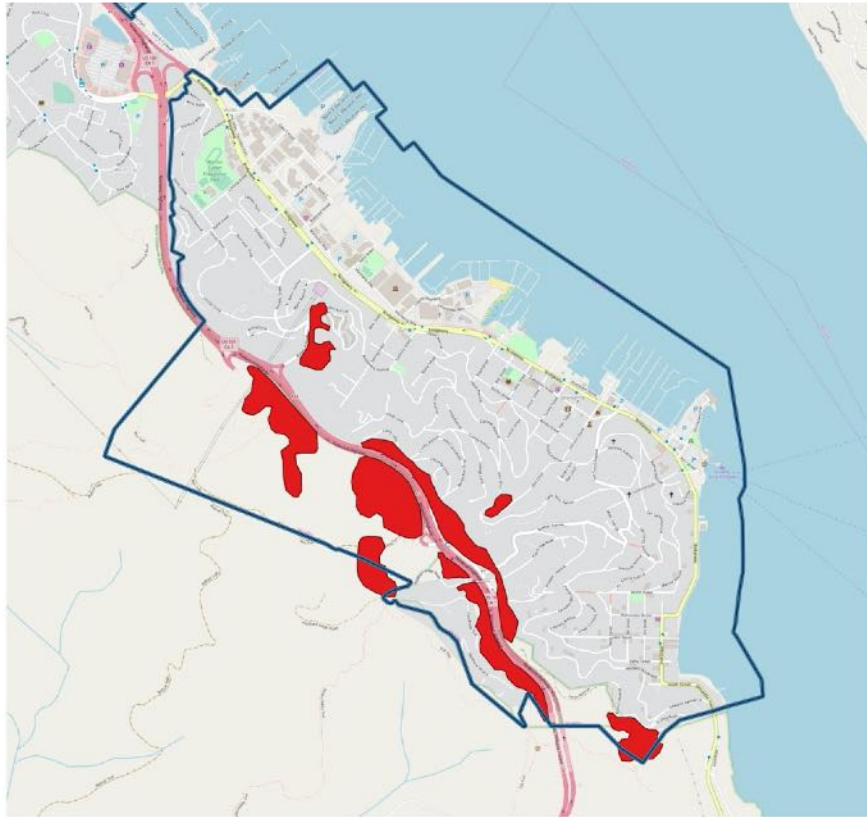
Eucalyptus Distribution
eucalyptus globulus

- District Boundary
- WUI Boundary
- Eucalyptus stand >.5 acres

0 1000 2000 ft



Eucalyptus Distribution: Sausalito



Southern Marin Fire Protection District

Eucalyptus Distribution
eucalyptus globulus

- District Boundary
- WUI Boundary
- Eucalyptus stand >.5 acres

0 1000 2000 ft



Tree diseases

Numerous dead or dying trees were observed along roadways, including coast live oaks (*Quercus agrifolia*) with indications of Sudden Oak Death, Monterey pines (*Pinus radiata*) in varying stages of decline (especially on the south and east facing slopes in Tamalpais and Homestead Valleys) and *Eucalyptus globulus* affected by attacks of two different species of tortoise beetles and two species of the eucalyptus longhorned borer. These trees may contribute to increased fire behavior, and pose a fall hazard, potentially creating safety hazards and blocking evacuation routes during wildfires.

Forest Health Implications

Tree diseases and insect infestations impact fire prevention and protection through tree weakness and mortality, resulting in reduced live fuel moisture, increased dead fuel loads, and fall hazards with the potential block roadways, cause injury, or ignite new fires by falling on power lines. Standing dead fuels contribute to increased wildfire hazard and require treatment and/or removal, especially within wildland urban interface areas. Care must be taken to avoid transportation of infected tools, chips, and trimmings and plant material into uninfected areas. A certified arborist should be consulted prior to removal or cutting of infected trees due to safety hazards of weakened structure and forest health implications.

Sudden Oak Death

The climate in Marin county strongly supports the Sudden Oak Death (SOD) pathogen. Signs of SOD were observed in several locations in Southern Marin while completing this report.

First discovered in Marin in the mid-1990s, Sudden Oak Death caused an immediate concern regarding its potential effects on wildland fire behavior, suppression, and impacts. Caused by the non-native pathogen *Phytophthora ramorum*, the disease infects tanoaks, coast live oak, California black oak, Shreve oak, and canyon live oak, killing over a million trees in coastal California forests since its discovery (Lee, 2009).

Field observations and anecdotal evidence suggest that sudden oak death (SOD), a disease caused by the pathogen *Phytophthora ramorum*, may alter fuel loading in affected forests. Although research has been inconclusive as to whether SOD contributes directly to increased fire behavior, additional ground fuel loading related to sick or dying oaks was observed in Southern Marin and almost certainly will contribute to heat output and make controlling wildfires more difficult.

Pine Pitch Canker

Examples of individual trees showing signs of Pine Pitch Canker were identified in Southern Marin during the field evaluations related to this report. Primarily affecting

Monterey pines (*Pinus radiata*), the disease-causing fungus (*Fusarium subglutinans* f. sp. *Pini*) affects a number of other pine species in Marin including Bishop pine (*Pinus muricata*). Pine pitch canker occurs in response to a fungal infection and is characterized by resinous cankers on the trunk, branches or roots accompanied by needle wilt, limb dieback and eventual tree mortality. The fungus is spread through distribution of the fungal spores by contact with infected material and by insect vectors including several species of bark, twig and cone beetles.

Bark Beetles

Many of Marin's neighborhoods built in the 1950s and 1960s were planted with Monterey pine trees to create fast growing landscapes and windbreaks. As these trees become stressed from age, drought, and a warming climate, they become more susceptible to disease and pests. Two pine bark beetles, the *red turpentine beetle* and the *five spined ips*, are commonly found in Marin.

Eucalyptus Beetles

Two species of eucalyptus leaf beetles from Australia, also called tortoise beetles (family *Chrysomelidae*), have been introduced into California. *Trachymela sloanei* was found in 1998 in Riverside County and now occurs throughout most areas of California where eucalyptus trees grow. *Chrysophtharta fuscum* was discovered in Orange County in 2003 and has spread to at least four nearby counties.

Notched eucalyptus leaves are usually the only obvious indication that trees are infested by tortoise beetles. Well-established and properly maintained eucalyptus appear to tolerate extensive leaf feeding.

The eucalyptus longhorned borer, (*Phoracantha semipunctata*), was discovered in Orange County in 1984. In 1995, a second cerambycid species, *Phoracantha recurva*, was found in southern California. *P. semipunctata* has been accidentally introduced into virtually all Eucalyptus-growing regions of the world and is causing significant tree mortality in many of the areas it has invaded. *P. recurva* is demonstrating a similar high level of invasion throughout areas of the world with significant eucalyptus production.

MITIGATION MEASURES, STRATEGIES, & TACTICS

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 within SMFPD's jurisdiction. Mitigation measures fall into the following general categories:

- Public and Community Outreach
- Wildfire Preparedness and Planning
- Reducing Structural Ignitability
- Vegetation Management and Defensible Space
- Evacuation Planning and Preparation

Mitigation strategies may be addressed in multiple plans, reports, and documents, making consistency important when pre-planning for wildfires and other disasters. Some examples of common mitigation *strategies* include fire prevention methods, reducing impacts when fires do occur, property protection, and fire suppression. Mitigation *tactics* are specific actions that can be taken to mitigate the impacts of a wildfire. Important mitigation *tactics* include

- Educating the public to build support for planning policies and guide responsible behavior;
- Adopting fire-safe building codes and standards and promoting home hardening;
- Developing strategic vegetation management and fuel reduction plans;
- Preparing the public to efficiently evacuate during a wildfire event;
- Improving land use planning practices to create improved fire resilient communities; and
- Increasing fire department suppression and response capabilities.

This report focuses on the first five mitigation measures listed above. The recommendations presented in the sections below were developed to mitigate the hazards identified in this assessment.

The Importance of Community Education and Collaboration

Effective mitigation strategies for achieving community-wide protection require acceptance throughout the community. Homeowners, land managers, SMFPD Directors, 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.

A major question for policymakers, land managers, fire officials, and community leaders is how best to engage and encourage residents to reduce the ignitability of their homes and to create Defensible Space. Studies have shown that in general, the rate of adoption of hazard reduction techniques is significantly lower than policy goals (Brenkert-Smith et al. 2011). Research has

uncovered a number of reasons why residents do not take steps to reduce risk from wildfire, including general knowledge and risk perceptions, economic issues, and the desire to protect amenity values and community aesthetics (e.g., not wanting to remove or thin trees) (Collins 2005). A community must be willing to collectively understand the risks and establish new standards to reduce fire hazards, balancing the safety of the community with private property rights.

Knowledge and Risk Perceptions

Perceptions and knowledge about wildfire risk can drive hazard mitigation. Studies have shown that when fire officials and wildfire specialists share information with residents about hazard reduction, it can help motivate mitigation activities (Brenkert-Smith et al. 2011). A widespread community understanding and acceptance of the overall wildfire risk is critical to gain support for any mitigation strategies adopted.

Generally, residents who are knowledgeable about wildfire risk are motivated to take action based on their perceptions of risk severity (Martin et al. 2007, McCaffrey et al. 2011). However, in at least one case study, residents supported hazard reduction activities even though they perceived that risk was low (Blanchard and Ryan 2007). Perceptions of wildfire risk are also influenced by individual's assessments of the costs and benefits of a particular measure (McCaffrey 2015). In most cases, residents recognize wildfire exists, but their perceptions of effective prevention measures and willingness to take action still varies (Nelson et al. 2004).

A study by Champ and colleagues (2013) shows that residents' age, income, and previous experience living in a fire-prone area are associated with taking actions to mitigate wildfire hazard. In another study, residents often undertook mitigation measures for reasons other than reducing wildfire hazard; for example, to improve insulation or as part of regular maintenance (McGee 2005). Often, mitigation tactics implemented at the individual house-level are connected to larger wildfire hazard reduction strategies. In fact, a series of case studies has shown that residents are more likely to support policies that promote hazard reduction at the house-level that are included within a larger wildfire hazard reduction strategy (Winter et al. 2009), illustrating the importance of neighborhood-scale mitigation strategies such as those promoted by the Firewise USA ® program.

Research suggests that neighbors can be the crucial factor that determines whether a resident will take steps to mitigate wildfire hazard (Brenkert-Smith 2011, Dickinson et al. 2015). WUI residents who characterize themselves as having less knowledge about fire are more likely to follow their neighbors' lead in hazard mitigation (Martin et al. 2007). In fact, the importance of neighbors as a motivator of hazard reduction activities cuts across the spectrum of communities from those with strong infrastructure to those with weak infrastructure (Brenkert-Smith et al. 2011). Again, this illustrates the importance of neighborhood-scale collaboration programs such as those promoted by Firewise USA®.

Economic Issues

Economic cost can be a major barrier to implementing hazard reduction measures. This is compounded by the fact that fuel reduction treatments are generally more expensive to implement in the WUI than in the wildland. One study showed that fuel treatments in the WUI can be on the order of 43 percent more expensive than in the wildland (Berry and Hessel 2004). Therefore, policymakers, land managers, and fire officials must consider the cost, benefits, and impacts of financing mitigation on public and private lands.

Economic feasibility, including the cost of fuel reduction and debris disposal, helps determine Defensible Space implementation (Winter et al. 2009). In some cases, mitigation strategies may need to include providing financial aid or incentives to property owners. For example, providing financial aid to assist the elderly and those on a fixed income to reduce hazardous vegetation around their homes. However, because of the economic disparities across communities, to be effective, these strategies require public buy-in and support.

Desire to Protect Community Aesthetics

Residents often choose to live in WUI environments because of the aesthetic value of the wildlands surrounding them. Residents are fond of the trees, plants, and wildlife around their homes and value, quiet, privacy, views, and recreational opportunities linked to the wildland (Nelson et al. 2004). Because of these realities, mitigation strategies must consider issues such as aesthetics. For example, wood structures, dense vegetation, and narrow roads contribute to the neighborhood character but also increase the risk of wholesale destruction of the community. Mitigation methods should focus on maintaining the desired aesthetics while decreasing structural ignitability and reducing fuels.

Public and Community Outreach

FIRESafe MARIN is a county-wide organization that supports fire agencies and communities throughout Marin. FIRESafe MARIN hosts 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 FIRESafe MARIN 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®

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.

Recommendations for Outreach and Education

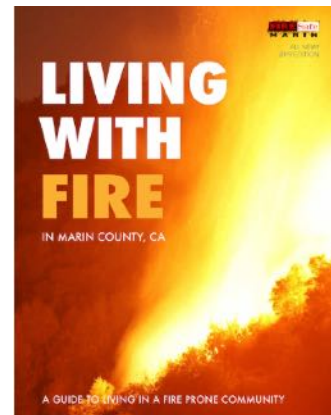
The mitigation strategy recommendations for outreach and education include communicating with residents in a variety of ways and following a specific timeline.

Overview

<p>Goal: Improve the public’s knowledge and understanding of fire risk and wildfire preparedness, and foster collaboration</p> <p>Status: Proposed</p> <p>Completed: N/A</p>	<p>Timeline: 07/01/2020 - 06/30/2025</p> <p>Cost Estimate: \$50,000-\$100,000 over the life of programs.</p> <p>Implementation:</p> <ol style="list-style-type: none"> 1. Promote <i>Living With Fire</i> seminars and booklet 2. Print and mail evacuation pamphlets in odd years 3. Expand the SMFPD website to include Firewise USA ® recommendations from this report 4. Conduct mailings to build awareness of projects and mitigation efforts
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Promote the “Living With Fire” Seminar and Booklet in Even Years

The 2019 *Living With Fire* seminar and booklet outlines wildfire hazards and homeowner mitigation methods to reduce structural ignitability and create Defensible Space. Seminars are conducted throughout the year and the booklet is available online or in printed format. SMFPD should consider promoting the *Living With Fire* seminars and printing the 2019 *Living With Fire in Marin County* booklet and mailing a copy to all residents and property owners in Southern Marin in even years beginning in 2020. Additional copies could be made available as handouts at community events throughout the year. Mailings should occur no later than May 1st so that arrival of the booklet coincides with the beginning of fire season.



Print and Mail Evacuation Pamphlets in Odd Years

The Evacuation Planning and Preparation section (below) suggests the development of a 4-fold, heavyweight brochure with an evacuation map on one side, and *Ready, Set, Go!* preparation and evacuation information on the opposite side. SMFPD should consider printing and mailing this document to all residents and property owners in Southern Marin in odd years beginning in 2021 through 2025, with any necessary updates applied prior to each printing.

Expand the www.SMFPD.org Website to Include Local Firewise USA® Recommendations and District Liaison

The Firewise USA® content contained in this report (below), was developed to complement the planning process. The specific findings and recommendations from the Firewise USA® assessment, should be adapted for web publication and posted at www.SMFPD.org/firewise. Continuous updates are necessary to engage the community and ensure timely and frequent engagement with the community.

Specific Mailings to Build Awareness of Adopted Recommendations and Projects

Following the adoption of this report, the District should consider developing engaging mailings to communicate all adopted recommendations and specific projects undertaken as a result of this assessment and/or related to wildfire preparedness. These mailings could incorporate Firewise USA® recommendations and educational content into District communications about specific projects. These mailings could be sent to all residents and property owners at least once annually.

Many of the mitigation strategies in other sections (below) contain specific communication or outreach recommendations but do not specify *how* to conduct the outreach. For example, in the Evacuation Planning and Preparation section, the recommendations to “*Promote AlertMarin*” and “*Provide Educational Materials and Checklists to Animal Owners*” do not have specific plans on how to conduct outreach. These types of services could be promoted in a number of ways including advertisement in an updated Living With Fire document, dedicated space on the Evacuation Route brochure, a dedicated web page, email communications, and/or hardcopy mailers from the District.

All District outreach and communications should emphasize SMFPD’s role as the primary emergency response and fire prevention agency.

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 in the WUI (Spyratos et al. 2007).
- Firebrands, lofted burning embers carried by the wind from the main fire, are a major cause of 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. 2010).
- Attributes such as roofing material can predispose a house to ignition, and then to destruction, under wildfire conditions (Cohen 2000).
- 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 accumulation at the base of exterior walls, and from exposure to radiant heat or direct flame contact. (Quarles 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. 2012).
- Thinning vegetation within 100 feet of houses can significantly reduce house ignitions (Cohen and Butler 1996).

A wildfire-safe home must be resistant 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 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.

Recommendations for Reducing Structural Ignitability

Reducing structural ignition is the highest priority when considering mitigation strategies to reduce the likelihood of urban conflagration.

Overview

<p>Goal: Improve community resistance to conflagration by reducing structural ignitability.</p> <p>Status: Proposed</p> <p>Completed: N/A</p>	<p>Timeline: 07/01/2021 - 06/30/2025</p> <p>Cost Estimate: \$500,000-\$1,000,000 over the life of programs.</p> <p>Implementation:</p> <ol style="list-style-type: none"> 1. Consider a wood shake roof replacement grant program. 2. Encourage fire resistant building construction. 3. Create an Enhanced Parcel Inspection Database to monitor building and parcel characteristics.
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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, 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, 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. Ranging 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 in Southern Marin 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

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 in WUI areas. These requirements only apply to new construction, and do not address existing structures or remodels and additions to existing structures.

There are several strategies to identify and implement regulatory and nonregulatory approaches to reduce 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 and wildfire preparedness.

State Regulations, Adopted Locally

Chapter 7A Building Code

- CA Building Code Chapter 7A (January 2009 Supplement)
- CA Fire Code Chapters 47
- CA Building Code Testing Standards
- 2010 Title 24 California regulations

Fire Safe Regulations

- 2006 International Wildland-Urban Interface Code
- Public Resources Code 4290
- Public Resources Code 4291
- California Code of Regulations Title 14
- 2010 California Fire Code
- California Code of Regulations, Title 24, Part 9 Chapter 49: Requirements for Urban-Wildland Interface Areas

Public Resources Code 4291

Public Resources Code (PRC) 4291 addresses wildfire vegetation issues in State Responsibility Areas (SRA), which includes approximately 2,575 residential and commercial parcels in Southern Marin, and 158 tax-exempt parcels. PRC 4291 applies to buildings/structures in, upon, and adjacent to mountainous areas; forest-covered lands; brush-covered lands; grass-covered lands; or any land covered with flammable material. PRC 4291 distinguishes between a zone within 30 feet of a structure where fuel reduction

and maintenance is most intense, and a slightly less restrictive “reduced fuel zone” from 30 to 100 feet.

Homeowners are required to maintain a fire break (a gap in the vegetation to prevent a fire from spreading) in the most intense, 30-foot zone. This includes clearing away all flammable vegetation and other combustible growth, with certain exceptions. For example, single well-pruned trees are allowed, but none of their branches shall reach within 10 feet of a chimney or stovepipe. Dead vegetation that overhangs a structure and any material on a roof needs to be removed. In the reduced fuel zone, 30-100 feet, dead and dying vegetation is to be removed and ladder fuel must be reduced.

The allowable spacing between shrubs depends on their height. If the home is located near a steep slope, then the allowed distance of a home to vegetation and the spacing between vegetation is larger. The law also includes directives about the dimensions of access roads (i.e. a fire truck has to be able to reach the home).

Local Ordinances

SMFPD may consider the adoption of local ordinances to address specific concerns not covered by existing codes or amendments. For example, the City of San Rafael’s juniper ordinance³⁰ and San Bernardino County’s City of Big Bear Lake ordinance for wood or shake roof replacement³¹ are examples of ordinances adopted at the local level to reduce fire hazard. 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.

Current codes (including PRC4291 and CAFC 4907.2) already adopted or applicable within the district, when enforced, can provide effective mitigation of vegetation hazard in the defensible space zones 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 and does not need to be adopted specifically in Southern Marin.

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,

³⁰ City of San Rafael’s Juniper Ordinance. Available at: (<https://www.cityofsanrafael.org/juniper-trimming-removal-guide-2018/>).

³¹ City of Big Bear Lake wood and shake roof ordinance. Available at: (https://thinisin.org/images/stories/downloads/Ord_2008-383.pdf).

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.”

Beginning in fall 2019, SMFPD began the process of adopting amendments to the Fire Codes as part of the standardization process in coordination with other Marin fire agencies. Future mitigation strategies and actions should focus on inspection, compliance, enforcement, and retrofitting of existing codes and standards as adopted.

Ignition Resistant Roofing to Reduce Structural Ignitability

Disaster examinations reveal that most destroyed homes are not ignited directly by intense wildfire (Maranghides 2007). This indicates 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. Typical Class-A roofing products include (but are not limited to):

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

Even a Class-A roof may be vulnerable to fire if leaf litter or needles are allowed to accumulate!



Field observations and sampling indicate that **approximately 1-3% of all residential roofs in SMFPD's area are made of wood shingles or shakes**, and as such make 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, unless replaced, the existing highly combustible structures are likely to remain for many years.

Based on field observations and sampling, the total number of wood roofs in Southern Marin Fire District's area is estimated at 100-300. Each exposed wood shake roof potentially threatens adjacent structures within a ½ mile radius due to the large number of firebrands (embers) likely to be produced should that structure ignite. Replacing wood shake roofs benefits the entire community.

Big Bear Case Study: Wood Shake Roof Replacement

City of Big Bear Lake Ordinance #2008-383 mandated the replacement of all Wood Shake/Shingle Roofs by over a five-year period ending September 1, 2012. The purpose of this program was to remove existing wood shake/shingle roofs and install primarily asphalt composition fire resistant "Class A" roof shingles or other fire resistant roof types on homes within the mountain communities of San Bernardino County. The local fire agency identified structures with wood shake roofs as the highest risk of igniting during a wildfire. A program was developed to help homeowners upgrade roofs to meet current codes, and in the process substantially reduced the risk of wildfire damage spreading in this community.



A cost sharing/reimbursement grant process assisted homeowners with the cost of roof replacement. Using FEMA and California EMA grant funds, the agency reimbursed eligible homeowners a percentage of the cost of replacing wood shake/shingle roofing with "Class A" fire resistant roofing, including the removal and disposal of existing wood shake/shingles. Three factors were utilized to limit the reimbursement:

- The reimbursement shall not exceed 70% of the cost of the lowest bid for roof replacement
- The reimbursement shall not exceed \$266.00 per square (100 sq/ft.)
- The grant cannot exceed a maximum reimbursement amount of \$4,500.00

This successful program replaced nearly 200 roofs. In 2019, only 2 homes remained in the jurisdiction with wood shake roofs.

See [Appendix F](#) for additional details on the grant program.

Proposal: A Program to Document and Support Replacement of Wood Roofs

Because of the potentially dramatic benefits to the community, and in order to facilitate a more rapid transition to 100% Class A roofing, SMFPD should consider adoption of a roof replacement grant program to be modeled after the successful Big Bear Lake program. SMFPD should inventory all existing wood shake roofs through the recommended enhanced hazard inspection program. When the locations of individual roofs is known, spatial analysis and modeling can be used to demonstrate specific potential benefits. When the total number of potential roof replacements is better understood, SMFPD should consider setting a budget or pursuing state or federal grants to assist homeowners with replacement. Novato Fire District has applied for a multi-million FEMA grant for a similar building upgrade program (pending approval 10/2019).

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, 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.

Consider adoption of a building upgrade program to improve ignition resistance of existing structures. A program might include:

- Distribution and mailing of Ignition Resistant Building Practices brochures such as the IBHS/FIRESafe MARIN “Ignition Resistant Building Retrofit Guide”;
- Simple upgrade kits including wire mesh, staple gun, and instructions for installation, made available to all Southern Marin residents to protect vent openings;
- Small grants to provide individual property inspections and recommendations;
- Grants for contractor installation of engineered ember resistant vent covers on crawlspace and attic vents.

Recommendations for Improving 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. 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.

Overview

<p>Goal: Improve Defensible Space for all homes in Southern Marin through programs designed to identify hazards and assist homeowners in vegetation removal and disposal.</p> <p>Status: Proposed</p> <p>Completed: NA</p>	<p>Timeline: 07/01/2020 - 06/30/2025</p> <p>Cost Estimate: \$150,000-\$450,000 annually</p> <p>Implementation:</p> <ol style="list-style-type: none"> 1. Improve Defensible Space 2. Conduct annual Chipper Days 3. Expand hazard inspections and notices 4. Enhance Defensible Space on priority risk parcels 5. Support removal of specific hazard plant species 6. Adopt hazard tree removal program 7. Conduct Resale Inspections
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Improve Defensible Space Around All Structures

Defensible Space 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 or building maintenance.

If all structures in SMFPD complied with Defensible Space requirements and current building standards, there would be little threat to assets and infrastructure from fire. Unfortunately, field observations reveal that *virtually no property* 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. Any fuel modification 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.

In order to improve high compliance with Defensible Space requirements across the District, the following steps are recommended for adoption by SMFPD:

1. Continue to provide community “Chipper Days” at least twice annually (spring and fall)
2. Conduct annual inspections and provide hazard notifications for all parcels
3. Recommend enhanced Defensible Space up to 200 feet to property boundary
4. Support removal of specific hazard species (i.e., juniper, pampas grass, bamboo)
5. Support removal of hazard trees in a timely manner

Community Chipper Days

SMFPD should encourage and support community Chipper Days in Firewise USA sites. A successful, model chipper program exists in Tam Valley. These 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 the neighborhoods meet annual Firewise USA® recognition and renewal requirements. As feasible, Chipper Days should be held annually, one to two times, in Tamalpais Valley, Homestead Valley, Strawberry-Alto, and Sausalito.

Proposed annual implementation timeline for each community:

- April: Mail *Living With Fire* or Evacuation Brochure to all residents, with a letter announcing the dates for spring Chipper Day(s). Configure online registration and email newsletter announcement. Set out signage on relevant major roadways.
- May-August: Conduct 2 day “door-to-door” chipper collection services.

To support Chipper Days, SMFPD should consider establishing a budget and contracting with local tree services to conduct the operations (note that the MWPA, if funded, may provide direct support for community chipper days). In addition, SMFPD should continue to (and expand) work with local tree services and organizations like Tamalpais Community Services District (TCSD) and the Homestead Valley Community Association (HVCA) to assist with operation of existing Chipper programs.

Hazard Inspections and Notices

SMFPD is responsible for enforcement of Defensible Space regulations in Southern Marin. During the public meetings conducted in spring 2019 as part of this assessment, there was public concern about a lack of compliance and enforcement for Defensible Space and vegetation management. One of the goals of Measure U is to “...*help the District prevent wildland fires by clearing vegetation and staying prepared.*” To support this goal, SMFPD plans to increase the number of property inspections and increase the enforcement of violations. These efforts will be supported by new staff under funding from Measure U. Enforcement will be geared toward working with property owners to help make their properties and homes more resilient to wildfire.

SMFPD should consider adoption of a one-year enhanced inspection program. As part of the enhanced program, hazard notices should be provided to *all non-compliant properties* in Southern Marin. A more in-depth, PRC 4291 specific inspection form modeled after the

MCFD/CAL FIRE “LE100” is recommended. Data collected on this form could be used to update the parcel hazard database recommended in the Structural Ignitability section.

This inspection program would require re-inspection of properties that do not meet standards on the first attempt. Multiple re-inspections, as outlined in PRC 4291, are required prior to enforcement actions. SMFPD should support multiple follow-up inspections, as required, to determine the number of properties that remain non-compliant. Any resulting enforcement actions should be reviewed by SMFPD staff.

Recommend Enhanced Defensible Space to 200 feet for Boundary Properties

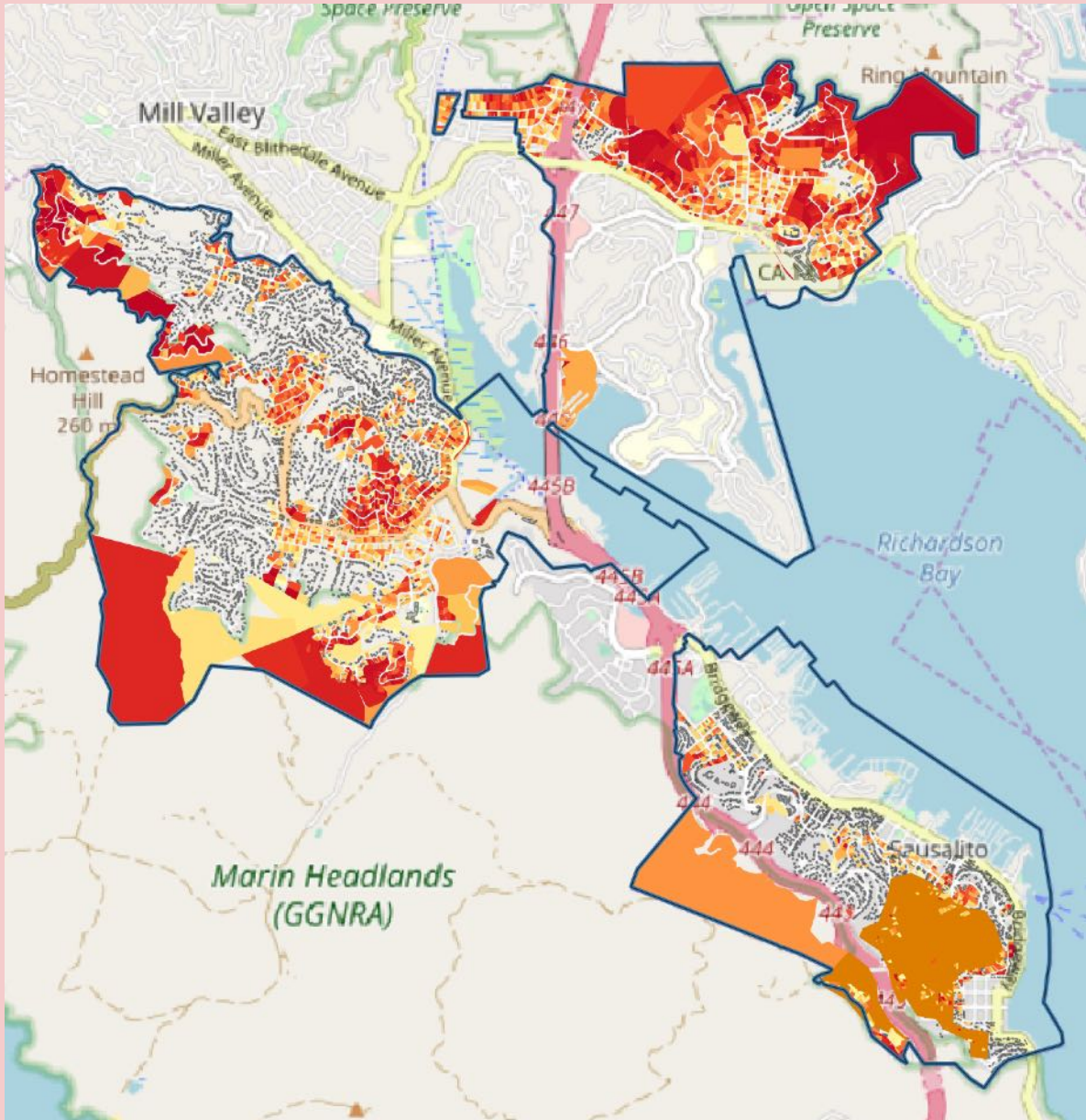
The hazard and risk assessment of this report finds that *parcels adjacent to large parcels of open space (public or private) and large tracts of contiguous vegetation are at particular risk from wildfire*. Properties at the boundary of large parcels of open space (private or public) should be encouraged to maintain up to 200 feet of Defensible Space. Where property lines are closer than 200 feet, refer to the recommendations under “Open Space and Common Space Areas” to work with landowners on large parcels to support vegetation management.

Specific recommendations should include cutting grass, thinning tree canopies, enhanced spacing of landscaping plants, and thinning native vegetation up to 200 feet from all structures on the side(s) facing contiguous vegetation.

This recommended enhancement is specific primarily to parcels listed in Appendix D that are located in the high hazard areas. A specific mailing with notification of risk and recommended actions should be considered for these parcels and repeated annually in the spring.

Priority Risk Parcels

Although all parcels in Southern Marin meet the accepted definition of Wildland Urban Interface (WUI), some parcels may be at particular risk from wildfire. By analyzing hazard data derived from wildfire modeling in conjunction with other data (see below) and field observations, all of Southern Marin falls into two categories: Moderate (Risk); and High (Risk). A graphical diagram is shown here:



Highlighted areas are of particular importance due to one or more factors:

- They are located at the edge of open space and/or large parcels of wildland vegetation.
- They are likely to be exposed to high flame lengths or rapid rate-of-spread during wildfires.
- They are at risk of ingress or egress impediment due to vegetation encroachment, steep or narrow roads, or travel time for responding fire resources.
- They are properties with undesirable construction types, surrounding vegetation, slope, or other observed factors that may contribute to increased fire behavior or ember susceptibility.

Additional details of the criteria and hazard analysis are available in [Appendix D](#).

Ground observations collected during the recommended Enhanced Inspection Program can be used to refine parcels into multiple hazard zones (low, moderate, high, extreme).

Support Removal of Specific Hazard Species

See recommendation under [Codes and Standards](#).



Juniper bushes near the entrance and exits of a home can impede a resident's escape. As a highly fire-prone species, junipers should not be present within the 100 foot Defensible Space zone.

Hazard Tree Removal

SMFPD should consider adoption of a Hazard Tree Removal Assistance Program. As discussed in the [Hazards, Trees and Forests](#) section, a variety of factors, including insects and diseases, result in significant tree mortality each year in Southern Marin. Standing dead trees, regardless of species, contribute to significant fire, injury, and infrastructure hazards (contributing additional fuel; ignition hazard by falling on power lines; falling on people or assets). The cost of individual tree removal and disposal is significant and often results in lengthy delays in removal due to the burden on individual property owners.



A Hazard Tree Removal Assistance Program would consist of one or more concepts:

- A matching grant program up to a specified maximum District contribution towards tree removal and disposal.
- Contracts with local tree services to conduct an annual “hazard tree removal day.”
- A tree hazard notification form, and or grant application, online.
- Support of hazard abatement enforcement by SMFPD.

Resale Inspections to Enforce Defensible Space and Vegetation Management

Another fire agency in Marin, Ross Valley Fire Department (RVFD), utilizes 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 the listed “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.

This successful program provides valuable access to fire department inspectors and ensures that property owners and buyers understand the wildfire risk and conform to standards to reduce hazards on their property. Because the cost associated with compliance is borne by the seller and buyer, and may be more easily absorbed during the sale process of a property. SMFPD already has plans to adopt a local ordinance, modeled after the RVFD, to require Resale Inspections for all real estate sales in the District. Resale Inspections will be conducted by new staff under funding from Measure U.

Recommendations for Firewise USA® Recognition

Firewise USA®, a program designed to give local communities tools and incentives to reduce their wildfire hazard at the neighborhood and community levels, builds on the power of neighbors and other trusted sources to motivate hazard reduction.

Overview

<p>Goal: Encourage neighborhoods/communities to obtain Firewise USA® Recognition with focus on select areas identified as high hazard.</p> <p>Status: Proposed</p> <p>Completed: N/A</p>	<p>Timeline: 07/01/2020 - 06/30/2025</p> <p>Cost Estimate: NA - Program support over the life of programs with existing personnel.</p> <p>Implementation:</p> <ol style="list-style-type: none"> 1. Encourage all WUI communities to obtain Firewise USA® Recognition with special focus on the following: <ul style="list-style-type: none"> ● Trestle Glen (Tiburon) ● Glen (Sausalito) ● Hurricane Gulch (Sausalito) ● The Seminary at Strawberry (Strawberry)
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The Firewise USA® program grew out of a partnership between the United States Forest Service (USFS), the US 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 1,600 communities across the country. Marin county is home to more Firewise USA® sites (59 as of December 2019) than any other county in the US.



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 (CFSC 2015). 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 California have both a fire safe council as well as Firewise USA® designation.

Firewise USA® incorporates many of the home mitigation and Defensible Space elements discussed in previous sections of this report. Research and post-wildfire assessments have shown these mitigation measures to be successful. New research is beginning to assess the effect of Firewise 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 et al. 2013). More specifically, treatments such as having low flammability plantings 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 associated with reduced damage (Maranghides et al. 2013).

Marin is the fastest growing Firewise USA® county, and has more recognized sites than any other county in the United States as of spring 2020. The following 7 Firewise USA® communities are located entirely or partly within the boundary of SMFPD at the time of this report's publication:

- De Silva Island Homeowners Association
- Homestead Valley
- Tamalpais Valley
- Marinview (Marin's First Firewise USA® site)
- Flying Y Ranch
- Alto-Sutton
- Lower Edgewood

It is encouraged that all communities with significant wildfire risk exposure consider becoming Firewise USA® communities. However, based on the results of the hazard assessment, the following neighborhoods should be areas of specific focus for future Firewise USA® organization and recognition:

- Trestle Glen (Tiburon)
- Glen (Sausalito)
- Hurricane Gulch (Sausalito)
- The Seminary at Strawberry (Strawberry)

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 FEMA gives Firewise USA® communities priority in consideration for pre-disaster mitigation planning and project grants.

Scientific research has shown the effectiveness and benefits of implementing wildfire mitigation concepts across individual property boundaries and throughout communities.

The Firewise USA® program can be tailored for adoption by any community and/or neighborhood association that is committed to ensuring its citizens maximum protection from wildland fire.

Using a six-step process, communities develop an action plan that guides their residential risk reduction activities, while engaging and encouraging their neighbors to become active participants in building a safer place to live. Hundreds of neighborhoods and communities throughout the US have embraced the benefits of becoming a recognized Firewise USA® community.

Firewise USA® Community Recognition

There are six steps required of a community/site seeking Firewise USA® recognition:

- Form a Firewise committee
- Complete a wildfire risk assessment as a written document.
- Create a three-year action-plan based on the assessment.
- Conduct an annual “Firewise” education event.
- Invest a minimum of approximately \$25 per household in hazard mitigation year.
- Submit an application to your state Firewise USA® liaison.

Property Insurance Implications

The California FAIR Plan is an association comprised of all insurers authorized to transact basic property insurance in California. Coverage through the FAIR Plan is available to all California property owners, provided submission guidelines³² are met. The FAIR Plan provides insurance as a last resort to homeowners unable to obtain policies in the open market - common in wildfire prone locations where traditional insurers may be less willing to assume risk. The California FAIR Plan provides direct discounts to residents of Firewise USA® sites in good-standing. Property owners should contact their FAIR Plan broker for details.

In May 2014, the California Department of Insurance approved a filing by USAA to give homeowner insurance discounts to USAA members living in communities recognized by the Firewise USA® program. This discount applied to policies issuing or renewing on or after October 1, 2014. New USAA policies for homes in recognized communities may also qualify for the discount, if USAA agrees to provide property insurance per its underwriting guidelines. USAA members living in a recognized community, who had a USAA California homeowner’s policy automatically received the discount when their policy renewed on or after October 1, 2014.

USAA has partnered with Firewise USA® to automatically determine if a home is in a recognized community. USAA believes community-level action is important and provides a discount to members in participating Firewise USA® communities to reward actions taken at the community level, rather than singling out individual properties.

This partnership between USAA and Firewise USA® evolved from the fact that the Firewise USA® recognition program has national scope and consistent criteria for recognition. NFPA has

³² <https://www.cfpnet.com/index.php/consumers/submission-guidelines/>

collected and maintained data on all participating communities since 2002, including data that specifies the exact location boundaries for each community. From this data, USAA's research found a favorable difference in loss experience for members who live in Firewise USA® communities in California. USAA chose Firewise USA® based on their expertise and experience in the community wildfire prevention and feels its program best aligns with its wildfire strategy.

Ongoing Maintenance

Maintenance of Firewise USA® recognition requires an ongoing commitment of time and resources. The annual minimum commitment to maintain recognition in 2020 includes:

- A per-parcel minimum “investment” of \$25 annually (in-kind based on the value of homeowner hours and/or actual expenditures on hazard reduction.
- Hosting of an education event to educate residents about local risk, hazard mitigation, and/or wildfire safety and preparedness.
- Documentation and recordkeeping of Firewise USA® activities.
- Annual renewal application submission.



Many fine examples of “Firewise” homes and landscaping already exist in SMFPD’s sphere-of-influence. Good selection of landscaping plants with proper spacing, fire resistant building materials, and use of hardscaping are shown here. Even for well prepared properties, annual maintenance and further refinement of landscaping and structures will only serve to enhance survivability of the entire community. In this case, the fine grasses should be moved at least 30’ from the structure and spaced at least 3’ from other plants. No combustibles should be allowed within 5’ of structures.

Recommendations to Monitor Building and Parcel Characteristics

Consider the development and maintenance of an enhanced parcel inspection database. The enhanced parcel inspection database would be a local database to collect, organize, and analyze relevant data regarding building characteristics; Defensible Space and vegetation characteristics; and Firewise USA® status for all parcels within the District. The collected data could be used to identify specific parcels for enforcement of Defensible Space requirements, allow for further analysis of hazard and risk, locate specific hazards for potential mitigation (eg, wood shake roofs for replacement), and better model wildfire in the WUI to prioritize future mitigation. Note that the potential passage of the funding initiative (Measure “C”) for the Marin Wildfire Prevention Authority JPA in March 2020 may introduce additional opportunities for funding or regional hazard inspection/assessment partnerships. Passage of this initiative would likely provide funding and direction to create a countywide database like the one described here.

Non-Residential Vegetation Management

This section provides location-specific information and recommendations for preliminary vegetation treatment goals and guidelines to be used when selecting and implementing fuel reduction actions for reducing wildfire hazards in SMFPD’s communities. The recommendations in this section are focused on non-residential vegetation management.

It is important to note that the District is not a landowner, and as such does not have the ability to conduct direct fuel modification treatments without landowner permission. All proposed fuel treatments 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, PRC 4291, or Title 14 CCR.

Preliminary vegetation management goals, proposed treatment methods, and local considerations are identified in this section for specific recommended treatment areas: roadways, open spaces, and undeveloped land.

Overview

<p>Goal: Support removal and maintenance of fuels to improve access and egress routes to enhance safety during fire response and evacuations, and reduce fire intensity in WUI areas.</p> <p>Status: Proposed</p> <p>Completed: NA</p>	<p>Timeline: 07/01/2020 - 06/30/2025</p> <p>Cost Estimate: TBD based on projects selected</p> <p>Implementation:</p> <ol style="list-style-type: none"> 1. Manage roadside vegetation 2. Work with GGNRA and MCOSD to maintain fuels 3. Maintain existing fire roads and conditions 4. Use fire for invasive species control 5. Work with public and private landowners to maintain fuels using targeted fuel modifications for areas identified in the hazard assessment
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Recommendations for Roadside Vegetation Management

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 Southern 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

Roadway Clearance Recommendations

SMFPD should consider funding enhanced vegetation maintenance in the public right-of-way to reduce vegetation that may threaten evacuation or impede fire apparatus access. Roadway clearance mitigation should prioritize roads and parcels identified in [Appendix D](#).

Because roadway vegetation maintenance is largely the responsibility of individual landowners, SMFPD should 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.

Specific Roadside Treatment Recommendations

- Remove all dead trees and limbs that might obstruct roadways or impact utility lines.
- Remove all conifer stems 6" and smaller within 10' horizontally from road edges.
- Tree canopies extending over the roadway should be raised to a minimum of 15 feet above the road surface to provide safe clearance for fire apparatus.
- Tree canopies on opposite sides of a road should not meet. Limbing or removal of specific trees may be necessary to achieve discontinuity of canopies.
- Roadside trees should be limbed up so the lowest point of lower limbs is at least 10 feet above grade.
- Fine "ignition fuels" such as grass and weeds along road edges should be removed annually, before June 1, or prior to the declared start of the fire season.

- Transition zones (from grass and weeds to shrubs and from low branches to tree canopies) should be disrupted by mowing grass and herbs, removing brush, brambles (blackberries) and limbing up trees.
- Roadway turnouts should be mowed as necessary to prevent catalytic converter ignitions. Mowing may occur once or more per fire season, as needed.
- 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, Monterey pine, or Douglas fir).
- Remove dead branches and clean up down and dead debris within 30 feet of all roadways.

Other Roadway Access/Egress Issues

Turnouts

Road width is a crucial element for allowing access/ egress during an emergency. Many roads and spurs within Southern Marin are relatively wide in WUI areas, however, some streets are narrow and potentially interfere with fire engine 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 improve visibility.

Fire Road Gate Access

Vegetation clearance near fire road gates is imperative for fire department and resident 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.

District should work with landowners (GGNRA; MCOSD; private) to ensure gate clearance is maintained and that gates are keyed and locked appropriately. Annual inspections/maintenance should be managed and logged.

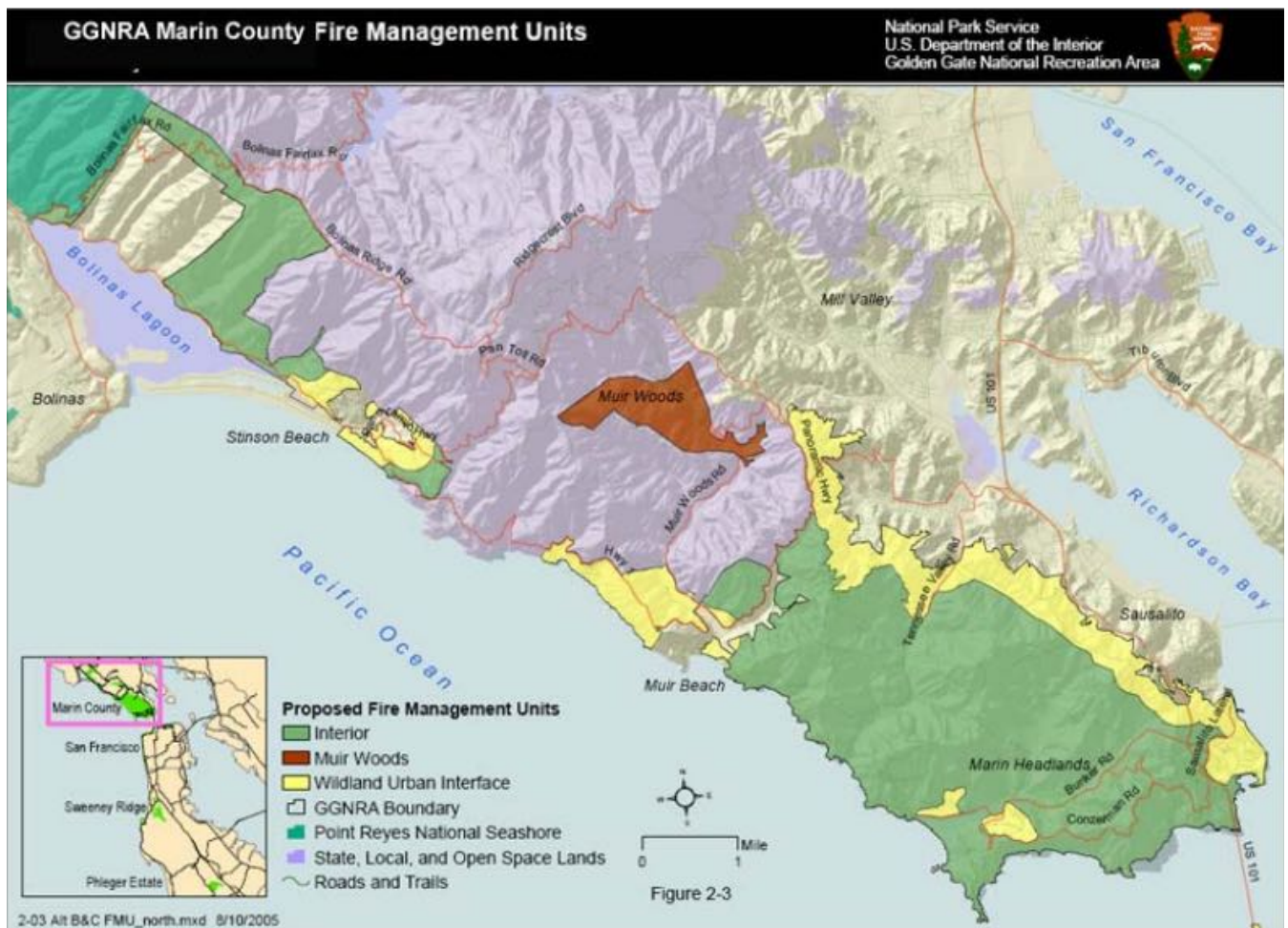
Recommendations for Open Space and Common Space Vegetation Management

Work With Golden Gate National Recreation Area to Maintain Fuels

The largest landowner of property bordering (and within) the District, is the GGNRA which is responsible for much of the vegetation adjacent to the District. Although the GGNRA legislative boundary covers a total area of 74,816 acres in Marin, San Francisco and San Mateo counties, GGNRA in Marin has primary jurisdiction over 15,700 acres administered by the National Park

Service (NPS). In Marin, the majority of public lands are administered by agencies other than the NPS including the California State Department of Park and Recreation, the Marin Municipal Water District (MMWD), and the Point Reyes National Seashore (PRNS), and California State Parks. Most of the NPS-managed land in Marin County is located in Southern Marin, specifically in the Marin Headlands. The northeastern and some of the eastern boundary of the Marin Headlands fall within the WUI areas in the District.

As discussed in Section 2, the GGNRA FMP is an operational manual containing the standards, practices and guidelines in use by the Fire Management Branch of the Law Enforcement Division of GGNRA for conducting actions within the 15,700 acres of primary jurisdiction. The GGNRA FMP defines fire management units (FMUs), several of which are in or adjacent to the Districts' WUI boundaries (see Section 2 - Golden Gate National Recreation Area Fire Management Plan).



The yellow areas show areas where the Golden Gate National Recreation Area (GGNRA) lands intersect WUI areas. The Fire Management Units listed below lie in the yellow areas along the eastern and northeastern border of the Marin Headlands.

GGNRA has identified vegetation management issues and actions for each of the FMUs in the District. The following lists the FMUs that are within or immediately adjacent to the WUI and summarizes the fire management issues and fuel reduction activities planned or ongoing by GGNRA:

- **Alta Project Area FMU:** large stands of nonnative evergreen forest adjacent to residential areas in Marin City and Tamalpais Valley; needed fuel reduction on fire roads, eliminating stands of broom and other nonnative vegetation and fostering the conversion to grassland and native scrub.
- **Homestead Valley Project Area FMU:** buildup of hazardous fuels in close proximity to residential areas of Homestead Valley and Tamalpais Valley.
- **Marin Headlands Project Area FMU:** buildup of hazardous fuels adjacent to historic structures; nearby residential communities; and the draw of popular visitor destinations within the project area served by roads that could limit access by emergency responders.
- **Tamalpais Valley Project Area FMU:** need to reduce fuel loads between the park and adjacent communities and to provide for safe fire road access and egress routes.
- **Wolfback Ridge/Sausalito Project Area FMU:** need to reduce the density of the eucalyptus forest west and east of the Wolfback Ridge neighborhood.
- **Oakwood Valley Project Area FMU:** maintain low fuel conditions and adequate fire road access/egress particularly along the residential community interface.

SMFPD should work with GGNRA to encourage and track project work in these FMUs and to help ensure that ongoing work is performed as needed.

Work with Marin County Parks and Open Space to Maintain Fuels

As discussed in Section 1, MCOSD manages three Open Space Preserves within the District: 1) Bothin Marsh, 2) Tiburon Ridge, and 3) Ring Mountain. In addition, there is significant open space around some areas within the District such as that around the Marinview Community Association in Tam Valley and the area of the Homestead Valley Land Trust which is jointly managed by Homestead Valley and Marin County Parks. SMFPD should work with MCOSD to encourage improvements and maintenance of fuels and fire roads in and around these preserves especially fuels in areas adjacent to neighborhoods and fire roads along ridgelines.

- The network of existing fire roads and surrounding natural vegetation-fuel types (grass and light fuels are nearly continuous from Tiburon Ridge to Ring Mountain) present an excellent naturally-defensible fuel break where firefighters may be able to contain fires outside the District.
- Reduced maintenance, lack of grazing, fire suppression, and invasive plants are contributing to a slow conversion of fuel types to heavier fuels that may present fire suppression difficulties in the future. Maintenance of existing grasslands, and restoration of historical grasslands, should be encouraged.

- MCOSD in their Draft / Vegetation and Biodiversity Management Plan (2015) outlines priorities for these and other Preserves that include developing and maintaining fuel breaks (4-61), protecting ingress and egress zones (4-71), and treating Fuel Modification Zones (4-71).
- Fire road maintenance is of particular importance, as unrepaired washouts and rutting have been observed in the area and may impede access of fire equipment.
- Fire modeling conducted as part of this assessment verified the value of fire containment in the Tiburon Ridge and Ring Mountain preserves.

MCOSD Vegetation and Biodiversity Management Plan

This draft plan addresses all types of vegetation management on MCOSD lands; the management of vegetation in fuel modification zones is one aspect of their overall program.

“Place a High Priority on Fuel Reduction in Defensible Space Zones: the establishment of Defensible Space zones along the wildland-urban interface can assist in fire control, reduce fuel loads, and protect structures and adjacent communities, when used in concert with fuel breaks. Given the most current information about the effectiveness of various fuel risk reduction practices, and the impacts associated with fuelbreaks (including invasive species infestations) in high-value resource areas, MCOSD is shifting its fuel reduction strategy to include a combination of tools as opposed to using one or the other. MCOSD will work with Marin County Fire and local fire agencies to collectively determine the most appropriate combination of strategies to enhance community wildfire protection, including collaborating with adjacent property owners to establish and maintain effective Defensible Space zones.”

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 this location for fuel maintenance and minor modifications.

Maintain Existing Fire Roads and Conditions

Maintenance of *existing fire roads and vegetation conditions* - specifically a 100' corridor of continuous grass along fire roads in the Tiburon Ridge and Ring Mountain preserves - ought to allow safe working conditions for firefighters. With the support of firefighting aircraft which are highly effective along ridgetop grasslands, containment of the fire in the first hour may be possible. Lateral spread of the fire shown in the model is less likely to actually occur since the models do not take into account initial attack fire suppression that would take place on the lateral flanks of a fire.

SMFPD should work with MCOSD to ensure 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 at precise 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 creates gaps for establishment of invasive plants. Like all other weed control practices such as herbicides, mowing, or tilling the soil, burning has to be utilized properly 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 biomass and expose target plants to follow-up herbicide treatments. After a fire, the majority of plant material is 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).

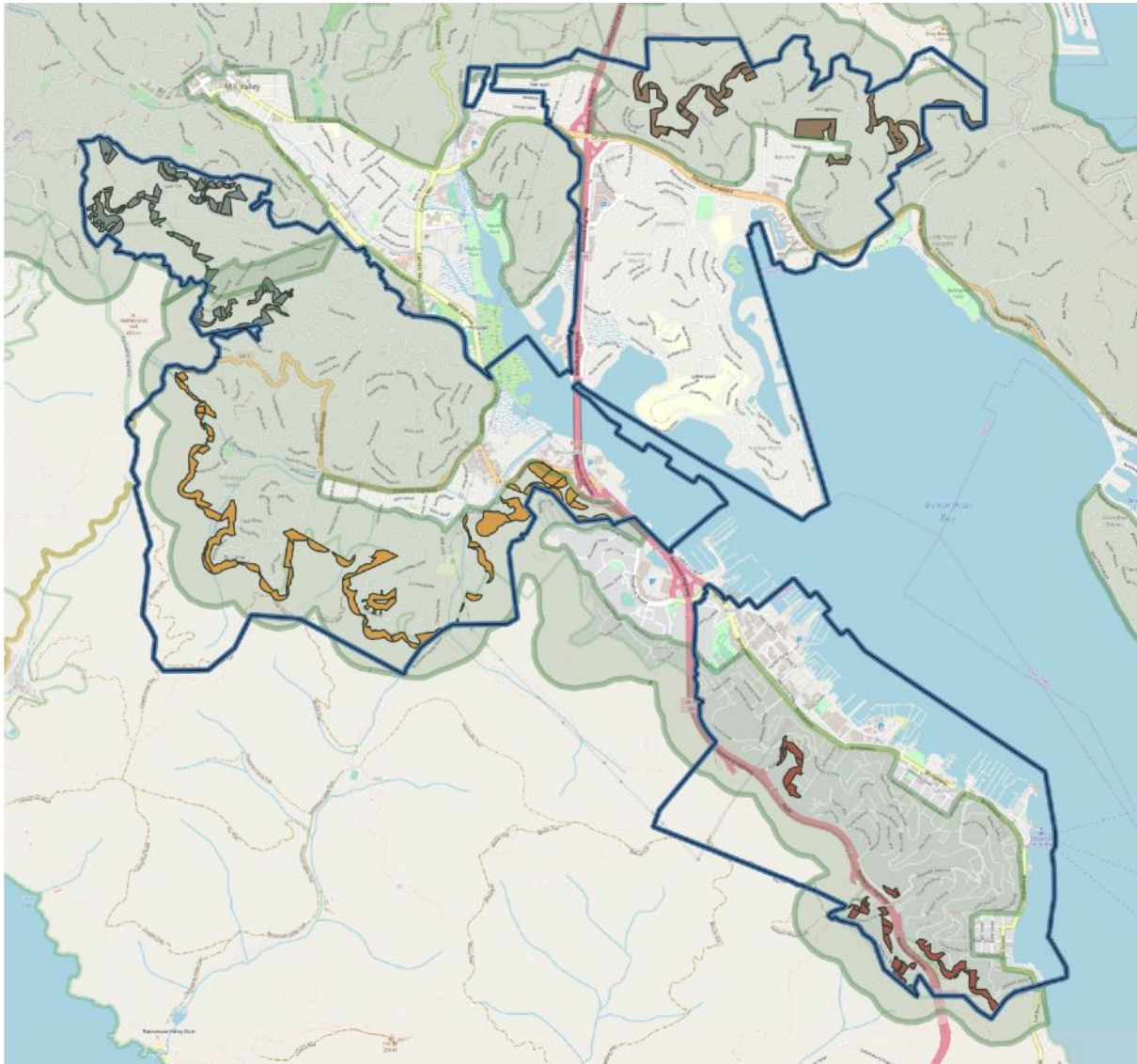
Work with Public and Private Landowners to Maintain Fuels

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. GIS analysis identified certain parcels where fuel treatment might provide the greatest benefit.

To identify parcels for fuel treatment, FlamMap modeling was compared for two distinct weather and fuel scenarios: the 2016 Marin CWPP “Extreme Weather Conditions” (97th percentile) and additional layer based on actual observed weather conditions during the October 27, 2019 Red Flag Warning fire-weather event (99th percentile).

These results identified parcels where flame-lengths are expected to exceed 8 feet within 200 feet of structures, and where no statutory responsibility exists for fuel maintenance (i.e., outside of the 100-foot Defensible Space zone and/or outside the developed parcel envelope of one or more structures). Because the parcel owners in these locations are not required to maintain vegetation, the District may consider forming partnerships with these landowners to assist in fuel reduction to mitigate hazards and benefit all District residents.

Priority Fuel Treatment Parcels



-  District Boundary
-  WUI Boundary
- Treatment Areas**
-  Alto/Tiburon
-  Homestead Valley
-  Tamalpais Valley
-  Sausalito

By working with landowners on a limited number of public and private parcels, targeted fuel modifications could potentially provide risk reduction to homes within the District. GIS analysis identified specific parcels where the District should encourage, partner, and or consider funding fuel reduction and hazard mitigation.

Specific parcels identified are listed in [Appendix D](#).

Engagement with landowners in strategic locations to coordinate fuel reduction projects that will benefit the community as a whole is recommended. Utilizing appropriate treatment techniques ([Appendix G](#)) for the vegetation present, reduce ground and ladder fuels, create shaded fuel breaks, thin canopies, maintain existing grasslands, cut annual grasses, and maintain private fire roads. District cost sharing, matching grants, or direct funding should be considered due to potential community-wide benefits.

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 likelihood that evacuees might become trapped on roadways and subjected to reduced visibility, smoke, heat or direct flame impingement.

While a majority of evacuating residents will evacuate by vehicle, it is recognized that some residents may be forced to shelter in place or evacuate by foot for a variety of reasons.

The County of Marin, through the Sheriff's Office of Emergency Services and local fire agencies, has adopted a "Mutual Threat Zone Plan" with detailed evacuation maps intended for emergency managers and responders. Southern Marin Fire Protection District is covered by the "Southern Marin" and "Ring Mountain" Mutual Threat Zones ([Appendix B](#)) and evacuation plan maps. Analysis of road conditions and potential evacuation routes for this report agree with all findings of that plan.

MTZ/Evacuation Notification Zones:

- Ring Mountain South
- Tennessee
- Countyview
- Shoreline Flats
- Marin Drive
- Northern
- Pinehill
- Erica/Chamberlain
- Greenhill
- Montford-Laverne

Overview

<p>Goal: Address community evacuation needs for wildfires and all-hazards to improve community understanding of evacuation issues and identify and improve the safety of potential evacuation routes.</p> <p>Status: Proposed</p> <p>Completed: NA</p>	<p>Timeline: 07/01/2020 - 06/30/2025</p> <p>Cost Estimate: Varies. \$250,000 - \$750,000 initial. \$25,000-\$50,000 annual maintenance.</p> <p>Implementation:</p> <ol style="list-style-type: none">1. Address roadway clearance and vegetation2. Promote “Alert Marin”3. Promote NOAA radios4. Promote improved cellular communications5. Adopt “Fire Clear” Evacuation Mapping6. Support designation of on-street parking7. Encourage off-street parking8. Conduct evacuation drills9. Consider evacuation/disaster LRAD and/or siren/horn10. Designate “Temporary Refuge Areas”11. Identify Vulnerable Populations12. Consider pets and large animals
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Recommendations to Improve Evacuation Conditions

Roadway clearance and roadside vegetation

Roadway clearance and roadside vegetation, specifically addressed in the Vegetation Management section, is critically important to secure safe evacuation routes and provide for ingress of firefighting resources. Vegetation management 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 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 (4907.3 and 4907.3), so code enforcement is critical to achieve 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), SMFPD should develop plans to encourage vegetation maintenance and consider funding partnerships to execute those plans.

Appendix D includes a list of all roadways in SMFPD's WUI areas, highlighting primary and secondary evacuation routes identified in the Marin MTZ Plan, with length of roadway and estimates of initial treatment cost based on best practices and recent Marin contracting experience.



The southern ridge forming Homestead Valley is home to particularly challenging roadside vegetation conditions. Narrow, steep roads (such as North Ferndale, pictured) create evacuation bottlenecks where roadways are likely to be exposed to flames, radiant and convective heat, embers, and blinding smoke conditions during a wildfire evacuation.

Promote “Alert Marin”

In 2015, Marin County adopted the *AlertMarin* system (www.alertmarin.org) that allows residents of all Marin jurisdictions to register their landline, cell phone or VoIP (voice over internet protocol) phone to receive emergency alerts sent by voice, text, email, or smartphone app from the County of Marin.

Emergency officials use the *AlertMarin* Emergency Notification System to deliver incident-specific information or potentially life-saving instruction to the precise geographic area(s) affected. Emergency situations may include:

- flooding, wildfires, and subsequent evacuations;
- public safety incidents including crimes that affect your neighborhood;
- and post-disaster information about shelters, transportation, or supplies.

Individuals may list up to five addresses per profile where they wish to receive notifications such as home, at work, at a child’s school, or a relative’s home. Each profile may contain up to two SMS (text) devices, two email addresses, a TTY device, four phone numbers (including a

mobile phone number) and a work phone number. An *AlertMarin* “*ContactBridge*” application is also available for Apple iOS or Android devices.

SMFPD should recommend that all Southern Marin residents sign up for this service and become familiar with receiving information from *AlertMarin*.

During wildfires, there is often 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.

Promote Adoption of NOAA Alerting Weather Radios

NOAA Weather Radio are excellent sources of information during emergencies, especially when power and/or communications infrastructure is disabled. Prices vary from \$20 up, depending on the model. Many receivers have an alerting feature that will trigger audible and visual alarms when weather warnings or evacuation or other emergencies are transmitted³³. Most models are battery operated, often with 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 system as 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 unable to receive Alert Marin notices. Multiple NOAA evacuation alerts were successfully transmitted in Sonoma County during the October 2019 Kincade Fire.

SMFPD should encourage local adoption of these radios, and consider subsidizing the initial purchase cost for vulnerable or low-income residents.

Promote Improved Cellular Communications

Recognizing that issues around the construction and placement of cellular communications equipment in Marin has contributed to an ongoing political debate, SMFPD might consider adopting a formal stance requesting that carriers work to improve cellular communication connectivity in Southern Marin. Cellular sites and wireless data transmissions may provide critical evacuation alerts, emergency communication, 911 system access, and critical updates to residents and visitors to Southern Marin. Without reliable wireless communications for residents, systems such as *AlertMarin* are ineffective.

Improvements to cellular communications may result from upgraded equipment, improved siting, and/or installation of new communication sites. Existing or potential new sites should be:

³³ <https://www.nws.noaa.gov/nwr/info/nwrrcvr.html>

- A. Evaluated for wildfire hazard;
- B. constructed of maximally fire resistant materials and design;
- C. maximally compatible with existing devices;
- D. backed up with generator power adequate for 96+ hours of operation during power outages;
- E. inspected annually for adequate Defensible Space; and
- F. considered for community concerns in balance with the need for emergency communications.

Create and Distribute Neighborhood Scale “Fire Clear” Evacuation Maps

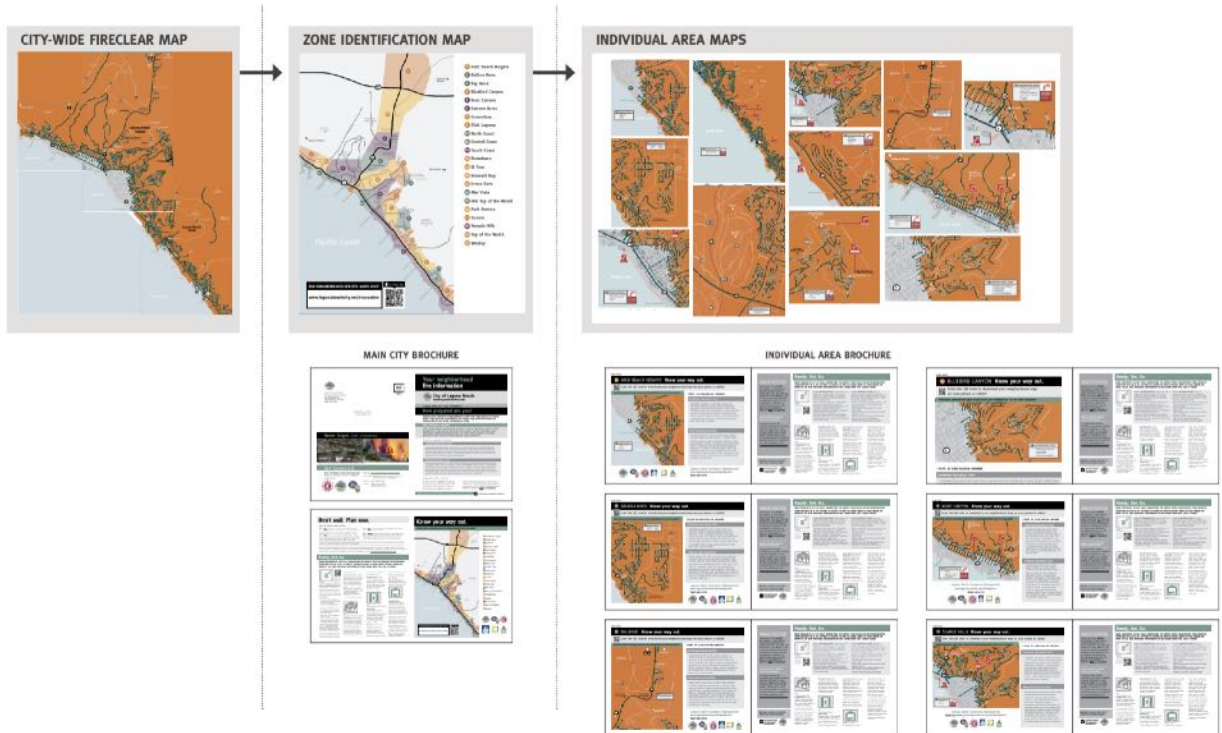
Proposed Local Evacuation Route Mapping for SMFPD: “Fire Clear”

SMFPD should consider adoption of the “Fire Clear” Evacuation route mapping program, currently under development by at least two Marin local agencies (Novato Fire Protection District and Town of Fairfax).

Adoption of the “Fire Clear” evacuation preparedness program would include: develop, print, and distribute custom educational pamphlets outlining evacuation best practices; mapping evacuation routes for the entirety of the SMFPD; and highlighting evacuation steps recommended by FIRESafe MARIN and neighboring agencies.

Examples of the Fire Clear wildfire evacuation maps and brochures are 11x17 full-color brochure, bifold, printed on both sides on heavy paper with a UV laminate for durability. On one side contains a full-color evacuation map of the target neighborhood (following MTX evacuation zones, see [Appendix B](#)), highlighting primary and secondary evacuation routes, direction of travel, potential safety zones, and rallying points/community refuge areas. The other side contains text information including evacuation checklists, emergency contact numbers/blank communications plans, and QR codes leading to additional, or more in-depth information. Any educational material must provide specific information on:

- Routes of travel
- Shelter-in-Place vs Evacuation
- Safety Zones
- Rallying points/Community Refuge Areas



Fire Clear Evacuation Map Campaign Sequence.

ZONE AREA

4 RIDGEWAY Know your way out.

Scan this QR code to download your neighborhood map on your phone or tablet!

Familiarize yourself with major routes out of your neighborhood in case of an evacuation.

EMERGENCY ALERTS & FIRE INFORMATION

WILDFIRES CAN STRIKE SUDDENLY AND WITHOUT WARNING. EMERGENCY MANAGERS WILL ATTEMPT TO NOTIFY RESIDENTS WHEN EVACUATION IS NECESSARY, BUT THIS IS NOT ALWAYS POSSIBLE. ADVANCE PREPARATION AND SITUATION AWARENESS ARE REQUIRED.

ALERT MARIN: Emergency Notifications and Evacuations

For ACTION at a specific ADDRESS

- Critical evacuation and life safety information, during emergencies, to specific addresses.
- Voice, Text, and Email messages

To register visit www.alertmarin.org

NIXEL: Information Notices

For INFORMATION to an entire ZIP CODE

- General information and less critical updates to larger populations, by zip code only.
- Text messages only

To register, text your zip code to 888777

AM/FM RADIO, SOCIAL MEDIA: Bay Area News; Twitter, Facebook

Monitor **FM 106.9, AM 740 (KCBS); AM 810 (KGO); FM 88.5 (KQED); FM 92.3; FM 90.5; FM 89.9 (KWMR)**

Facebook: @OurTownNovato, @NovatoPolice, @NovatoFireDistrict;
 Twitter: @TweetchNovato, @NovatoPolice, @NovatoFireDist;
 NOAA Radios: tune to 162.500 or 162.400 (same code 006041)

EVACUATION SAFETY TIPS

What to where?
 Wear goggles, leather gloves, and heavy shoes/boots; protect skin with long cotton or wool clothing; protect airway and face with an N95, mask and bandanna. Wear a hat to protect hair from embers.

Where to go? Avoid hillsides. Head for a valley floor by car, away from the fire if possible.

Last resort... Go on foot or bicycle only if no other option exists. Sheltering indoors or in a car is usually safer than being exposed outside.

Never evacuate uphill, on fire roads, or into open spaces where there is unmaintained vegetation.

Don't panic in traffic inside a car on pavement is one of the safest places during a wildfire.

Sample individual zone map (front page). The routes and information shown on this or any adopted local evacuation map should not contradict the County of Marin “Southern Marin and Ring Mountain Mutual Threat Zone” evacuation plan maps ([Appendix C](#)).

Support Designation of On-Street Parking, Encourage Off-Street Parking

Work with the County of Marin Department of Public Works to consider designating on-street parking spaces that are compliant with clearance requirements (similar to those designated on Christmas Tree Hill near Corte Madera and some locations in Mill Valley) to encourage legal on-street parking. In some instances, these efforts could result in an increase in the net on-street parking spaces due to the clearance of vegetation to make room for a dedicated parking space.

This work should also take place with the roadways that are not county-maintained. For these roadways, typically the owners of the adjacent properties have responsibility for the roadway and appropriate clearing. In many cases there is vegetation or structure (e.g retaining wall) in the right-of-way and immediately adjacent to the roadway surface. For these conditions, identifying and selecting locations for designated on-street parking will be more difficult. For example, in Tam Valley, many paved roadways are NOT maintained by county or local agencies.

Evacuation Drills

Consider adoption of annual or biannual evacuation drills to be conducted in cooperation with SMFPD, Marin County Sheriff's Office, and MCFD. SMFPD should work with local law enforcement agencies to facilitate the drills. Modeled around the multi-agency examples set in Mill Valley, Kentfield, and Novato, these drills have proven to be an excellent education opportunity for both residents and the fire service and law-enforcement. The Marin Humane Society and the American Red Cross should be invited to attend and/or participate as well.

Installation of Long Range Acoustic Device (LRAD) for Evacuation Alerts

SMFPD should consider potential benefits and drawbacks 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.

The City of Mill Valley installed a network of 5 LRAD devices in 2019 at Cascade, Blithedale and Warner Canyons, plus Scott Valley and atop Mill Valley City Hall.

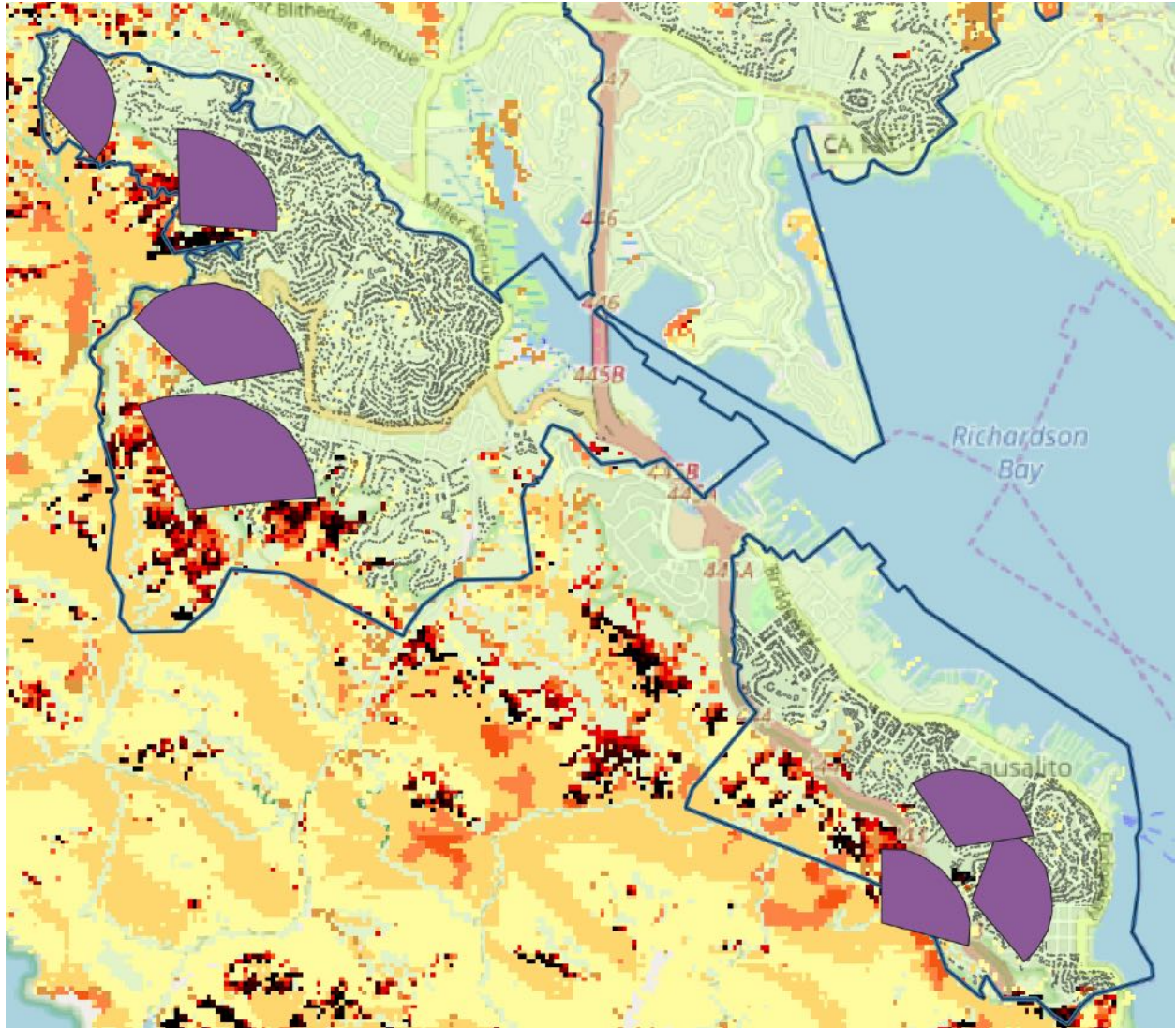
When considering LRQAD or other audible warning systems like "air-raid" sirens or horns, it's important to understand their limitations and use cases. These devices are typically audible outdoors for up to 1KM or more in ideal conditions (low ambient noise, calm air, clear skies). Testing shows that LRAD is audible indoors only within 100-300 meters of the transmitter.

With an installed cost for LRAD devices of approximately \$300,000 each³⁴, the system's effectiveness must be critically evaluated. In order to "blanket" SMFPD's area with audible warnings, a huge network of LRAD devices would be required. A more reasonable and cost effective approach would be the identification of the most vulnerable neighborhoods, with placement of devices nearest the highest risk locations where early evacuation will serve the greatest benefit. Areas where evacuation routes are constrained, where evacuation routes are located on vulnerable, mid-slope roads, or where concentrations of vulnerable residents exist should be considered first. Locations where fire modeling predicts extreme fire behavior, with high flame lengths and rapid rates of spread should be considered as well.

Potential LRAD locations based on a review of fire behavior, terrain, and population include:

- Marin Drive (Tam Valley)
- Eastwood Park (Tam Valley)
- North Ferndale (Homestead Valley)
- Castle Rock Dr (Homestead Valley)
- Wolfback Ridge (Sausalito)
- Prospect Ave (Sausalito)
- Glen Drive (Sausalito)

³⁴ <http://www.cityofmillvalley.org/fire/emergency/warnings.htm>



Example LRAD Locations, with 600m-1000m coverage arcs.

Designate Temporary/Community Refuge Areas

SMFPD should consider the adoption of designated Temporary/Community Refuge Areas. 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 are compromised during a wildfire, formal alternate safety zones should be established. Potential candidate locations for safety zones are the irrigated playing fields at local public and private schools, community centers (Tam Valley, Strawberry, Homestead Valley, and Almonte), parks and open spaces, 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.

SMFPD should work with facility administrators to review site options and issues and develop joint plans for use of these locations during a wildfire when evacuation is not possible. In addition, SMFPD should work with the agency managing these locations to suggest and implement any vegetation management actions that will improve the viability of the locations as refuge sites.

Vulnerable Populations

- Elderly
- Disabled
- Pet/Large Animal Owners
- Students/Schools

Animal Evacuation

Consider Pets, Large Animal, and Livestock Evacuation

Recent catastrophic events, including the Valley Fire in 2015 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) due to the failure to locate animals or lack of preparation 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.

Disaster and wildfire preparedness for equine and large animal owners may differ somewhat from disaster preparedness for domestic pet owners; however, general guidelines and recommendations are similar.

During a wildland fire, local animal rescue organizations (primarily the Marin Humane Society) 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.

Work with Marin Humane Society to Complete Animal Inventory and Database

Consider working with Marin Humane Society to promote voluntary registration and ensure that the Humane Society's existing database of large animals and livestock is complete and current for Southern Marin. At a minimum, the database should contain:

- Type of animal
- Animal name

- Animal location
- Owner contact information
- A photograph of the animal
- Special concerns or access notes.

Conduct Animal Evacuation Exercises

The Marin Humane Society is tasked with animal evacuation and care responsibilities in Marin and should be invited to attend planned evacuation drills in Southern Marin. All large animal and pet owners should be encouraged to participate in annual evacuation drills. Additional training should be conducted in conjunction with exercises of emergency response plans and procedures to ensure large animal issues are addressed. Emergency plans should be activated at least once a year in the form of a simulated emergency to provide practical controlled operational experience to residents, fire department staff, and volunteers.

Provide Educational Materials and Checklists to Animal Owners

Consider adopting and distributing a custom pamphlet or brochure for distribution to large animal and pet owners outlining specific recommendations, with checklists for preparation.

Educational materials for emergency preparedness for animals should include the following tips and information:

Animal Evacuation Tips

Animal owners must provide an appropriate standard of care for their animals at all times, including during emergencies, disasters, and evacuations. It may not always be possible to evacuate horses or livestock, but having a plan in place for a potential evacuation is important.

Prepare for future evacuations

- Develop an emergency evacuation plan for all animals.
- Know where to take animals in the event of an emergency, and be familiar with at least two possible evacuation routes.
- Most owners affected by disasters and needing to evacuate should take their animals to stay with friends or family. Self-reliant behavior should be encouraged at all times.

Prepare for imminent evacuation

- When a fire is burning in the area, or it becomes known that evacuation is possible, make arrangements quickly and in advance to move livestock from the danger zone.
- Large animals should be moved to a confined area where they can be easily controlled in the event evacuation becomes necessary.
- Gather small animals in crates and carriers and keep near vehicles.
- Keep halters and leads ready.
- Have a trailering and transportation plan in place.

Be ready to shelter in place

- Prepare a portable first aid kit, as well as several days' supply of water, hay, feed and medications.
- Consider alternative methods of watering your animals, as water supplies can become contaminated.

Make sure your animals have identification

- Wildfire and severe weather can damage fencing and containment structures like barns, potentially allowing animals to leave your property.
- Proper identification for large animals includes a combination of metal tags and microchips, helping to quickly identify animals and ensure their safe return.
- Visible identification should include the owner's name and contact information.

Provide safe containment

- Owners may not be home, and may not be able to return to your home to evacuate animals once a fire starts.
- Barns and stalls should be accessible to the fire service and neighbors, to allow access during wildfires and other emergencies.
- High perches, ledges and access to high ground can be a lifesaver for poultry, livestock and other animals in an emergency.

After evacuation

- While at an emergency shelter, provide hay, feed, and medications if needed, for a minimum of several days.
- Owners should be prepared to provide all proper care for their animals while at a shelter.

The FIRESafe MARIN website has dedicated web pages with information on evacuating small pets (<https://www.firesafemarin.org/evacuation/pets>) and large animals/livestock (<https://www.firesafemarin.org/evacuation/large-animals>).

Fire Roads and Evacuation

During public meetings, residents asked about the feasibility of evacuation by fire road. An analysis of fire road locations using GIS data and imagery available from MarinMap.org considered potential fire behavior including flame length (FL) and rate-of-spread (ROS) from the 2016 Marin CWPP in proximity to these locations.

- 1. An analysis of fatalities during the Camp Fire (2018, 86 fatalities³⁵) and North Bay Fires (2017, 43 fatalities) found NO deaths of evacuating residents who remained inside their vehicles on paved roads. Of the nearly 130 fatalities, a majority died inside their homes. Of those that die while evacuating, nearly all were outside of vehicles and/or on rural, unpaved roads.**
- 2. Based on the analysis of fire road locations and modeling to estimate potential FL and ROS, there are *no likely wildfire scenarios where self-evacuation by residents via unpaved fire roads would be safer than evacuation via paved surface roads.***

An analysis of fire fatalities and locations in both the 2017 Tubbs Fire (23 fatalities, Sonoma county)³⁶ and the 2018 Camp Fire (86 fatalities, Butte county)³⁸ showed that there were no fatalities of evacuees who *remained in their vehicles on paved roads*. In fact, fatalities of evacuees in vehicles occurred on unpaved (fire or rural) roads exclusively, or when vehicles left the roadway into unburned or burning vegetation.

It is conceivable that fire personnel, law-enforcement officials, or fire Incident Commanders could determine in *specific instances* that alternate evacuation routes, including by fire road, might be necessary or recommended. In those instances, the authority of the emergency personnel should be observed and followed, even if it means deviating from pre-designated evacuation routes or the recommendations set forth in this report.

Fire Road Evacuation Assessment

“Fire road” refers to unpaved roads intended to allow firefighting apparatus access to remote areas where wildfires are likely to occur. In some cases, these roads may be used

³⁵ <https://www.mercurynews.com/2018/12/13/map-a-representation-of-where-residents-died-in-camp-fire/>

³⁶ <https://www.latimes.com/local/lanow/la-me-northern-california-fire-victims-20171016-htmllstory.html>

³⁷

<https://www.mercurynews.com/2017/10/11/hundreds-missing-in-wine-country-fires-here-are-some-of-their-stories/>

³⁸ <https://www.mercurynews.com/2018/12/13/map-a-representation-of-where-residents-died-in-camp-fire/>

for other emergency access (e.g., medical emergencies) or recreational uses such as mountain biking, horseback riding, or hiking.

A network of existing fire roads exists along the ridges to the south and west of Tamalpais Valley and Homestead Valley. These fire roads are primarily converted ranch roads or roads that were installed specifically for the purpose of accessing and suppressing wildfires. Some of the roads first appear on area maps in the 1890s and were often installed without extensive engineering. Most of these roads are located on GGNRA or MCOSD public lands.

In the 2005 Unit Strategic Fire Plan, MCFD emphasizes the importance of the existing network of fire roads for firefighter access and potential control lines during wildfires.

Fire road maintenance has historically fallen on cooperation between landowners and MCFD, and more recently, MCOSD.

These fire roads are characterized by unpaved surfaces, often deeply rutted, with seasonal washouts, steep slopes, washboard surfaces, and rocks and other obstructions that make passage by four-wheel-drive vehicle necessary. Few turnouts exist for passing, road widths average 12-16 feet total (too narrow to allow two vehicles to pass safely), and steep drop offs, ruts, and washouts that are often concealed by overgrown vegetation.

- Evacuation of residents via fire roads during wildfires is not feasible or recommended.
- Paved surface streets in the District are generally adequate to support the safe evacuation of residents downhill and down valley to evacuate during a wildfire.
- Typical roadway widths, even on many hillside streets, will support vehicle turnouts and passage of evacuating residents while fire apparatus respond uphill.
- Fire agencies are unlikely to commit apparatus to roadways where large numbers of residents are evacuating, so resident fears of roads being blocked by incoming firefighting resources (expressed during public meetings) are largely unfounded.
- Area fire roads are not adequately maintained to support passenger vehicles.
- There were NO adequate safety zones or refuge areas identified in the vicinity of fire roads.
- High clearance four-wheel-drive vehicles are required to safely navigate nearly all fire roads in Marin.
- Passing vehicles on fire roads is not adequately supported by turnouts or road width.
- Fire modeling shows that nearly all fire roads in the vicinity of Southern Marin's response area could potentially be impacted by high or very high flame lengths. Fire roads, by virtue of their location in wildlands, and confirmed by hazard analysis,

are more likely to be impacted by fire than paved roads and present a greater threat to the safety of evacuating residents than would be present on paved roadways.

- Signage does not exist on fire roads to lead evacuating residents to safe areas. Although this could be overcome with the installation of signs, unfamiliarity with the fire roads is likely to lead to confusion and potential traffic jams.
- Locked gates, including those leading to private property, are likely to cause entrapments and potentially expose evacuating residents to impingement by wildfire.
- Some communities have designated evacuation routes by “steps, lanes, and paths,”³⁹. This concept can be considered on a case-by-case basis; however, data from recent wildfires does not support the safety of evacuation on foot.



Fire roads - many deeply rutted and lacking signage - require high-clearance four-wheel drive vehicles to navigate safely. Few fire roads lead to a safer location. Residents attempting to “evacuate” by fire road would likely be impacted by fire conditions more severe than on paved surface roads. The risk of entrapment behind locked gates is another factor discouraging use for evacuation. Residents should be encouraged to stay on pavement, inside their vehicles while evacuating.

³⁹ <http://www.cityofmillvalley.org/Index.aspx?page=875>

SUMMARY OF RECOMMENDATIONS

The following Table provides a summary of mitigation measures and recommendations described in this report.

Mitigation Measure	Summary Recommendations
Public and Community Outreach	<ol style="list-style-type: none"> 1) Promote <i>Living With Fire</i> seminars and booklet in even years 2) Print and mail evacuation pamphlets in odd years 3) Expand the www.SMFPD.org website to include the Firewise USA® recommendations from this report 4) Conduct mailings to build awareness of projects and mitigation efforts
Wildfire Preparedness and Planning	<ol style="list-style-type: none"> 1) Reducing Structural ignitability <ol style="list-style-type: none"> A) Consider wood shake roof replacement grant program B) Encourage fire resistant building construction C) Create an Enhanced Parcel Inspection Database to monitor building and parcel characteristics 2) Improving Defensible Space <ol style="list-style-type: none"> A) Improve Defensible Space around all structures B) Conduct annual Chipper Days C) Expand hazard inspections and notices D) Enhance Defensible Space on priority risk parcels E) Support removal of specific hazard plant species F) Adopt a hazard tree removal program G) Conduct Resale Inspections 3) Promoting Firewise USA ® Recognition <ol style="list-style-type: none"> A) For all WUI communities B) For areas specifically identified in the hazard assessment
Non-Residential Vegetation Management	<ol style="list-style-type: none"> 1) Manage roadside vegetation 2) Work with GGNRA and MCOSD to maintain fuels 3) Maintain existing fire roads and conditions 4) Use fire for invasive species control 5) Work with public and private landowners to maintain fuels using targeted fuel modifications for areas identified in the hazard assessment
Evacuation Planning and Preparation	<ol style="list-style-type: none"> 1) Address Roadway Clearance and Vegetation 2) Promote "Alert Marin" 3) Promote NOAA radios 4) Promote improved Cellular Communications 5) Create and Distribute Educational Pamphlet and Evacuation Maps 6) Adopt Community Emergency Response Training (CERT) 7) Support Designation of on-street parking 8) Encourage off-street parking 9) Conduct Evacuation Drills 10) Consider Evacuation/Disaster LRAD and/or Siren/Horn 11) Designate "Temporary Refuge Areas" 12) Consider Pets and Large Animals

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APPENDIX A

Glossary

Where applicable, definitions are excerpted from 14 CCR § 1271.00 § 1271.00.

Accessory building: Any building used as an accessory to residential, commercial, recreational, industrial, or educational purposes as defined in the *California Building Code, 1989 Amendments, chapter 11, group M, division 1*.

Agriculture: Land used for agricultural purposes as defined in a local jurisdiction's zoning ordinances.

Bark Beetle: An insect that bores through the bark of trees to eat the inner bark and lay its eggs.

Building: Any structure used or intended for supporting or sheltering any use or occupancy that is defined in the California Building Code, 1989 Amendments, chapter 11, except group M, division 1, Occupancy. For the purposes of this subchapter, building includes mobile homes and manufactured homes, churches, and daycare facilities.

CAL FIRE, CDF: California Department of Forestry and Fire Protection. The State of California agency ultimately responsible for fire protection and suppression in the SRA. In Marin County, CAL FIRE is represented by Marin County Fire Department by contract.

Canopy/Crown: The more or less continuous cover of branches and foliage formed collectively by the crowns of adjacent trees.

Conifer: A tree that produces cones, such as redwood, pine, spruce, or fir species.

CRA/TRA: Community Refuge Area, or Temporary Refuge Area. A sheltered location that may serve as a safety zone or refuge area, primarily during wildfire evacuations in the WUI, for evacuating residents unable to safely egress from the path of a fire. Typically at least 30' to 100' from combustible vegetation and protected from terrain and topographical features to provide protection from radiant and convective heat. Playing fields, parking lots, and other unvegetated open areas are common examples. May be designated or unofficial.

Crown: The part of a tree, or other woody plant, bearing live branches and foliage.

Crown Fire (crowning): A fire that advances through the crown fuel layer (typically tree canopies) normally in direct conjunction with a surface fire. Three categories of "crowning" are recognized (passive, active, and independent); they are determined by three crown fuel properties (live crown base height, foliar moisture content and bulk density) and two characteristics of fire behavior (spread rate and surface intensity).

CWPP (Community Wildfire Protection Plan): A CWPP is a plan developed by a community in an area at-risk from wildland fire. The CWPP is a collaborative product involving interested parties, local

government, local firefighting agencies, the state agency which oversees forest management and, if present in the vicinity, federal land management agencies. Southern Marin Fire Protection District is included in the Marin County CWPP 2016. With additional community input, this report would meet the definition of a CWPP.

Dead-end road: A road that has only one point of vehicular ingress/egress, including cul-de-sacs and looped roads.

Defensible space: The area within the perimeter of a parcel, development, neighborhood or community where basic wildland fire protection practices and measures are implemented, providing the key point of defense from an approaching wildfire or defense against encroaching wildfires or escaping structure fires. The perimeter as used in this regulation is the area encompassing the parcel or parcels proposed for construction and/or development, excluding the physical structure itself. The area is characterized by the establishment and maintenance of emergency vehicle access, emergency water reserves, street names and building identification, and fuel modification measures. Also see "Survivable Space."

Defensible Space Zone: A type of fuel modification zone established between a developed area and the surrounding undeveloped areas for the purpose of reducing the potential for wildfires to spread between the two areas. Typically 0-100' from structures, and not more than 200' from structures.

Density (Stand): The number of trees growing in a given area usually expressed in terms of trees per acre.

Development: As defined in section 66418.1 of the California Government Code.

Diameter Breast Height (DBH): Tree diameter, measured 4.5 feet above ground.

Direct Attack: Line is constructed adjacent to the fire perimeter: usually the preferred method, because of immediate access to escape routes and safety zones. Used when fire behavior, weather and fuel permit. Directly related to individual experience, escape routes and safety zones. Usually involves burnout of interior fuels as the line construction progresses or the fire is allowed to burn into the fire line.

Director: Director of Southern Marin Fire Protection District (elected or appointed).

Domestic Animals: animals that have been domesticated by humans by having their behavior, life cycle or physiology systematically altered as a result of generations of human control.

Driveway: A vehicular access that serves no more than two buildings, with no more than 3 dwelling units on a single parcel, and any number of accessory buildings.

Dwelling unit: Any building or portion thereof which contains living facilities, including provisions for sleeping, eating, cooking and/or sanitation for not more than one family.

Ecosystem: A functional unit consisting of all the living organisms in a given area, and all of the non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be of any size, but it always functions as a whole unit.

Ember (or “Firebrand): a small piece of burning material, often carried aloft by convective heat or wind during wildfires.

Ember Wash, Ember Shower: A mass of firebrands blown ahead of the main fire, capable of igniting multiple spot fires.

Escape Route: A route to access a safety zone.

Exception: An alternative to the specified standard requested by the applicant that may be necessary due to health, safety, environmental conditions, physical site limitations or other limiting conditions such as recorded historical sites, that provides mitigation of the problem.

FEMA (Federal Emergency Management Agency): A federal agency with the mission “to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards.”

Fuel modification area: An area where the volume of flammable vegetation has been reduced, providing reduced fire intensity and duration.

Extreme Fire Behavior: "Extreme" implies a level of fire behavior characteristics that ordinarily precludes methods of direct control action. One or more of the following is usually involved: high rate of spread, prolific crowning and/or spotting, the presence of fire whirls, strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

Fine Fuels: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a time lag of one hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

Fire Behavior: How fire reacts to the influences of fuel, weather and topography.

Fire Hazard: The ease of ignition and resistance to control of a fuel source.

Fire Intensity: A general term relating to the heat energy released by a fire.

Fire Line: A linear fire barrier that is scraped or dug to mineral soil.

Fire Risk: The probability or chance of fire starting in a given location, determined by the presence and activities of causative agents.

Fire Severity: A relative measure of the post-fire appearance of vegetation as it relates to the intensity of the fire and the consumptive effects on vegetation.

Fire Suppression (Fire Control): All of the work and activities connected with fire extinguishing operations, beginning with discovery and continuing until the fire is completely extinguished.

Firefighter Safety: A work environment where foreseeable risks have been minimized through the mitigation of known hazards associated with wildfire suppression.

FlamMap: A computer fuel and fire behavior prediction model developed by the USDA Forest Service at the Intermountain Forest Fire Research Laboratory. Additional information regarding FlamMap can be found at the following website: <http://www.firemodels.org/content/view/14/28/>

Forb: A herbaceous flowering plant that is not a graminoid (grasses, sedges and rushes). The term is used in biology and in vegetation ecology, especially in relation to grasslands and understory.

Forest Health: The condition in which forest ecosystems sustain their complexity, diversity, resiliency, and productivity while providing for human needs and values.

Fuel: Combustible material that includes vegetation such as grass, leaves, ground litter, plants, shrubs and trees. (See Surface Fuels.) Includes both living plants; dead, woody vegetative materials; and other vegetative materials which are capable of burning.

Fuel Break (or fuelbreak): A zone in which fuel quantity has been reduced or altered to provide a position for suppression forces to make a stand against wildfire. Fuel breaks are designated or constructed before the outbreak of a fire. Fuel breaks may consist of one or a combination of the following: Natural barriers, constructed fuel breaks, man-made barriers.

Fuel Loadings: The oven dry weight of fuels in a given area, usually expressed in tons per acre. Fuel loadings may be referenced to fuel size or time lag categories; and may include surface fuels or total fuels. The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area.

Fuel Modification Zone: A specific area where vegetation has been removed, planted, or modified in ways that increase the likelihood a structure will survive a wildfire, improve the Defensible Space around that structure needed for firefighting activities, and prevents direct flame contact with structures. Vegetation includes native and ornamental plants, non-native naturalized annual grasses, and other invasive or naturalized species. Fuel modification activities can include removal, partial or total replacement of existing plants with adequately spaced drought-tolerant and fire-resistant species, and thinning of existing native or ornamental species.

Fuel Management: Manipulation or reduction of flammable matter for the purpose of reducing the intensity or rate of spread of a fire, while preserving and enhancing environmental quality.

Fuel Reduction: Manipulation, including combustion or removal of fuels, to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control.

Geographic Information System (GIS): Computer software that provides database and spatial analytic capabilities. Often used to analyze the spatial characteristics of vegetation, fuels, development patterns, and terrain.

Greenbelts: A facility or land-use, designed for a use other than fire protection, which will slow or resist the spread of a wildfire. Includes parking lots, irrigated or landscaped areas, golf courses, parks, playgrounds, maintained vineyards, orchards or annual crops that do not cure in the field.

Ground Fuels: All combustible materials below the surface litter layer. These fuels may be partially decomposed, such as forest soil organic layers (duff), dead moss and lichen layers, punky wood, and deep organic layers (peat), or may be living plant material, such as tree and shrub roots (Miller 1994).

Hammerhead/T: A roadway or driveway feature that provides a “T” shaped, three-point turnaround space for emergency equipment, being no narrower than the road that serves it.

Hazard: Any real or potential condition that can cause injury, illness, or death of personnel, or damage to or loss of equipment or property.

Hazard Reduction: Any treatment of a hazard that reduces the threat of ignition and fire intensity or rate of spread.

Heavy Fuels: Fuels of large diameter such as snags, logs, large limb wood, that ignite and are consumed more slowly than light fuels.

Hydrant: A valved connection on a water supply/storage system, having at least one 2 1/2 inch outlet, with male American National Fire Hose Screw Threads (NH) used to supply fire apparatus and hoses with water.

IFTDSS: Interagency Fuel Treatment Decision Support System. A web-based, service-oriented framework architecture for fuels treatment planning. Developed by Sonoma Technology, Inc of Petaluma for the US Joint Fire Science Program, and used extensively in the development of the Marin County CWPP 2016 and this report for wildfire modeling and hazard and risk analysis.

Ignition Prevention Zone: A type of fuel modification zone designed and managed to minimize and, if feasible, reduce the chance of a fire igniting.

Ingress/Egress/Access zone: A type of fuel modification zone designed and managed to ensure that patrol, maintenance, fire, and other emergency vehicles have unobstructed roadway access.

Initial Attack: An aggressive suppression action by the Fire Department, typically immediately after the first report of a fire, characterized by an assessment of conditions, evacuation and rescue of threatened people and animals, attempts to halt the spread of fire, and requests for additional firefighting resources if needed. Actions are consistent with firefighter and public safety and the values and assets to be protected.

Invasive Species: A species whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health. Invasive species reduce biodiversity by displacing native organisms, bring about changes in species composition, community structure, or ecosystem function. Not all nonnative plants are invasive. Only a small minority of the thousands of species introduced to California has escaped cultivation, and a minority of those has established problematic populations in natural areas.

Ladder Fuels: Fuels which provide vertical continuity between strata. Fire is able to carry from the surface fuels by convection into the crowns with relative ease.

Light Fuels: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a fuel moisture time-lag of one hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

Live Fuels: Living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms, rather than by external weather influences.

Live Fuel Moisture: The moisture content of living vegetation fuels, expressed as a percentage of the total mass of a standard foliage sample. Fluctuates seasonally according to plant life cycles, rainfall, ground and atmospheric moisture, and plant health. Lower live fuel moistures contribute to increased fire behavior.

Livestock: cattle, horses, sheep, goats, pigs, poultry and other animals typically associated with agriculture, farming, food production, and recreation.

Local Jurisdiction: Any county, city/county agency or department, or any locally authorized district that issues or approves building permits, use permits, tentative maps or tentative parcel maps, or has authority to regulate development and construction activity.

Native Species: Species that are indigenous to a region: not introduced or exotic.

Occupancy: The purpose for which a building, or part thereof, is used or intended to be used.

One-way road: A minimum of one traffic lane width designed for traffic flow in one direction only.

Overstory: The portion of the trees that form the uppermost canopy layer in a forest of more than one story.

Pets: Domestic animals commonly kept as household companions.

PRC 4291: The California Public Resources Code section that defines Defensible Space and actions that must be taken by property owners to protect structures from wildfire.

Prescribed Fire: The intentional application of fire to wildland fuels in either their natural or modified state under such conditions as will allow the fire to be confined to a predetermined area and at the same time to produce the intensity of heat and rate of spread required to further certain planned objectives (i.e., silviculture, wildlife management, etc.). Any fire ignited by management actions under certain, predetermined conditions to meet specific objectives related to hazardous fuels or habitat improvement. A written, approved prescribed fire plan must exist, and CEQA requirements must be met, prior to ignition.

Project: An organized effort to achieve an objective, identified by location, activities, outputs, effects, and time-period and responsibilities for execution.

Pyrophytic plants (pyrophyte): Referred to in this document as “fire-prone” plants, sometimes known as pyrophytic, pyrophytes, or more accurately, prophasic. Plants that have adapted to tolerate fire and/or to require fire for regeneration. Typically burn with greater intensity, and a higher likelihood of burning, than plants without specific adaptations for fire.

Riparian: A geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it. This includes floodplains, woodlands, and all areas within a specified distance from the normal line of high water of a stream channel, or from the shoreline of a standing body of water.

Roads, streets, private lanes: Vehicular access to more than one parcel; access to any industrial or commercial occupancy; or vehicular access to a single parcel with more than two buildings or four or more dwelling units.

Roadway: Any surface designed, improved, or ordinarily used for vehicle travel.

Roadway structures: Bridges, culverts, and other appurtenant structures which supplement the roadway bed or shoulders.

Open Space: Undeveloped land, either under public or Private ownership, but most often referring to parklands maintained by the Marin County Open Space District.

Safety Zone (SZ): Areas that are fuel free zones that are incapable of burning. They afford a very high degree of firefighter or public safety from an advancing wildfire. They can be natural or human made fire resistant areas such as irrigated fields, dirt, gravel or asphalt parking lots, roads and areas already burned.

Shoulder: Roadbed or surface adjacent to the traffic lane.

Spot Fire: A fire ignited by firebrands landing in flammable fuels, usually ahead of the main fire.

State Responsibility Area (SRA): The area in the state where the State of California has the primary financial responsibility for the prevention and suppression of wildland fires. *As defined in Public Resources Code sections 4126-4127; and the California Code of Regulations, title 14, division 1.5, chapter 7, article 1, sections 1220-1220.5.*

Structure: That which is built or constructed, an edifice or building of any kind, or any piece of work artificially built up or composed of parts joined together in some definite manner.

Subdivision: As defined in section 66424 of the Government Code.

Suppression: The act of extinguishing or confining a fire.

Survivable Space: The area within the perimeter of a parcel, development, neighborhood or community where more intensive wildland fire protection practices and measures are implemented, providing adequate protection from an approaching wildfire such that any structures are likely to survive without firefighters or fire suppression activity. The area is characterized by the establishment and maintenance of fuel modification and structural hardening measures in a more intensive manner than "Defensible Space."

TRA: Temporary Refuge Area. See CRA/TRA.

Traffic lane: The portion of a roadway that provides a single line of vehicle travel.

Turnaround: A roadway, unobstructed by parking, which allows for a safe opposite change of direction for emergency equipment. Design of such areas may be a hammerhead/T or terminus bulb.

Turnouts: A widening in a roadway to allow vehicles to pass.

Understory: The portion of vegetation that is underneath the dominant tree canopy.

Urban Conflagration: The potentially catastrophic ignition of multiple structures in a wildland urban interface fire, with ignitions occurring structure to structure, either through radiant heat, direct flame impingement, or firebrand ignitions.

Watershed: The drainage basin contributing water, organic matter, dissolved nutrients and sediments to a stream, lake or river.

Vertical clearance: The minimum specified height of a bridge or overhead projection above the roadway.

Wildfire (Wildland Fire, Wildfire, Vegetation Fire): A fire, other than prescribed fire, that occurs from natural or human causes in the wildlands or on undeveloped land, primarily burning vegetation. *As defined in Public Resources Code sections 4103 and 4104.*

Wildlands: Lands that are in a natural uncultivated state, especially when they form habitat for wildlife.

WUI - Wildland Urban Interface: Includes those areas of resident human population at imminent risk from wildfire, and human developments having special significance, typically where wild vegetation and open space meet said development. These areas may include critical communications sites, municipal watersheds, high voltage transmission lines, observatories, camps, schools, and other structures that if destroyed by fire, would result in hardships to communities. These areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites, regardless of the distance involved.

APPENDIX C

Title 14 CCR

California Code of Regulations

Title 14. Natural Resources

Division 1-5. Department of Forestry and Fire Protection

Subchapter 2: SRA Fire Safe Regulations

Subchapter 3: Fire Hazard

Title 14 regulations serve the purpose of establishing minimum wildfire protection standards in conjunction with building, construction and development in SRA.

Article 2. Emergency Access Standards Road and street networks, whether public or private, shall provide for safe access for emergency wildland fire equipment and civilian evacuation concurrently, and shall provide unobstructed traffic circulation during a wildfire emergency.

Article 3. Signing and Addressing Standards To facilitate locating a fire and to avoid delays in response, all newly constructed or approved roads, streets, and buildings shall be designated by names or numbers, posted on signs clearly visible and legible from the roadway. This section shall not restrict the size of letters or numbers appearing on street signs for other purposes.

Article 4. Emergency Water Supply Standards Emergency water for wildfire protection shall be available and accessible in quantities and locations specified in the statute and these regulations, in order to attack a wildfire or defend property from a wildfire. Such emergency water may be provided in a fire agency mobile water tender, or naturally occurring or man made containment structure, as long as the specified quantity is immediately available.

Article 5. Fuel Modification and Defensible Space Standards To reduce the intensity of a wildfire by reducing the volume and density of flammable vegetation, the strategic siting of fuel modification and greenbelts shall provide

- 1. increased safety for emergency fire equipment and evacuating civilians; and*
- 2. a point of attack or defense from a wildfire.*

These regulations apply to new construction and development in State Responsibility Area (SRA) in California. These regulations are not retroactive to existing structures and facilities, unless a new use or occupancy is applied for. CAL FIRE offices and fire stations, as well as, County Planning and Building Departments can assist in modifying specific SRA boundaries. The following is a summary only for the purpose of information. Reference to the specific adopted language should be made before construction or development plans are prepared.

14 CCR § 1299.03

§ 1299.03. Requirements.

Defensible space is required to be maintained at all times, whenever flammable vegetative conditions exist. One hundred feet (100 ft.) of Defensible Space clearance shall be maintained in two distinct "Zones" as follows: "Zone 1" extends thirty feet (30 ft.) out from each "Building or Structure," or to the property line, whichever comes first; "Zone 2" extends from thirty feet (30 ft.) to one hundred feet (100 ft.) from each "Building or Structure," but not beyond the property line.

The vegetation treatment requirements for Zone 1 are more restrictive than for Zone 2, as provided in (a) and (b) below. The Department of Forestry and Fire Protection's "Property Inspection Guide, 2000 version, April 2000," provides additional guidance on vegetation treatment within Zone 1 and Zone 2, but is not mandatory and is not intended as a substitute for these regulations. This publication may be found on the Department of Forestry and Fire Protection (CAL FIRE) website.

(a) Zone 1 Requirements:

- (1) Remove all dead or dying grass, plants, shrubs, trees, branches, leaves, weeds, and pine needles from the Zone whether such vegetation occurs in yard areas around the "Building or Structure," on the roof or rain gutters of the "Building or Structure," or any other location within the Zone.*
- (2) Remove dead tree or shrub branches that overhang roofs, below or adjacent to windows, or which are adjacent to wall surfaces, and keep all branches a minimum of ten feet (10 ft.) away from chimney and stovepipe outlets.*
- (3) Relocate exposed firewood piles outside of Zone 1 unless they are completely covered in a fire resistant material.*
- (4) Remove flammable vegetation and items that could catch fire which are adjacent to or under combustible decks, balconies and stairs.*

(b) Zone 2 Requirements:

- (1) In this zone create horizontal and vertical spacing among shrubs and trees using the "Fuel Separation" method, the "Continuous Tree Canopy" method or a combination of both to achieve Defensible Space clearance requirements. Further guidance regarding these methods is contained in the State Board of Forestry and Fire Protection's, "General Guidelines for Creating Defensible Space, February 8, 2006," incorporated herein by reference, and the "Property Inspection Guide" referenced elsewhere in this regulation. The "General Guidelines for Creating Defensible Space" may be found on the Board's website.*

(2) In both the Fuel Separation and Continuous Tree Canopy methods the following standards apply:

- (A) Dead and dying woody surface fuels and aerial fuels shall be removed. Loose surface litter, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches, shall be permitted to a maximum depth of three inches (3 in.).*
- (B) Cut annual grasses and forbs down to a maximum height of four inches (4 in.).*
- (C) All exposed wood piles must have a minimum of ten feet (10 ft.) of clearance, down to bare mineral soil, in all directions.*

(c) For both Zones 1 and 2:

- (1) "Outbuildings" and Liquid Propane Gas (LPG) storage tanks shall have the following minimum clearance: ten feet (10 ft.) of clearance to bare mineral soil and no flammable vegetation for an additional ten feet (10 ft.) around their exterior.*

(2) Protect water quality. Do not clear vegetation to bare mineral soil and avoid the use of heavy equipment in and around streams and seasonal drainages. Vegetation removal can cause soil erosion, especially on steep slopes. Keep soil disturbance to a minimum on steep slopes.

Public Resource Code 4290 and 4291

<p>Public Resources Code 4290</p> <p>4290. (a) The board shall adopt regulations implementing minimum fire safety standards related to Defensible Space which are applicable to state responsibility area lands under the authority of the department. These regulations apply to the perimeters and access to all residential, commercial, and industrial building construction within state responsibility areas approved after January 1, 1991. The board may not adopt building standards, as defined in Section 18909 of the Health and Safety Code, under the authority of this section.</p> <p>As an integral part of fire safety standards, the State Fire Marshal has the authority to adopt regulations for roof coverings and openings into the attic areas of buildings specified in Section 13108.5 of the Health and Safety Code.</p> <p>The regulations apply to the placement of mobile homes as defined by National Fire Protection Association(NFPA) standards. These regulations do not apply where an application for a building permit was filed prior to January 1, 1991, or to parcel or tentative maps or other developments approved prior to January 1, 1991, if the final map for the tentative map is approved within the time prescribed by the local ordinance. The regulations shall include all of the following:</p> <ol style="list-style-type: none"> (1) Road standards for fire equipment access. (2) Standards for signs identifying streets, roads, and buildings. (3) Minimum private water supply reserves for emergency fire use. (4) Fuel breaks and greenbelts. <p>(b) These regulations do not supersede local regulations which equal or exceed minimum regulations adopted by the state.</p>	<p>Public Resources Code 4291</p> <p>4291.1. (a) Notwithstanding Section 4021, a violation of Section 4291 is an infraction punishable by a fine of not less than one hundred dollars (\$100), nor more than five hundred dollars (\$500). If a person is convicted of a second violation of Section 4291 within five years, that person shall be punished by a fine of not less than two hundred fifty dollars (\$250), nor more than five hundred dollars (\$500). If a person is convicted of a third violation of Section 4291 within five years, that person is guilty of a misdemeanor and shall be punished by a fine of not less than five hundred dollars (\$500).</p> <p>If a person is convicted of a third violation of Section 4291 within five years, the department may perform or contract for the performance of work necessary to comply with Section 4291 and may bill the person convicted for the costs incurred, in which case the person convicted, upon payment of those costs, shall not be required to pay the fine. If a person convicted of a violation of Section 4291 is granted probation, the court shall impose as a term or condition of probation, in addition to any other term or condition of probation, that the person pay at least the minimum fine prescribed in this section.</p> <p>(b) If a person convicted of a violation of Section 4291 produces in court verification prior to imposition of a fine by the court, that the condition resulting in the citation no longer exists, the court may reduce the fine imposed for the violation of Section 4291 to fifty dollars (\$50).</p> <p>4291.3. Subject to any other applicable provision of law, a state or local fire official, at his or her discretion, may authorize an owner of property, or his or her agent, to construct a firebreak, or implement appropriate vegetation management techniques, to ensure that Defensible Space is adequate for the protection of a hospital, adult residential care facility, school, aboveground storage tank, hazardous materials facility, or similar facility on the property.</p> <p>The firebreak may be for a radius of up to 300 feet from the facility, or to the property line, whichever distance is shorter.</p>
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APPENDIX D

Priority Treatment Parcels

Alto/Tiburon

Parcel Number	(Acres)		Use		Site Address
	Parcel	Treatment	Code	Description	
034-012-21	1.615	0.76	10	Single-Resid. - Unimproved	
034-012-26	5.851	4.04	10	Single-Resid. - Unimproved	70 N KNOLL RD
034-012-27	8.428	3.69	10	Single-Resid. - Unimproved	
034-012-28	1.21	0.89	10	Single-Resid. - Unimproved	
034-012-29	5.037	2.32	10	Single-Resid. - Unimproved	
034-012-48	11.805	0.45	80	Tax Exempt	
034-012-50	53.127	4.93	80	Tax Exempt	
034-012-52	5.634	4.05	80	Tax Exempt	
034-291-09	0.324	0.32	80	Tax Exempt	
034-330-17	1.1	1.10	11	Single-Resid. - Improved	86 VIA LOS ALTOS
034-330-46	2.111	2.07	11	Single-Resid. - Improved	92 VIA LOS ALTOS
034-360-25	2.665	1.85	15	Common Area	
038-182-14	10.296	0.00	80	Tax Exempt	
038-182-17	45.188	3.88	80	Tax Exempt	
038-182-46	14.159	3.06	80	Tax Exempt	
038-322-10	10.358	9.62	80	Tax Exempt	277 KAREN WAY
038-400-16	15.119	9.41	15	Common Area	
038-400-17	0.531	0.52	15	Common Area	
038-450-15	1.014	1.01	11	Single-Resid. - Improved	60 VISTA TIBURON DR
038-450-16	0.967	0.97	11	Single-Resid. - Improved	55 VISTA TIBURON DR
038-450-25	0.711	0.71	15	Common Area	15 VISTA TIBURON DR
033-102-28	35.523	8.09	80	Tax Exempt (Outside District)	1 LOMITA DR
038-182-37	158.391	7.30	80	Tax Exempt (Outside District)	
026-252-08	5.936	2.50	80	Tax Exempt (Outside District)	
038-182-37	158.391	9.40	80	Tax Exempt (Outside District)	

Homestead Valley

Parcel Number	(Acres)		Use		Site Address
	Parcel	Treatment	Code	Description	
047-021-11	0.891	0.89	80	Tax Exempt	
047-021-12	2.454	2.40	80	Tax Exempt	
047-041-16	1.705	1.71	80	Tax Exempt	
047-042-09	1.521	1.52	80	Tax Exempt	
047-044-08	0.104	0.10	80	Tax Exempt	
047-046-10	0.842	0.84	80	Tax Exempt	
047-047-04	0.768	0.77	80	Tax Exempt	
047-048-06	0.604	0.60	11	Single-Resid. - Improved	99 EDGEWOOD AVE
047-048-07	1.006	1.01	21	Multiple-Resid. - Improved	3 HART LN
047-049-01	0.834	0.58	80	Tax Exempt	
047-092-23	7.856	6.27	10	Single-Resid. - Unimproved	
047-092-25	1.818	1.43	10	Single-Resid. - Unimproved	
047-092-26	0.355	0.34	10	Single-Resid. - Unimproved	
047-092-27	0.106	0.11	10	Single-Resid. - Unimproved	
047-096-03	0.263	0.26	10	Single-Resid. - Unimproved	
047-101-01	7.691	1.54	80	Tax Exempt	
047-102-01	1.947	1.09	80	Tax Exempt	
047-103-01	0.59	0.57	80	Tax Exempt	
047-112-53	0.942	0.94	80	Tax Exempt	
047-112-54	0.968	0.96	80	Tax Exempt	
047-121-08	0.237	0.24	80	Tax Exempt	
047-121-09	0.768	0.48	80	Tax Exempt	
047-122-10	0.221	0.22	80	Tax Exempt	
047-123-01	3.135	2.30	80	Tax Exempt	
047-131-05	0.451	0.40	80	Tax Exempt	
047-131-06	0.104	0.04	80	Tax Exempt	
047-131-07	0.193	0.03	80	Tax Exempt	
047-131-08	0.216	0.00	80	Tax Exempt	
047-131-09	2.171	1.14	80	Tax Exempt	
047-131-10	1.019	0.67	80	Tax Exempt	370 MONTFORD AVE
047-131-11	1.933	1.93	80	Tax Exempt	
047-131-13	0.26	0.14	80	Tax Exempt	

047-131-14	0.135	0.11	80	Tax Exempt	
047-131-15	0.168	0.17	80	Tax Exempt	
047-131-16	0.423	0.42	80	Tax Exempt	
047-131-21	0.598	0.60	10	Single-Resid. - Unimproved	
047-141-01	2.354	0.45	80	Tax Exempt	
047-141-07	1.623	0.68	80	Tax Exempt	
047-141-13	1.299	0.95	80	Tax Exempt	
047-171-01	13.282	0.31	80	Tax Exempt	
047-201-04	8.467	1.44	80	Tax Exempt	
047-201-09	1.941	1.69	80	Tax Exempt	
047-231-06	9.742	1.53	80	Tax Exempt	
048-081-07	0.968	0.93	10	Single-Resid. - Unimproved	64 MADRONE PARK CIR
048-081-14	0.625	0.63	11	Single-Resid. - Improved	398 N FERNDALE AVE
048-081-17	0.505	0.51	10	Single-Resid. - Unimproved	36 MADRONE PARK CIR
048-081-19	0.857	0.86	10	Single-Resid. - Unimproved	
048-092-02	1.645	0.42	80	Tax Exempt	
048-092-03	1.973	1.25	80	Tax Exempt	
048-092-04	3.469	1.16	80	Tax Exempt	
048-101-23	2.975	2.71	11	Single-Resid. - Improved	245 REED ST
048-101-24	1.231	1.22	11	Single-Resid. - Improved	241 REED ST
048-102-01	1.136	1.12	80	Tax Exempt	
048-141-11	12.846	4.89	80	Tax Exempt	

Tam Valley

Parcel Number	(Acres)		Use		Site Address
	Parcel	Treatment	Code	Description	
049-051-29	0.84	0.82	10	Single-Resid. - Unimproved	
049-051-31	0.44	0.43	10	Single-Resid. - Unimproved	
049-051-32	0.856	0.84	10	Single-Resid. - Unimproved	
052-062-30	8.563	5.39	21	Multiple-Resid. - Improved	214 VILLA GARDEN DR
052-100-01	26.071	1.32	80	Tax Exempt	
052-100-06	4.15		60	Exemption - Vacant	
052-100-12	9.117	3.16	60	Exemption - Vacant	
052-100-13	20.04	8.67	61	Exemption - Improved	301 TENNESSEE VALLEY

					RD
052-182-01	3.468	1.50	50	Commercial - Unimproved	
052-182-02	5.743	3.27	51	Commercial - Improved	155 SHORELINE HWY
052-182-05	3.773	3.25	61	Exemption - Improved	115 SHORELINE HWY
052-211-01	5.633	4.04	11	Single-Resid. - Improved	
052-231-03	6.57	3.06	50	Commercial - Unimproved	
200-010-04	69.867	15.44	80	Tax Exempt	1010 MARIN DR
200-010-05	6.286	2.22	80	Tax Exempt	
200-010-16	26.201	10.85	80	Tax Exempt	
200-010-47	0.679	0.68	80	Tax Exempt	665 EASTWOOD WAY
200-010-51	161.257	3.09	80	Tax Exempt	
200-010-52	90.481	10.90	80	Tax Exempt	
200-181-14	0.468	0.04	80	Tax Exempt	
200-181-17	0.786	0.79	11	Single-Resid. - Improved	8 FRIARS LN
200-210-15	6.153	2.25	80	Tax Exempt	
200-210-37	0.319	0.02	80	Tax Exempt	417 COUNTYVIEW DR
200-210-55	4.669	1.89	80	Tax Exempt	
200-210-58	33.508	7.19	80	Tax Exempt	
200-210-59	22.326		80	Tax Exempt	
200-220-02	3.823		80	Tax Exempt	
200-272-07	5.84	5.16	80	Tax Exempt	

Strawberry

Parcel Number	(Acres)		Use		Site Address
	Parcel	Treatment	Code	Description	
043-224-15	1.538	NA	10	Single-Resid. - Unimproved	
043-224-17	3.485	NA	15	Common Area	
043-224-18	0.505	NA	10	Single-Resid. - Unimproved	
043-261-25	48.445	NA	21	Multiple-Resid. - Improved	201 SEMINARY DR
043-261-26	25.128	NA	51	Commercial - Improved	300 STORER DR
043-401-05	4.137	NA	10	Single-Resid. - Unimproved	133 CHAPEL DR
043-401-16	15.283	NA	51	Commercial - Improved	5 CHAPEL DR
043-402-05	0.5	NA	10	Single-Resid. - Unimproved	124 MISSION DR

043-402-06	0.742	NA	10	Single-Resid. - Unimproved	130 MISSION DR
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Sausalito

Parcel Number	(Acres)		Use		Site Address
	Parcel	Treatment	Code	Description	
064-133-05	2.639	2.49	80	Tax Exempt	
064-133-06	0.642	0.27	80	Tax Exempt	
064-181-21	1.814	1.38	80	Tax Exempt	
064-181-40	9.32	3.60	80	Tax Exempt	
064-271-04	1.74	0.37	80	Tax Exempt	
064-276-01	0.714	0.71	80	Tax Exempt	
064-276-04	1.544	0.86	80	Tax Exempt	
064-276-23	0.538	0.40	10	Single-Resid. - Unimproved	
064-276-24	0.88	0.88	11	Single-Resid. - Improved	11 WOLFBACK RIDGE RD
064-280-01	0.739	0.73	11	Single-Resid. - Improved	201 CLOUD VIEW TRL
064-280-09	1.011	0.82	11	Single-Resid. - Improved	301 CLOUD VIEW TRL
064-280-10	0.464	0.37	80	Tax Exempt	
064-280-12	3.379	1.00	80	Tax Exempt	
065-181-40	0.271	0.27	11	Single-Resid. - Improved	260 SPENCER AVE
065-181-44	0.981	0.92	80	Tax Exempt	300 SPENCER AVE
065-251-15	4.003	2.82	80	Tax Exempt	
065-281-21	3.763	3.05	80	Tax Exempt	
065-282-08	5.378	0.17	80	Tax Exempt	
065-291-05	2.02	1.62	80	Tax Exempt	
065-311-41	8.289	2.68	80	Tax Exempt	
200-130-43	0.359	0.26	10	Single-Resid. - Unimproved	1 ROSE BOWL DR
200-310-06	0.669	0.62	10	Single-Resid. - Unimproved	40 WOLFBACK RIDGE RD
200-310-08	0.557	0.45	10	Single-Resid. - Unimproved	40 WOLFBACK RIDGE RD
200-310-12	0.775	0.78	10	Single-Resid. - Unimproved	51 WOLFBACK RIDGE RD
200-310-18	1.038	1.04	21	Multiple-Resid. - Improved	51 WOLFBACK RIDGE RD

Roadside Vegetation Treatment (WUI Roadways)

Miles of Roadway in SMFPD WUI

	Sausalito	Strawberry-Alto	Tam/Hstd Valley
Public Roads	23.35	7.20	44.60
Private Driveway	1.95	0.44	0.71
Fire Roads	3.23	1.32	1.15

SMFPD WUI Roads by ZIP Code

94965		94920		94941	
Roadway	Length (ft)	Roadway	Length (ft)	Roadway	Length (ft)
Alexander Ave	325	Blackfield Dr	2674	Almonte Blvd	2754
Cazneau Ave	3142	Reed Ranch Rd	5641	Miller Ave	164
Crescent Ave	2189	Andrew Dr	985	Sequoia Valley Rd	1455
Spencer Ave	3334	Baccharis Pl	483	Northern Ave	3818
Second St	343	Barn Rd	349	Tennessee Valley Rd	4028
Currey Ave	1810	Buckwheat Ct	368	Alta Vista Rd	1407
Filbert Ave	2446	Burrell Ct	410	Alta Way	1138
Girard Ave	1925	Cayford Dr	401	Alturas Way	1649
Glen Dr	3604	Cecilia Ct	620	Amaranth Blvd	1014
Bridgeway	2720	Cecilia Way	1216	Andre Ln	167
Johnson St	1039	Circle Dr	1629	Ash St	12
Main St	776	Corte Las Casas	211	Ashton Ln	242
Monte Mar Dr	3828	Corte Palos Verdes	569	Autumn Ln	1159
Marinship Way	15	Corte San Fernando	487	Barone Ln	310
Nevada St	1974	Cypress Hollow Dr	890	Bay Rd	1635
San Carlos Ave	3355	East Ter	529	Bay Vista Dr	2507
Rodeo Ave	2787	Greenwood Ct	268	Bell Ln	587
Santa Rosa Ave	3278	Indian Rock Ct	803	Beryl St	667
Atwood Ave	938	Janet Way	378	Birds Nest Ct	579
Sausalito Blvd	5246	Lower North Ter	796	Blue Bird Ln	150
Bulkley Ave	2845	Mariposa Ct	321	Blue Jay Way	385
Spring St	1566	Midden Ln	619	Brabo Ter	463
Third St	19	Monterey Dr	827	Bristol Pl	197

Woodward Ave	3767	North Ter	423	Brookline Way	610
Caledonia St	753	Paseo Mirasol	2491	Browning Ct	508
South St	1040	Rancho Dr	179	Browning St	2127
Wolfback Ridge Rd	4523	Reedland Woods Wy	862	Cabin Dr	949
Anchorage Rd	1065	Southridge Dr	339	California Ave	3105
Arana Cir	987	Southridge East	1177	Cape Ct	422
Bee St	25	Southridge West	1054	Carolyn Ln	270
Bonita St	1801	Terrace Ct	239	Carrera Dr	3677
Booker Ave	412	Upper Cecilia Way	1150	Castle Rock Dr	1671
Buchanan Ct	118	Upper North Ter	519	Cecily Ln	249
Buchanan Dr	1666	Via Capistrano	1555	Cedarwood Ln	199
Butte St	927	Via Elverano	531	Central Ct	638
Cable Roadway	328	Via Los Altos	3149	Central Dr	858
Canto Gal	155	Via San Fernando	1326	Centro Way	502
Central Ave	1472	Vista Tiburon Dr	826	Chamberlain Ct	1270
Channing Way	414	Warrens Way	724	Chapman Rd	651
Cloud View Cir	131			Charles Ln	471
Cloud View Rd	1553			Cherry Blossom Ln	328
Cloud View Trl	2709			Circle Way	327
Coloma St	28			Cleveland Ave	1622
Crecienta Dr	1048			Cleveland Ct	280
Crecienta Ln	203			Columbia Ave	489
Currey Ln	1066			Countyview Dr	2969
Cypress Pl	1209			Courtney Ln	320
Easterby St	698			Creek Side Way	179
Edwards Ave	1888			Crystal Ct	122
El Portal St	25			Curry Ln	345
Excelsior Ln	267			Dawn Ct	100
Filbert Ct	168			Deertrail Ln	1167
Fourth St	6			Denise Ct	175
George Ln	1153			Dolan Ave	2418
Glen Ct	428			Doretha St	460
Gordon St	264			Douglas Dr	276
Harrison Ave	2417			Durant Way	2649

Hecht Ave	2677			E Laverne Ln	172
Hi Vista Rd	619			Eagle Rock Rd	1705
Josephine Ave	294			Eastwood Way	1300
Kendell Ct	322			El Cide Ct	231
Laurel Ln	314			Enterprise Cncrse	651
Lincoln Dr	2556			Erica Rd	2175
Litho St	355			Ethel Ave	696
Locust Rd	474			Ethel Ln	436
Locust St	24			Eucalyptus Way	574
Lwr Anchorage Rd	180			Everest Ct	179
Lower Crescent Ave	825			Evergreen Ave	2071
Lower Glen Dr	648			Evergreen Ln	503
Marie St	851			Fairview Ave	837
Marin Ave	1634			Fern Way	75
Marion Ave	1553			Flamingo Rd	41
Miller Ave	720			Forest Way	1180
Miller Ln	309			Friars Ln	358
Napa St	438			Gibson Ave	279
North St	968			Glenwood Ave	1441
Olima St	720			Glenwood Ct	297
Olive St	385			Gomez Way	20
Pearl St	462			Green Glen Way	2445
Pine St	253			Greene St	1921
Platt Ave	1439			Greenfield Ct	77
Princess Ln	119			Greenhill Rd	2938
Princess St	482			Hart Ln	219
Prospect Ave	1970			Harvard Ave	1395
Reade Ln	238			Harvest Ln	179
Richardson St	16			Hawk Hill Rd	160
Rose Ct	292			Hawthorne Ave	478
Rosebowl Dr	92			Headlands Ave	321
Sacramento Ave	654			Heavenly Way	171
Spencer Ct	220			Helen Ave	294
Spring Hill Cir	398			Hidden Ln	393

Sunshine Ave	937			Highland Ln	501
Sweetbriar Ln	161			Hilldale Way	223
Tomales St	1368			Holly St	374
Toyon Ct	554			Homestead Blvd	4380
Toyon Ln	1364			Joyce Way	553
Turney St	260			Julia Ave	785
Valley St	6			Laguna Rd	872
Vista Clara Rd	618			Lark Ln	1124
W Harbor Dr	496			Lattie Ln	1995
Wateree St	308			Laurel Way	934
West Ct	220			Lavender Ln	556
West St	695			Laverne Ave	7250
William Ct	154			Lehman Ln	356
Willow Ln	964			Leo Ln	393
Wolfback Terrace Rd	1470			Lilac Ln	475
Wray Ave	544			Lillian Ln	441
N Hwy 101 Ramp	1088			Linda Way	59
S Hwy 101 Ramp	2830			Linden Ln	748
Cooper Ln	297			Live Oak Dr	2231
El Monte Ln	315			Lomita Dr	2694
Saghalie Ln	325			Loring Ave	3017
SCA Trl	55			Lowell Ave	1924
Testa St	174			Madrone Park Cir	1810
Alta Ave	319			Maple St	540
Oakwood Fire Rd	32			Marin Ave	5989
Rodeo Valley Trl	14			Marin Dr	5964
Sundial Rd	10			Marin Way	431
				Maxwell Ln	307
				McRae Rd	592
				Median Way	924
				Melaleuca Ln	454
				Melrose Ave	2065
				Midvale Way	1107

					Midway Ave	1089
					Montford Ave	4117
					Montford Pl	231
					Morning Sun Ave	7577
					Mountain Lodge Ln	257
					N Ferndale Ave	2669
					N Knoll Rd	1863
					Neila Way	365
					Palma Way	274
					Park Way	579
					Patricia Ln	230
					Peralta Ave	825
					Perry St	629
					Pine Crest Rd	435
					Pine Ridge Way	298
					Pine St	139
					Pinehill Rd	2358
					Pineo Ave	690
					Pixie Trl	1140
					Plaza Dr	152
					Poplar St	86
					Primrose Path	305
					Princess Ln	189
					Princeton Ave	1896
					Prospect Path	197
					Reed St	2294
					Rhonda Way	189
					Richardson Ct	380
					Richardson Way	1835
					Ridge View Dr	168
					Ridgeview Ln	261
					Ridgewood Ave	3301
					Rising Rd	515
					Rosemont Ave	883

				Ross Dr	75
				Rydal Ave	556
				S Morning Sun Ave	1806
				Scott St	324
				Seymour Ln	274
				Shasta Way	1147
				Sheffield Ave	1177
				Shell Ct	151
				Shell Rd	157
				Sky Rd	1145
				Skyline Ter	1167
				Smith Rd	1837
				Spring Dr	1273
				Springfield Way	430
				Springside Way	393
				Spruce St	55
				Stadium Ave	1533
				Stanford Ave	1707
				Sunny Brook Ln	410
				Sunset Way	433
				Tamalpais Dr	1018
				Tennessee Ave	1774
				Tennessee Glen Way	527
				Thomas Dr	910
				Todd Way	256
				Trillium Ln	1072
				Upper Autumn Ln	646
				Valley View Ln	247
				Ventura Way	937
				Vernal Ave	1332
				Vernal Ave N	474
				Vernal Ave S	193
				Vernal Way	209

					Via Recodo	311
					View Point Rd	161
					Viewpark Ct	629
					Villa Garden Dr	1080
					Vista de Valle	397
					W California Ave	4424
					W Fairview Ave	465
					W Live Oak Dr	424
					Walker St	208
					Walsh Dr	35
					Wanda Ln	272
					Waterview Dr	1762
					Wellesley Ave	4091
					Wellesley Ct	244
					Wendy Way	917
					Western Ave	1048
					Wickham Dr	406
					Wisteria Way	501
					Woodside Ave	1394
					Yale Ave	623
					Shoreline Hwy	12985
					DIPSEA TRAIL	246
					Miwok Trail Access	1283
					Ross Dr Path	34
					Horse Hill Fire Rd	
					Miwok Trl	304

APPENDIX E

San Rafael Juniper Ordinance/Code Amendment

4.12.030 Vegetation Management Standards.

A. Any person owning, leasing, controlling, operating or maintaining a property containing a structure in or upon the City Wildland-Urban Interface, and any person owning, leasing controlling, operating or maintaining a property that is adjacent to another property containing such a structure, shall at all times maintain a defensible space within 100 feet of such a structure as follows:

1) Raise the crown of all trees, by removing growth less than 3-inches in diameter, from the ground up to a maximum height of 10 feet, provided that no crown shall be raised to a point so as to remove branches from more than the lower one-third of the tree's total height.

2) Cut and remove all dry grasses (by means other than discing, tilling or other soil manipulation) so that their height does not exceed 3 inches.

3) Remove all combustible vegetation, provided that single specimens of combustible vegetation are permitted if separated by a distance equal to two (2) times the height of the next adjacent combustible or non-combustible bush on slopes 0 to 20%, four (4) times the height of the next adjacent combustible or non-combustible bush on slopes 21 to 40%, and 6 (six) times the height of the next adjacent combustible or non-combustible bush on slopes exceeding 40% as measured from the most outer edge of both bushes.

Exception: Remove all Junipers (genus *Juniperus*) and Bamboo (genus *Bambusa*) within 15 feet of any structure. Remove all Junipers (genus *Juniperus*) and Bamboo (genus *Bambusa*) from 15 to 100 feet of a structure before January 1, 2011. After January 1, 2011, single specimens of Junipers or Bamboo are permitted beyond 15 feet of a structure if separated by 2 times the height of the taller of the nearest bush as measured from the most outer edge of the bush.

4) Remove or chip the wood of all dead trees and other dead vegetation from the ground that is less than 3 inches in diameter, provided that the stump of a dead tree does not need to be removed. Chipping materials left upon the surface of the ground shall not exceed a depth of 3 inches.

B. Any person owning, leasing, controlling, operating or maintaining a property containing a structure in or upon the City Wildland-Urban Interface shall at all times:

1) Remove combustible vegetation on the ground of the property within 10 feet of any highways, city streets, or private streets used for vehicle traffic.

2) Remove all vegetation within 10 feet of a chimney outlet.

3) Remove any portion of trees or brush on the property that overhang any roadway and reach within 13 feet 6 inches (13'6") vertically above the roadway surface.

4) Remove any combustible vegetation under the eaves, decks or other components of the structure on the property.

5) Maintain the roof of any structure on the property free of leaves, needles, or dead vegetative growth.

6) Maintain woodpiles a minimum of 2 times the height of the woodpile away from any component of the structure on the property.

C. To the extent there is any conflict, the vegetation management standards in this Section shall supersede the property development standards for protecting the natural state of property as contained in Sections 14.12.030(C) and 14.12.040 of the City of San Rafael Municipal Code.

APPENDIX F

San Bernardino/Big Bear Wood Roof Replacement Program

- City of Big Bear Lake Ordinance #2008-383 mandates the replacement of all Wood Shake/Shingle Roofs by September 1, 2012. | [Download the ordinance](#)
- County of San Bernardino Ordinance #4225 mandates the replacement of all Wood Shake/Shingle Roofs in the County by July 1, 2016. | [Download the ordinance](#)

ELIGIBLE APPLICANTS

Due to the nature of the funding source, the applicant must own an "Eligible Unit" with a wood shake/shingle roof. Any and all work to replace wood shake/shingle roofs must be conducted after the property owner receives a "Notice to Proceed" from the MAST organization.

ELIGIBLE IMPROVEMENTS

Eligible improvements include the replacement of wood shake/shingle roofs with a minimum "Class A" rated asphalt composition shingle roof or other approved non-organic material having a minimum 30 year warranty and underlaid with a minimum 30 lb. felt material or equivalent, replacement of skip sheathing with solid sheathing, ice dams, drip edge, vent flashing, and non-ember intrusion vents.

INELIGIBLE IMPROVEMENTS

Ineligible improvements include the replacement of dormers, skylights, rain gutters, insulation, roof additions or other accessories, and existing plywood sheathing. Other ineligible costs are costs associated with the installation and/or repair of any structural improvements that may be needed or required.

GRANT LIMITS AND SOURCE OF FUNDING REIMBURSEMENT PROCESS

Property owner understands that his/her participation in this Roof Replacement Program is a cost sharing/reimbursement process. The MAST organization through its Roof Replacement Program agrees to use its available FEMA and Office of Emergency Services grant funds to reimburse selected homeowners a percentage of the cost of replacing wood shake/shingle roofing with "Class A" composition roofing having a minimum 30 year warranty underlaid with 30 lb. felt with ice dam, including the removal and disposal of existing wood shake/shingles. There are three factors which will be utilized to limit the reimbursement:

- The reimbursement shall not exceed 70% of the cost of the lowest bid for roof replacement
- The reimbursement shall not exceed \$266.00 per square (100 sq. ft.)
- The grant cannot exceed a maximum reimbursement amount of \$4,500.00

(Note: an adjustment will be made at the beginning of each calendar year to reflect price adjustments based upon the San Bernardino County Consumer Price Index.)



SHAKE/SHINGLE ROOF REPLACEMENT PROGRAM

GRANT GUIDELINES FOR DR 1884 AND LPDM 08

GRANT PURPOSE

The purpose of this program is to remove existing wood shake/shingle roofs and install primarily asphalt composition fire resistant “Class A” roof shingles on homes within the mountain communities of San Bernardino County. These identified structures are at the highest risk of igniting during a wildfire occurrence. This program seeks to help homeowners upgrade these structures to current codes, and substantially reduce the risk of wildfire damage spreading in this community.

GRANT SCOPE

San Bernardino County Fire Department and the City of Big Bear Lake has applied for and has received funding through FEMA’s Hazard Mitigation Grant Program to undertake upgrades of pre-identified existing vulnerable wood shake/shingle roofs. The Roof Replacement Grant is intended only for those properties that have been previously identified by the Mountain Area Safety Taskforce (MAST) operations group and that are located near the San Bernardino National Forest.

ELIGIBLE UNITS

Single family residences, multifamily residences, garages, and commercial structures are eligible for this grant.

ELIGIBLE APPLICANTS

Due to the nature of the funding source, the applicant must own an “Eligible Unit” with a wood shake/shingle roof previously identified by MAST. Any and all work to replace wood shake/shingle roofs must be conducted after the property owner receives a “Notice to Proceed” from the MAST organization.

ELIGIBLE IMPROVEMENTS

Eligible improvements include the replacement of wood shake/shingle roofs with a minimum “Class A” rated asphalt composition shingle roof or other approved non-organic material having a minimum 30 year warranty and underlaid with a minimum 30 lb. felt material, replacement of skip sheathing with solid sheathing, ice dams, drip edge, vent flashing, and non-ember intrusion vents.

INELIGIBLE IMPROVEMENTS

Ineligible improvements include the replacement of tile, stone or other roofing material, dormers, sky lights, rain gutters, insulation, roof additions or other accessories, and existing plywood sheathing. Other ineligible costs are costs associated with the installation and/or repair of any structural improvements that may be needed or required.

GRANT LIMITS AND SOURCE OF FUNDING REIMBURSEMENT PROCESS

Property owner understands that his/her participation in this Roof Replacement Program is a cost sharing/reimbursement process. The MAST organization through its Roof Replacement Program agrees to use its available FEMA and Office of Emergency Services grant funds to reimburse selected homeowners a percentage of the cost of replacing wood shake/shingle roofing with “Class A”

composition roofing having a minimum 30 year warranty underlaid with 30 lb. felt with ice dam, including the removal and disposal of existing wood shake/shingles. There are three factors which will be utilized to limit the reimbursement:

- The reimbursement shall not exceed 70% of the cost of the lowest bid for roof replacement
- The reimbursement shall not exceed \$254.00 per square (100 sq. ft.)
- The grant cannot exceed a maximum reimbursement amount of \$4,500.00

(Note: an adjustment will be made at the beginning of each calendar year to reflect price adjustments based upon the San Bernardino County Consumer Price Index.)

APPLICATION PROCESS

Applications for the Roof Replacement Program are limited to the properties identified on a prescreened list. Applications are available by contacting the MAST wood shake shingle roof replacement program. Applications will be accepted on a year-round basis from qualified property owners. Funding is reserved on a first come, first served basis for property owners who have successfully submitted a complete application to the MAST wood shake/shingle roof replacement program. Roof replacement improvements will be authorized throughout the year based on funding, staffing resources, and weather. Once funding is exhausted, property owners will be placed on hold for future funding and/or the application will be denied due to lack of funding.

MAST will maintain an “approved” list of licensed, qualified roofing contractors from which program participants can obtain bids for the work to be completed. Please note that no self-labor will be permitted under this program. To be eligible for reimbursement, the property owner must submit three bids from approved licensed roofing contractors.

The MAST staff will work with property owners to ensure that all requirements are met prior to issuing a “Notice to Proceed.” After all conditions of the application process have been fulfilled, the property owner will be issued a “Notice to Proceed” by the Fire Department. Only reroofing work commenced AFTER the property owner receives a “Notice to Proceed” shall be eligible for reimbursement. The property owner will have three (3) months to complete authorized reroofing work from the commencement date entered on the Notice to Proceed. Failure to complete the reroofing work within three (3) months may void the property’s eligibility for reimbursement.

Each property owner shall ensure that the chosen roofing contractor obtains all required permits and inspections by the applicable jurisdiction. Periodic progress checks will be conducted by the MAST organization prior to a final inspection. The property owner shall provide approval from the Building & Safety Department that the roofing work has been completed in accordance with the California Building Code and local code amendments. The MAST organization and/or his/her designee shall “review and approve” or “review and deny” reimbursement based upon completeness of information submitted.

APPENDIX G

Fuel Treatment Techniques

Excerpted, *East Bay Regional Parks Wildfire Hazard Reduction and Resource Management Plan*. 2015.

This appendix provides a detailed discussion of the following fuel treatment methods and techniques:

- Hand Labor
- Mechanical Treatment
- Chemical Treatment
- Grazing

Hand Labor Techniques

Hand labor techniques vary significantly and can include pulling weeds and shrubs from the under-story, cutting saplings and chaparral, removing ladder fuels, and conducting mosaic thinning (which entails the removal of fuels within specific physical spaces to inhibit wildfires from torching trees). More common hand labor techniques to manage fuel loads are described below.

Weed Whipping

This technique uses a hand-held tool (normally gas-powered) that cuts grass and very small shrubs with a plastic line or cutting blade. Weed whipping is typically used annually after grasses have dried or cured so that the grass does not grow back. This technique reduces the height of the fuel, but does not create areas of bare soil, as the vegetation is not completely removed. However, while most large woody stems are not cut by the treatment (which limits its application on vines such as vinca, ivy, and Himalayan blackberry) seedlings can be severely damaged by the cutting line. Weed whipping is often the only type of "mowing" treatment possible in steep wooded areas or landscaped slopes. Heavier weed-whipping machines can be fitted with plastic or steel knives or serrated saw blades, such as brush cutters or brush saws. Utilizing a cutting blade enables the mulching of cuttings in a single process and allows treatment of woody stems, but this option is limited to pieces under 1 inch diameter in size.

Brush Removal

Hand labor can also involve the use of chainsaws and other instruments to masticate or remove brush and break apart brittle materials that can act as ladder fuels. Fallen branches and material cut from brush can then be further broken into compact mulch and distributed across the site or removed for disposal.

Ladder Fuel Reduction

Ladder fuel reduction entails removing or reducing the amount of understory shrubs, small trees, and small lower limbs of trees to create a vertical separation (i.e., discontinuity) between surface fuels and the tree canopy overhead. Ladder fuel reduction lowers ignitability, decreases available fuel, decreases the potential for spotting, and reduces heat output from understory fires, which in turn reduces the potential for fires to move from the ground up to "ladder" fuels and into the tree crown.

Thinning

Thinning dense stands of trees by removal of trees up to 10" dbh is a common hand labor technique. Such thinning is done to improve the health and vigor of the residual stand, including desirable understory

components, by reducing inter-tree competition for water, light and nutrients, and to make the stand more resilient to future fires by reducing the quantity and continuity of live and dead fuels that would otherwise contribute to rapid rates of spread, high intensity burning and extreme fire behavior.

Several types of thinning techniques exist to reduce the overall amount of fuels in an area, and can include (among others) low, crown, mechanical, mosaic, and drip-line thinning. Low thinning involves the removal of smaller, less vigorous trees in a stand. Crown thinning removes stems and branches to increase light penetration and air movement throughout the crown of a tree or stand. Mechanical thinning removes a selected number of trees according to a predetermined spacing amount or pattern and is particularly useful prior to harvesting or yarding operations. Mosaic thinning is a hand removal technique for fuel reduction where retained trees are variably distributed throughout the treatment area; rather than removing saplings, shrubs, and grasses evenly across an area. Tree “clumps” are alternately thinned to varying degrees to create a mosaic of plantings.

Drip-line thinning is a technique that involves removing shrubs and smaller trees that exist within the drip lines of overhead trees to prevent torching. In both cases removing smaller trees and shrubs, such as poison oak or coyote bush, is usually done with a hand-held chain saw; trees smaller than 3 inches in diameter may be removed with loppers as well. Because the material removed during these operations typically consists of smaller trees and shrubs that result in larger debris sizes, chipping or off site hauling is usually required.

Mulch Application

The application of mulch, such as wood chips from pruning operations, can slow the growth of grasses, shrubs, and saplings for up to one full season and acts as an effective temporary fuel reduction method. Mulch at depths of 2 inches or more increases the growth necessary for seedlings to reach the sunlight, thereby suppressing the number of plants that actually reach the surface.

Mechanical Treatment Techniques

Mechanical treatments tear or cut vegetation, rearranging the fuel’s structure and compacting the debris that is left behind. Specific techniques, such as those described below, can break apart or cut up vegetation into small pieces, tear up and bury the resulting debris, or remove plants entirely and pile the debris for burning or removal.

Grading

This technique is often used to maintain fire trails through wildlands, creating a strip of land absent of fuel. A tractor with an attached blade can effectively produce a firebreak 8 to 12 feet wide with one to two passes of the vehicle. Treatment is usually done in the spring after the ground is fairly dry but before grass is entirely cured (so that a fire cannot occur before the scraping is done).

Removal of all vegetation in the area disturbs water drainage patterns where the side banks of the graded land interrupt cross-slope water travel, and may also accelerate water travel inside the graded lane. The disturbance created by annually graded fire trails can result in excellent establishment sites for weed species, which also should be taken into consideration when considering this technique.

Mowing

Mowing using a tractor or similar equipment with a mower attachment, such as a rotary or flail mower, reduces fuel height which in turn reduces the flame length and possibly the rate of spread in a grass fire.

Timing of mowing has an impact on the type of grasses promoted; late mowing after annual grasses have cured enhances growing conditions for perennial native grasses, provided mowing does not occur during seed production. Mowing at the appropriate time to a height of approximately 4 inches minimizes weed and brush encroachment and reduces the amount of manual work needed to maintain the site, but should be avoided when birds are actively ground nesting in the area. Mowing of weeds and native grasses is typically required annually. Mowing may be used in conjunction with other techniques, such as disking, to require a thinner strip of disked area.

Mechanical Tree Removal

Feller-bunchers can be used to harvest or remove trees in a short period of time. The main advantages of using this equipment include a higher production rate, improved safety, reduced residual stand damage due to controlled felling, higher skidding productivity, and lower remaining stump height. Their disadvantages include distinct limits of stem size capability, higher initial capital investment, stability limitations on steep slopes, and limitations on operational areas due to rough terrain, boulders, or dense residual stand spacing. Feller-bunchers may need to be supported by skidders to move trees and materials to a landing, and by loaders and log trucks to remove trees and other materials from the site.

Mechanical Cutting and Crushing

A tractor or similar equipment can be used to crush fuel materials using a blade that is kept slightly off the ground. A variety of attachments include rollers (e.g., brush hog), a horizontal cutting blade (which operates similar to a large mower), or a set of chains to flail the material being treated. Grinding machines with an articulated arm to grind off woody material, and in some cases shatter or crush shrub roots, can also be used to reduce the overall size of materials.

Chipping or Mulching

This mechanical technique sometimes is used subsequent to other removal techniques and reduces the size of materials by passing them through a series of high-speed blades. The smaller-sized materials produced may then be removed from the site or redistributed as mulch. Natural compaction of this layer presents a fuel structure that is less likely to ignite. Larger grinders, such as tub grinders, can chip logs up to 24 inches in diameter.

Chemical Treatment Techniques

(Ed. Note: Chemical treatment is a controversial topic. It's inclusion here as a vegetation management tool is included for comparison's sake, and does not represent an endorsement or recommendation of the practice).

Chemicals that prevent seed germination (i.e., pre-emergence chemicals) and kill sprouted plants (post-emergence chemicals) can be used to establish firebreaks and in roadside treatments, or to assist in the restoration of less flammable native vegetation by inhibiting the growth of non-native species. Two primary treatment techniques are used:

- **Cut Stump Application:** To maximize the efficacy of treatment the tree must be cut leaving a stump not more than four (4) inches in height above soil surface and the cut surface of the stump must be treated with an herbicide within minutes of the cut. Garlon 4 Ultra is applied to the exposed cambium (zone of living transport tissue) layer of the tree. The herbicide is translocated to the roots and disrupts the transportation of nutrients and water, causing the plant to die.
- **Basal Bark Application:** This treatment consists of spraying at very low pressure a solution of Garlon 4 Ultra mixed with esterified vegetable oil to the lower 12 to 15 inches of the resprout. This

application method permits the operator to selectively treat resprouts without injury to adjacent vegetation, and is particularly effective on resprouts less than 6 inches in diameter.

Grazing Treatments

Although the concept of grazing is the same regardless of which type of animal is used, how each animal type conducts its grazing varies significantly. As a result, not all animals will be ideally suited for grazing treatments in all areas.

Cattle

Using cattle for grazing treatments is appropriate in large grassy areas (typically with a minimum of 100 acres) with a less than 35 percent slope. Cattle do not usually eat shrubby material, and so cannot be used to create fuel reduction zones. They will, however, easily maintain a grassland area. Cattle grazing for commercial production can be cost-effective, and even revenue-generating depending on the use agreement.

The availability of alternative pastures on public open space or private property in the vicinity of treatment areas where livestock can be moved following attainment of target use levels is critical to reducing potential adverse impacts. Fencing must be used to prohibit grazing animals from venturing into areas outside the treatment area. However, fencing is typically the major expense in utilizing livestock for fuel management. As a result, ranchers and others supplying grazing animals are typically asked to provide and repair fencing during treatment. Additionally, water sources are required for animals and need to be provided if an insufficient number are available at the treatment site. Exclusion fencing to prevent livestock from gaining access to riparian zones and wetlands may be necessary to prevent degradation of water quality and habitat.

Horses

Grazing with horses is another effective way to reduce fire hazards because they prefer grass and other plant materials that constitute flashy, ignitable fuels during summer months. Horses can be grazed on slopes over 35 percent, making them an ideal complement to cattle grazing, but erosion can be a problem in small areas where bare dirt is exposed as a result of high hoof traffic. Horses do not usually prefer shrubby material, and so cannot be used to completely clear areas as firebreaks. Horse grazing in areas open to the public may generate user conflicts as well.

Sheep

Sheep will eat both forbs and grasses, will graze steep slopes, and are more likely to eat shrubs than horses or cattle. Their herding instinct allows grazing without the installation and maintenance of permanent fences, but requires that a shepherd and dogs be present.

Sheep grazing also requires that drinking water sources be present, which typically are provided through hauled water tanks. A combination of sheep and goats can be a viable option when a mixture of grass and shrubs are present in the area to be treated.

Goats

Conversely to cattle and horses, goats prefer to “browse” on woody vegetation (e.g., tree leaves, twigs, vines, and shrubs) and will eat materials up to 6 feet above the ground. This grazing pattern creates a desirable vertical separation between the canopy and ground cover, but is best used in areas with low numbers of plants intended for retention, since goats will indiscriminately damage most plants (the bark of large-diameter trees is typically not affected, however). Goat grazing is also preferable in areas of steep

terrain, where other grazing animals are less-suited for the topographic conditions and are therefore less effective in grazing to achieve the desired vegetation management results.

Goats can utilize a variety of forages including the light and heavy fuels discussed above. Goats are also active and explorative eaters, often climbing trees in pursuit of food and nutrition. This propensity towards variety coupled with an uncanny ability to consume unlikely feedstuffs such as low lying branches, small trees, grasses, weeds, chaparral, shrubs and a panoply of fire-hazardous exotic and invasive species, creates the unlikely but nonetheless perfectly suited fire fighting tool in the goat.

As a goat moves through a fire prone area it will begin to target the light fuels while browsing on the branches of trees and shrubs as high as it can reach (up to approximately five feet). This vegetation is the ladder fuel, the vegetation which allows fire to spread upwards from ground, to trees, to homes. Slowly but efficiently the goat will increase the distance between combustible vegetative materials.

Portable electric fences are commonly used to help control the herd and the outcome of their grazing. Measures may also be taken to prevent girdling of small trees that can result from the goats browsing on tree bark. A herd of 200-300 goats can graze up to 1 acre per day. Herd movement has the advantage of breaking off dead material in a stand as well as punching a humus layer into the soil (if the ground is somewhat moist) and thereby removing available fuel. Plans should include goals and implementation actions to ensure that timing of grazing treatment is optimal to prevent the spread of seeds from invasive and other targeted species and to maximize fuel reduction. The plan should also provide a range analysis to determine the optimum stocking rate and duration. Monitoring should be conducted by qualified personnel to determine when utilization and fuel load objectives are attained so that grazing animals are removed in a timely manner.

APPENDIX I

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