MONTECITO
COMMUNITY WILDFIRE PROTECTION PLAN AMENDMENT



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PREPARED BY:

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COMMUNITY WILDFIRE PROTECTION PLAN AMENDMENT
MUTUAL AGREEMENT PAGE

The Community Wildfire Protection Plan developed for the Montecito Fire Protection District:

- ✓ Was collaboratively developed. Interested parties, key stakeholders, local fire departments, and federal land management agencies managing land in the vicinity of Montecito have been consulted.
- ✓ This plan identifies and prioritizes areas for hazardous fuel reduction treatments and recommends the types and methods of treatment that will protect the community of Montecito.
- ✓ This plan recommends measures to reduce the ignitability of structures throughout the area addressed by the plan.

The following entities mutually agree with the contents of this Community Wildfire Protection Plan Amendment:

Recommended by: ______________________________
Chip Hickman
Fire Chief, Montecito Fire Department

Approved by: ______________________________
Mark Hartwig
Fire Chief, Santa Barbara County Fire Department

Approved by: ______________________________
Scott Jalbert
Fire Chief, San Luis Obispo Unit – CAL FIRE

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This CWPP Amendment includes only those sections that were modified or updated due to the 2017 Thomas Fire. Please see the original 2016 CWPP for those sections not addressed in this Amendment.

SECTION 1. INTRODUCTION

The Montecito Fire Protection District (District) completed their Montecito Community Wildfire Protection Plan (CWPP) on February 22, 2016. This plan was the result of a community-wide effort to quantify and evaluate the wildfire threat to Montecito and to develop mitigation strategies that enhance protection of life safety and community values from wildfire.

The Thomas Fire, now the second largest wildfire in California history, burned into the community of Montecito on December 16, 2017 having already destroyed more than 1,000 structures in Ventura and Santa Barbara counties (See Figure 2). Only 7 primary residences were destroyed by the fire and another 40 structures were damaged or destroyed. The area above Montecito was severely burnt by the Thomas Fire, which removed most of the vegetation that normally would have stabilized the soil helping to keep slopes and drainages intact during rain events. The loss of vegetation changed the physical properties and erodibility of the soil and altered the stability of the hillsides above the community.

Figure 1 Drainage above Montecito

Following the Thomas Fire, a significant rain event occurred on January 9, 2018 causing severe debris flows to barrel down three major drainages, Montecito, San Ysidro, and Romero creeks into the community. These debris flows killed 21 people (two people remain missing) and injured 163 others, destroyed 100 homes, and damaged over 300 structures in Montecito.

Approved in 2016, the CWPP is relatively new, however, the Thomas Fire significantly altered the fire environment thereby affecting portions of the CWPP Action Plan. This change to the fire environment and the implications for the existing Action Plan has prompted a need to review and update the CWPP. Utilizing results from the report, *A Defensible Community? A Retrospective Study of Montecito Fire Protection District's Wildland Fire Program during the 2017 Thomas Fire* found that the District's Wildland Fire Program and the 2016 CWPP effectively enhanced protection of the community's values. This CWPP amendment provides guidance to Montecito on activities that, when implemented, can enhance wildfire protection for the next five years, at which time a full update to the CWPP should be considered.

This Amendment does not replace the existing CWPP, but updates only those sections that require change as a result of the Thomas Fire and new information.

1.1 PURPOSE OF THE PLAN

As with the 2016 CWPP, the primary purpose of this amendment is to enhance the protection of human life and reduce the wildfire threat to community values such as structures, critical infrastructure, businesses, and natural and historic resources. The amendment will serve to guide

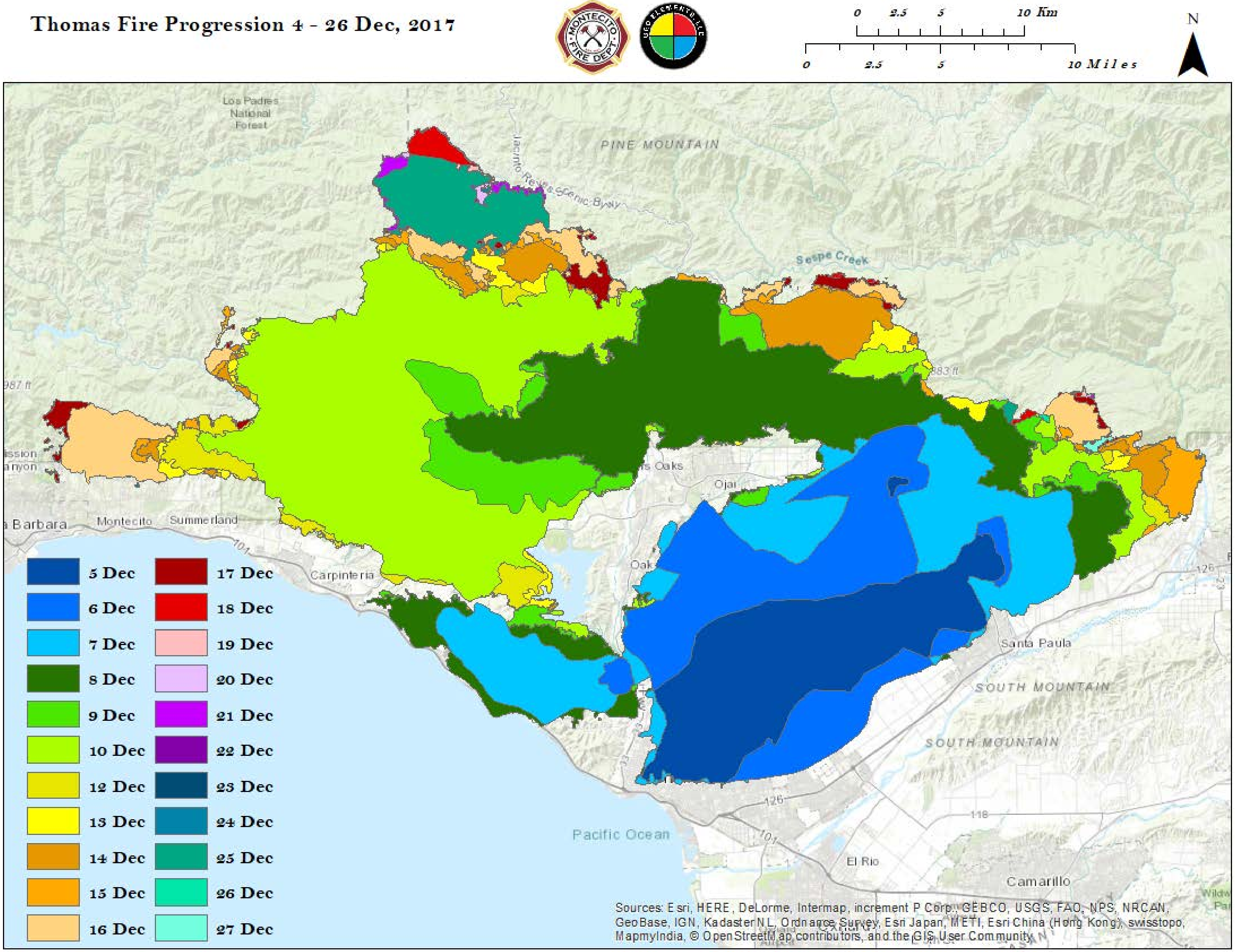


Figure 2 2017 Thomas Fire Progression Map future actions for the District, property-owners, and other interested stakeholders in their efforts to enhance the protection of Montecito from the future wildfire threat.

Recommended actions within this amendment are subject to available funding, other District priorities, the ability to implement projects on private lands, and environmental review under the California Environmental Quality Act (CEQA).

1.4 CWPP AMENDMENT PROCESS

Geo Elements is a wildland fire and fuels consulting team comprised of professionals who have extensive on-the-ground experience in all aspects of wildland fire and vegetation management throughout the Unites States. The team brings together experts in community wildfire protection planning, wildland fire behavior modeling and analysis, wildland fire hazard risk assessment, fire management planning, and geospatial analysis and cartography. The goal of Geo Elements on all projects is to develop practical solutions based on the best available science and technology to address complex issues involving the wildfire environment. More information regarding the Geo Elements team can be found at their website: http://geoelementsllc.com/index.htm. With their pre-existing knowledge of Montecito and their expertise with developing the 2016 CWPP, the District contracted with Geo Elements to assist in the development of this CWPP amendment.

As with the 2016 CWPP, a priority for the District during the development of the plan's amendment was to engage stakeholders, educate the community on the purpose for the amendment and it's core recommendations, and to encourage participation in the collaborative process. The process included three formal meetings held at the District's Headquarters. The first meeting was on November 17, 2018 and included a presentation of the report *A Defensible Community? A Retrospective Study of Montecito Fire Protection District's Wildland Fire Program during the 2017 Thomas Fire* by Geo Elements owner Carol Henson and Fire Ecologist Crystal Kolden. On January 8, 2018 the District facilitated a meeting attended by adjacent fire and land management agencies. Those in attendance included representatives from Santa Barbara County Fire Department, Carpinteria/Summerland Fire Protection District, and the Los Padres National Forest. District staff presented the key points of the amendment and ensured agreement and support specifically for the recommendations outlined in the plan. A community meeting presenting the CWPP amendment was held on February 20, 2019. The meeting was well attended and included the Montecito Fire Protection District Board of Directors, community members, and local organizations such as Los Padres Forest Watch, Urban Creeks Council, Legacy Works Group and Cuyama Lamb. Following the presentation of the amendment by the Districts' fire prevention bureau, there was a question and answer session facilitated by the Districts' Fire Marshal. There were several written comments received at the conclusion of the meeting, all of which received responses from the District's Wildland Specialists. The Legacy Works Group, which has extensive experience in facilitating collaborative partnerships, assisted the District in consolidating comments received during the process and incorporating them into the final CWPP amendment.

In 2017, the Thomas Fire stripped the landscape of the majority of the vegetation above Montecito, which significantly diminishes the wildfire threat to the community from within the Thomas Fire footprint over the next 5 – 10 years. However, this is not the time for the District and property-owners to lose focus as there is still a wildfire threat from enclaves of wildland vegetation within the community and areas of the Tea and Jesusita fires that did not burn in the Thomas Fire.

As property-owners go forward following the fire and flood, now is the time for the community to determine their future actions related to the wildfire threat. For those property-owners that are rebuilding and/or landscaping, it is an opportunity to substantially reduce their risk from a future wildfire threat by hardening their structures and applying current building standards on reconstruction projects. As important as construction practices are to the community, also creating defensible space and utilizing fire resistant vegetation will assist in protecting life safety and homes during the next wildfire.

2.1.4 Natural and Historic Resources

As discussed in the 2016 CWPP, natural and historic resources can be either temporarily or permanently altered by wildfire and its impacts. The Thomas Fire and the subsequent debris flows destroyed at least one historic resource and damaged many others in the District. The fire and debris flows also severely impacted natural resources across much of the District. While natural resources are generally likely to recover with time, some natural resources may be permanently lost, and regulated natural resources may need to be re-evaluated by regulatory entities.

Natural Resources

The setting within and adjacent to Montecito includes a variety of natural resources and environmentally sensitive areas that exemplify key natural resource values. The Montecito Community Plan EIR identifies six natural habitats within the project area including marine interface, chaparral, oak woodland, riparian, coastal sage scrub, and grassland. These Environmentally Sensitive Habitat areas are available in Figure 5, Environmentally Sensitive Habitat Areas (ESHAs) Map in the 2016 CWPP. There are approximately fifty species of rare or threatened mammals, birds, insects, reptiles, and plants (www.wildlife.ca.gov/Data/CNDDB, 09 August 2018) in the planning area.

Natural resources damaged by wildfire can take years to recover and can require significant and unique restoration activities. Additionally, post-fire events such as flooding and debris flows can significantly damage watersheds and habitat, and also include an increase in invasive species and erosion.

The Thomas Fire burned approximately 30% of the ESHAs in the District. Of the ESHA area burned in the Thomas Fire, 49% burned at high severity and an additional 30% burned at moderate severity. Only 21% burned at low severity or with minimal impacts, which suggests that much of the ESHA area within the fire perimeter was likely destroyed for the near-term and will require several years of recovery.

Primary natural resources that are currently recovering following the Thomas Fire include habitat for sensitive (rare, threatened, and endangered) species, ephemeral water in riparian zones, aesthetic value and recreation capacity in the canyons in and above Montecito that were consumed by the fire (particularly both Hot Springs and Cold Spring canyons that have high recreation value), and soil retention and erosion prevention from upland vegetation. Additionally, a less-recognized natural resource benefit associated with more heavily vegetated areas, such as riparian zones, is the localized cooling capacity, wherein trees provide both shade to lower ground temperatures and reduce the ambient air temperature through evapotranspiration. Until these areas are recovered from burning in the Thomas Fire, there will be a quantifiable increase in localized heating temperatures and reduced relative humidity, impacting energy and water needs.

Historic Resources

The Leaping Greyhound Bridge was destroyed in the January 9, 2017 debris flows so is no longer a historic resource.

2.1.5 Recreation Amenities/Facilities

The trail systems above and within Montecito suffered extensive damage and the Cold Springs Trail is currently closed as a result of the Thomas Fire and subsequent debris flow.

SECTION 3. DEFINING THE WILDFIRE PROBLEM

As the Thomas Fire demonstrated, wildfires are inevitable and can be catastrophic. The following describes updates to the wildfire problem in Montecito.

3.1 FIRE ECOLOGY

The following describes the changes and updates to fire ecology within and adjacent to the project area.

3.1.1 Vegetation

The chaparral ecosystem is a heathland type consistent with Mediterranean biomes globally and is dominated by three primary species: manzanita (Arctostaphylos spp.), chamise (Adenostoma fasciculatum), and California lilac (Ceanothus spp.) shrubs. Additional species such as oaks and some herbaceous plants will also be found in this system; these are confined primarily to riparian areas on the south facing slopes that characterize the south slopes of the Santa Ynez Mountain Range. These species are fire-adapted in that they are not destroyed by fire, but rather re-sprout very rapidly following fire (sometimes within weeks) from roots and burls in the woody skeleton of the plant. Due to the high content of volatile oils found in the schlerophyllus (hard and waxy) evergreen leaves of these shrub types and the amount of fine fuels from prior years of growth that collect in and below the shrub canopy, they function as contributors to rapid fire spread.

Riparian systems are found wherever streams drain from the Santa Ynez Mountains, with vegetation in these drainages consisting of species such as oaks, sycamore, and willows. These riparian corridors typically resist fire due to higher moisture levels and shading but can burn under extreme conditions. Wildlife uses these corridors to meet a variety of basic needs, with greater biodiversity supported at the interfaces of the upland chaparral systems and the riparian corridors (and leading to most of the riparian systems being classified as environmentally sensitive areas).

Overall, the historical (pre-Euro-American settlement) fire return interval in chaparral ecosystems was more infrequent compared to current day. Van de Water and Safford (2011) conducted a literature review to determine historical fire return intervals for various vegetation types. They concluded that the 'chaparral and serotinous conifer' Presettlement Fire Regime Type exhibited a median fire return interval of 59 years and a mean minimum and mean maximum of 30 and 90 years. In modern times, chaparral in southern California is burning more frequently due to increased human ignitions (Keeley and Fotheringham, 2001).

The chaparral shrub species and oaks that characterize the Montecito area have evolutionary characteristics consistent with fire-adapted ecosystems. Some shrub species (e.g., scrub oaks) are obligate resprouters that utilize stored reserves to regenerate from existing stems shortly following the fire event. Thus, they must build up sufficient carbon reserves before the next fire in order for the regenerative machinery to function. Other shrub species are obligate seeders (e.g., Ceanothus and Manzanita), regenerating only from a stored seed bank in the soil or adjacent unburned areas. In the coastal sage scrub community, as for many sagebrush ecosystems, the seedling recruitment period is generally multiple decades, with an early period of grasses and herbaceous species that later dwindle and die off as shrub canopy crown cover increases and reaches closure. This transition requires many decades between fires to reach late succession and is particularly vulnerable to increased fire frequency. Finally, facultative seeders (e.g., chamise) that colonize resource-poor sites both re-sprout and regenerate from the seed bank and can take several decades to establish enough seed reserves to survive subsequent fire. As such, they are also sensitive to increased fire frequency.

3.1.2 Post-Thomas Fire Ecological Recovery

In the chaparral ecosystem, initial recovery is usually very rapid and resprout begins within weeks to months. Due to the extreme and anomalous conditions under which the Thomas Fire burned and the observed severity of the fire effects, there was initial concern regeneration may be delayed or replaced with invasive species. However, the 2019 water year (October 1 – September 30) has brought above normal precipitation to the area and many of the initial concerns regarding regeneration have proven to be unwarranted.

There has been considerable interest in the rate of post-fire vegetation regeneration in chaparral ecosystems, with variable lengths of time suggested until vegetation is no longer resistant to re-burning. Some earlier scientific literature suggested that chaparral species would resist fire until 30-40 years old; however, more recent observations suggest that either this earlier estimate was an underestimate (potentially based on a low number of fires observed) or that the fire return interval has actually decreased (i.e., vegetation is ready to burn again in a shorter time period) potentially due to increased fire ignitions, invasive species, or climate change. Either way, Kolden and Abatzoglou (2018) reported that while the Thomas Fire burned predominantly in 31-40 year old vegetation, over a quarter of the fire (27%) burned in <30 year old vegetation. This was evident to the research team in the Montecito area, as they observed areas of 9-year old vegetation that grew after the 2008 Tea Fire scorched and fully consumed on some slopes.

Anywhere on the District that is currently in grass, either through type conversion or temporarily following the Thomas Fire, has the potential to burn at any time of year in any given year due to annual climatic cycles in California. The Mediterranean climate produces annual grass growth in response to winter and spring rains and cooler temperatures, and rapid curing under summer drought and high temperatures. Oaks that have survived the Thomas Fire, particularly the vigorous resprouter tan oak, should regenerate rapidly and begin to rebuild flammable litter substrate within a few years. Similarly, chaparral species such as Manzanita and chamise should begin to resprout and potentially be available to re-burn in 10-15 years. By 20 years post-fire, any fire-resistant properties of early shrub growth rapidly declines, and unaltered shrub dominated landscapes should produce sufficient litter and dead material to support running shrub crown fire and active ember dispersal.

3.1.3 Wildlife

Riparian systems are found wherever streams drain from the Santa Ynez Mountain Range, with vegetation in these drainages consisting of species such as oaks, sycamore, and willows. These riparian corridors typically resist fire due to higher moisture levels and shading, but can burn under extreme conditions, as occurred in the Thomas Fire. Wildlife uses these corridors to meet a variety of basic needs, with greater biodiversity supported at the interfaces of the upland chaparral systems and the riparian corridors (and leading to most of the riparian systems being classified as environmentally sensitive areas). Dominant faunal communities in this ecosystem are smaller avian species (e.g., songbirds), small mammals, reptiles, and insects. These species primarily survive fire either in ground burrows or in fire refugia, with most species able to recolonize rapidly after wildfires from surrounding intact habitat (van Mantgem et al. 2015).

As noted in section 2.1.4, nearly 80% of the area burned by the Thomas Fire in Environmentally Sensitive Habitat Areas (ESHAs) in Santa Barbara County burned at moderate to high severity, and the subsequent January 2018 debris flows further negatively impacted ESHAs and riparian areas. This likely negatively impacted wildlife populations using these corridors, and the recovery period for these populations is likely to be on the order of years to decades depending on habitat and cover needs.

3.2 CLIMATE

The Santa Barbara Front, like much of southern California, is described as a Mediterranean climate, and this description is also applied to the vegetation communities found in the area, which are primarily determined by the climatic regime. Mediterranean landscapes are generally temperate, being dominated by maritime influences that limit the annual temperature range to approximately 10-20 degrees Fahrenheit (F) difference between the mean January and July temperatures. Winter temperatures generally remain above freezing, while summer temperatures generally remain moderated by the effects of a daily onshore breeze and a moisture-laden marine layer (i.e., a coastal fog) that forms at the interface of land and sea.

3.2.1 Climate Change

While global climate change is often reported as an average rise in temperature (i.e., warming) for the entire planet, the observed changes are highly variable across the globe and even within small countries and states such as California. Changes in temperature, precipitation, and other meteorological phenomena are also variable both across the seasons of the year, and in terms of the intensity of extreme events. As wildfire tends to occur under extreme conditions in the Planning Area, namely hot, dry Sundowner wind events, it is critical to understand how climate change specifically impacts both the frequency and intensity of these extreme weather events, as well as how it affects the vegetation fueling the fire.

Fire-climate relationships in the area including the District have been difficult to tease out in the scientific literature, for two primary reasons. The first reason is that the broader Southern California area is typically treated holistically as one region, but there are two very distinct fire seasons: one season occurs during the summer and is primarily driven by dry fuels inland with steep topography and the other season occurs during the autumn that is primarily wind-driven (Kolden and Abatzoglou, 2018). Fires in the region also follow this bi-modal pattern according to conditions for Sundowner wind events. The second reason it can be difficult to understand fire-climate relationships is that different climate factors tend to control fire activity in forested and non-forested (shrubland and grassland) sites. In the shrublands that comprise the District, an area burned during a wildfire is generally associated with high temperatures and drought conditions in spring, summer, and fall often following a year of slightly above normal precipitation that facilitates fine fuel growth (Abatzoglou and Kolden, 2013).

The south coast of California has warmed 2.7° F in the last 100 years (Figure 3) with mean temperatures in 2014, 2015, and 2016 as the top three hottest years for the region since 1895. The warming has occurred across all four seasons and for both daytime highs and nighttime lows, but the greatest warming are the nighttime lows, particularly in spring, summer, and fall. By contrast, both annual and seasonal precipitation has not changed significantly over the past century. These trends support anecdotal observation from fire suppression personnel that fires are more active at night now than they have been in the past, which is consistent with reduced nighttime relative humidity recovery.

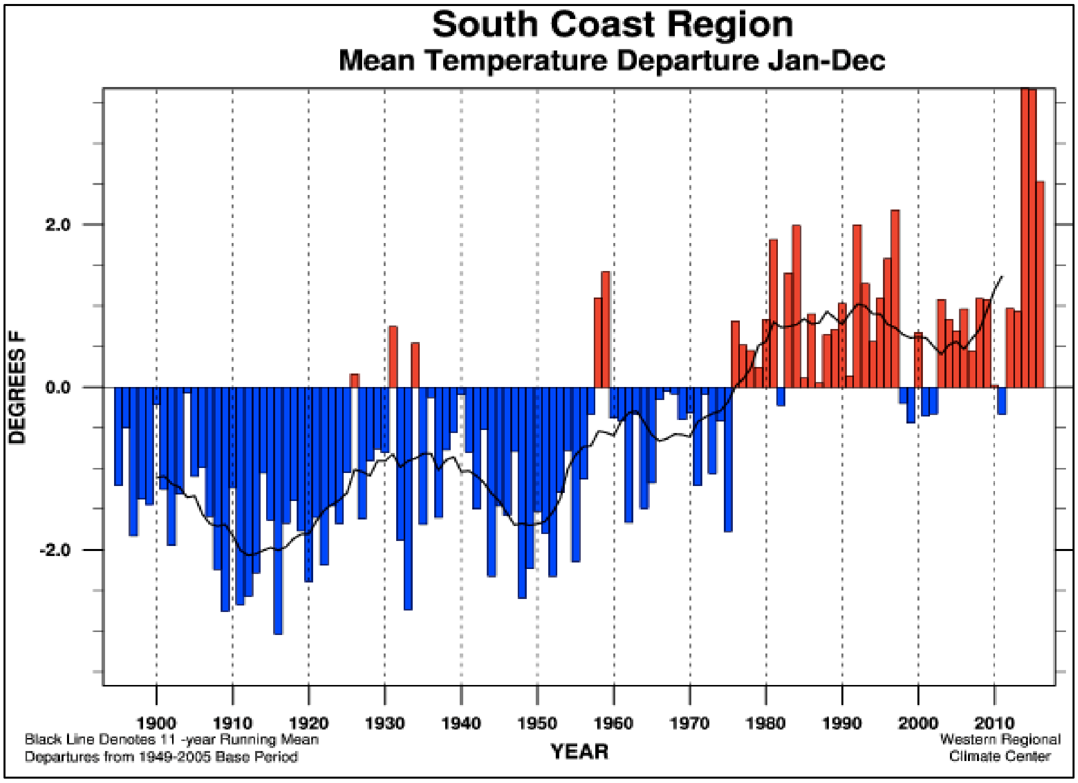
This reduced nighttime humidity recovery across spring, summer, and fall seasons is a contributing factor to an observed trend towards increased fire danger, specifically because fuel aridity is higher and fuels are less resistant to fire spread (Abatzoglou and Williams, 2016). When a Sundowner wind event develops in conjunction with low fuel moisture (i.e., high fuel aridity) there is a greater probability of rapid fire spread and the development of large, longer duration wildfires (Rolinski et al. 2016). These were the conditions that occurred during and fueled the growth of the Thomas Fire

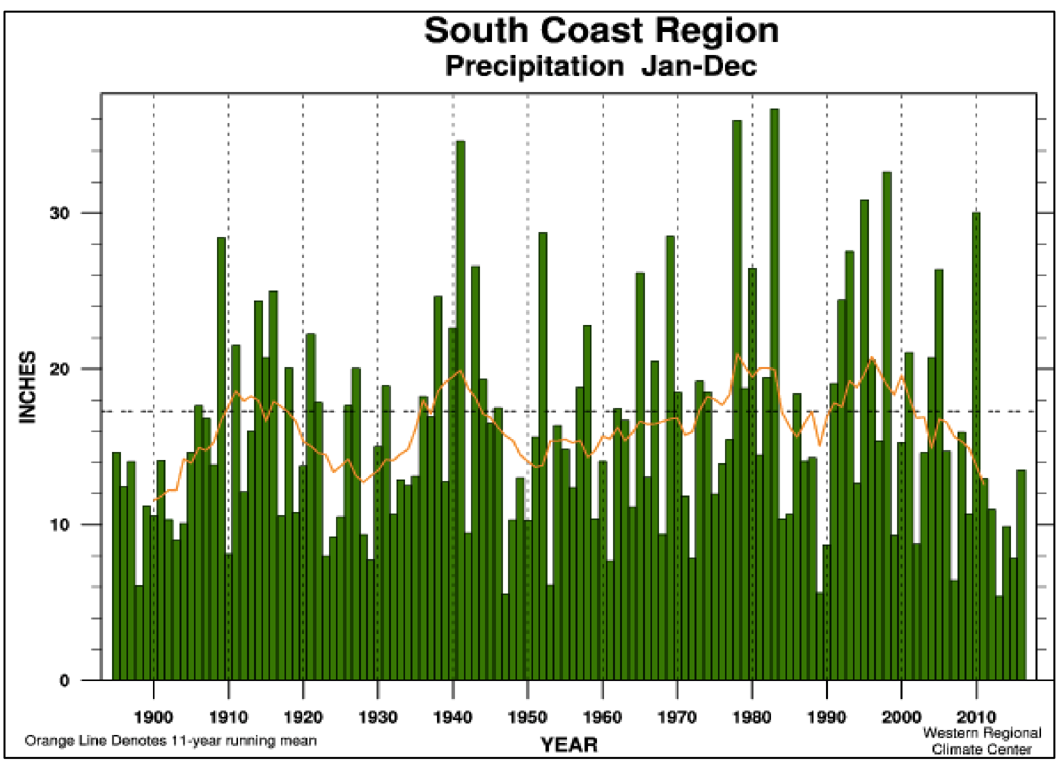
Projections of future climate change are modeled based on anthropogenic (i.e., human) emissions of greenhouse gases, but also account for natural climate variability. Increases in fire activity across the western United States have been definitively partially attributed to anthropogenic climate change (Abatzoglou and Williams, 2016), so there is high confidence that projections of future climate will have implications for fire (i.e., these trends aren't just part of Earth's natural climate variability).

In the area including the District, there is a projected temperature increase of an additional 3-4°F by 2070, with increases seen across all seasons, and for both maximum and minimum daily temperatures (Abatzoglou, 2013). In contrast to high relative certainty that temperatures will continue to increase, there is less certainty about how climate change will impact precipitation. Winter, summer, and autumn precipitation amounts are projected to remain relatively consistent with the present, but spring precipitation is project to decline slightly.

This combination of even warmer temperatures year-round and drier springs would facilitate increased large fire probably at all times of the year, but especially during the spring period when Sundowners are currently frequent (May-June) but vegetation is often too wet to burn. Currently, most large fires occur during the autumn, but a period of drier vegetation in the spring coinciding with Sundowner wind events would facilitate more area burned, faster rates of spread, and more intense fire behavior than has historically been seen during spring fires.

Figure 3 Mean annual temperature and annual precipitation for the South Coast Region from 1895 - present (California Climate Tracker)





The frequency and timing of Sundowner wind events themselves has not been addressed in the context of climate change impacts, as changes in extreme meteorological wind events is one of the most difficult areas of climate change impacts to predict. However, studies projecting changes in Santa Ana wind events have suggested that Santa Ana winds may shift to later in autumn, and potentially become more frequent (Miller and Schlegel, 2006). Given that the same atmospheric pressure conditions produce both Sundowners and Santa Ana winds, it's likely that this may also apply to Sundowner potential, thus extending the fire season to later in autumn.

3.2.2 Drought

Drought is an annual summer occurrence in the region; drought is defined as a water deficit relative to evapotranspiration demands. However, multi-year droughts are of particular concern for the District and much of California, as such droughts produce extensive vegetation mortality and fuel larger wildfires (Abatzoglou and Williams, 2016). Under climate change, extended multi-year droughts are projected to increase across California (Diffenbaugh et al., 2015), increasing the probability for large wildfire events associated with these prolonged periods without sufficient moisture.

3.3 LOCAL FIRE HISTORY

The Thomas Fire was added to the large fire history table.

Table 1 Large Fire History

Fire Name	Date	Estimated Fire Size (acres)	Structures Lost	Fatalities
Thomas	December, 2017	281,893	1,063	2
Jesusita	May, 2009	8,733	160	0
Tea	November, 2008	1,940	210	0
Painted Cave	June, 1990	4,900	440 homes, 28 apartments, 30 other structures	1
Sycamore Canyon	July, 1977	805	195	0
Romero Canyon	October, 1971	15,650	4	4
Coyote	September, 1964	65,339	106	1

3.4 MONTECITO'S WILDLAND FIRE ENVIRONMENT

The interaction of fuels, topography and weather all affect the likelihood of a fire starting, the speed, direction and intensity of the fire and the resistance to firefighting control efforts. The Thomas Fire has significantly altered the fuel component of the fire environment while the subsequent debris flow resulted in changes in topographical component. This section describes the wildland fuels component that now surrounds the community of Montecito, but should be reevaluated in a CWPP update in 5 years.

3.4.1 Fuels

The Thomas Fire has significantly altered the fuel component of the fire environment, particularly north of Bella Vista Drive, Park Lane, and East Mountain Drive roads. The change is most discernable on the east side of the community where an absence of recent wildfires provided a continuous mature chaparral fuel bed to support fire spread. As the Thomas Fire spread west within the community, it interacted with both the Tea and Jesusita fire burns where a younger, less dense fuel bed acted as a partial barrier to fire spread. Firefighters who were actively engaged in suppression actions on the December 16th and 17th, 2017 stated that fire intensity immediately decreased as the main fire burned into these younger fuels and that spot fires within the recent burn areas did not actively spread.

Very little of the Thomas Fire spread south of Bella Vista Drive and East Mountain Drive and the impacts of the January 2018 debris flow had a larger effect on the fuels south of these roads than did the fire. Major drainages had the entire vegetation component scoured out or covered in debris. Narrow incised drainages, such as Romero and Hot Springs canyons, which once supported dense riparian vegetation, are now largely void of vegetation. The burned areas not heavily impacted by the ensuing flood will likely regenerate, but rates of regeneration and species composition are highly dependent upon several uncertain factors. While chaparral generally follows a well-document post-fire recovery trajectory, wherein re-sprouting occurs rapidly post-fire and cover generally exceeds 80% within 10 years, the Thomas Fire was unprecedented in its timing, its size, and the observed post-fire effects. The lack of sprouting four months post-fire suggests that the regeneration process may be slower or altered due to the fire intensity, drought stress pre-fire, post-fire erosion levels, or other factors. Regeneration is also dependent upon future weather, and climate change research suggests that even more extreme conditions, including drought, erratic precipitation patterns, and heat waves, are likely to occur. Any of these climatological processes can further inhibit regeneration processes. Additionally, if invasive grasses are able to capitalize newly disturbed sites and establish in areas that were previously chaparral, this will fundamentally alter the fuels and the fire regime and facilitate a higher probability of a sooner-than-expected return of wildfire to the landscape.

It is also important to note that while the Thomas Fire consumed vegetation above the high road system, much of the District was not impacted and fuels in the more developed areas of the community remain available to burn. This is particularly important where one or more properties contribute to a dense pocket of fuel within the community, as an ignition in one of these wildfire enclaves could support a localized fire with the potential to impact dozens of homes or more. This scenario was observed in July 2018 to the west of Montecito, when the Holiday Fire ignited in a rural subdivision above Goleta and consumed 13 structures while only burning 113 acres. Incidents such as the Holiday fire and the 2017 Tubbs fire in Santa Rosa act as reminders of the potential damage a wildfire can cause a community under extreme weather conditions and that burning structures act as major ignition sources during high wind events.

Finally, riparian fuels do not follow the same recovery trajectory that upslope chaparral areas do, and will likely take sufficiently longer to regenerate, particularly given the post-fire debris flow.

The debris flow removed trees to their roots, filled the stream channels, and left broad alluvial plains of uncompacted silts along drainages. It is possible that there will be a significant lag in regeneration of riparian vegetation, and that continued erosion of the uncompacted alluvium over the next several years will facilitate multiple re-colonization events before riparian vegetation is able to fully establish.

3.4.3 Topography

Within the community, the erosion and debris flow event substantially altered topography in the riparian areas, while areas outside of the Thomas Fire footprint remain relatively unchanged. Above the high road system (East Mountain Drive, Park Lane, and Bella Vista Drive) that runs along the upper edge of the alluvial fans that underlie Montecito, channels were widened and incised in some locations by the magnitude of the debris flow. In contrast, below the high road system, the sediment dispersion along the drainages left an alluvial plain of uncompacted sediments that has raised the elevation of these areas by up to 15 feet in some locations. It is unknown how landform changes will play out in the long term, given the ongoing debris removal efforts and further erosion in the coming years.

SECTION 5. WILDFIRE ASSESSMENT

The wildfire assessment for the areas outside of the Thomas Fire footprint found in the 2016 CWPP are still valid; however, the fire environment within the Thomas Fire burn area has changed substantially. Over the next five years, the greatest threat to the community of Montecito comes from wildland fuel enclaves found within the community and from areas of the 2009 Jesusita and 2008 Tea fires.

As described in the report, *A Defensible Community? A Retrospective Study of Montecito Fire Protection District's Wildland Fire Program during the 2017 Thomas Fire*, the wildfire assessment provided in the 2016 CWPP is valid concerning the potential impacts of a wind driven wildfire on Montecito. The tools and methodologies utilized in the CWPP to evaluate fire potential were appropriate and provided fire managers insights into the possible impacts on the community.

Given the recent changes to the fire environment, an updated wildfire hazard assessment was required to represent current conditions. The objective of this new fire behavior modeling exercise was to determine fire spread pathways under north/northeast wind conditions and identify areas where a future fire is most likely to spread into the community. These fire flow paths can be used to prioritize future fuel treatment locations. Fire models including FlamMap and WindNinja were used to determine the primary fire flow paths for Montecito (additional information on these models are available in the appendix).

Flow Paths show the most significant fire spread pathways

The results of the simulation show that north to northeast winds align with topography and push fire downhill into the community as evident during previous fires. North to south running ridgetops exposed to the wind are identified as the predominate pathway for fires to spread south under offshore wind conditions. Identifying the locations of these pathways in the field and observing their relationship to existing fuel treatments and values at risk are helpful in prioritizing areas for further treatment and structure hardening.

The District implemented a number of projects that were identified in the 2016 CWPP. Out of the 23 fuel treatment projects that were identified in the 2016 CWPP, all but 6 projects had been completed by the District and property-owners (See Figure 4, map of completed fuel treatments).

As noted in the *A Defensible Community? A Retrospective Study of Montecito Fire Protection Districts' Wildland Fire Program during the 2017 Thomas Fire* report, defensible space and fuel treatments implemented by the District contributed substantially to diminishing the impacts of the Thomas Fire on the community of Montecito. Much of this implementation occurred in partnership with property-owners and the District through programs such as the dead tree removal program, work crew engagement, the neighborhood chipping program, and property surveys. The defensible and reduced-fuel spaces on properties across the northern portion of the District filled in many of the gaps in the District fuel treatment network allowing firefighters to access and defend homes safely, which contributed to minimal structure loss in Montecito during the Thomas Fire. As such, a District priority should be the continuance and expansion of these community outreach efforts to facilitate structure hardening and fuel reduction across private property, particularly in areas where there is substantial dense vegetation that could support a wildfire in the community.

Utilizing the *A Defensible Community? A Retrospective Study of Montecito Fire Protection Districts' Wildland Fire Program during the 2017 Thomas Fire* report, the strategy and activities identified below can help mitigate the wildfire hazards and risks that now threaten Montecito over the next five years until an updated CWPP is completed. The following describes an updated fuels management strategy:

6.3 FUELS MITIGATION STRATEGY

As defined in the 2016 CWPP, the basis for this fuels treatment strategy for the community of Montecito is to *enhance wildfire protection for life safety, structures, and other values identified by community stakeholders while also protecting the visual quality of the community, watershed, and its biological and cultural resources.* This strategy is still valid post-Thomas Fire and provides the vision as to how the fuel management program will move into the future.

What has changed after the Thomas Fire are the priorities as to where the District and property-owners can direct their efforts. The treatment strategies required to best address the post-fire landscape may influence existing CEQA decisions and future proposed actions. At a minimum, existing and proposed projects should be reviewed for environmental compliance given the changes to the physical environment from both the fire and ensuing flood.

6.3.2 Prioritization of Fuel Treatment

The existing CWPP used modeled fire intensity to determine a fire hazard rating that was then applied to rank the Vegetation Management Units (VMUs) to establish a priority for future fuel treatments. With so much of the landscape north of Bella Vista and East Mountain roads burned

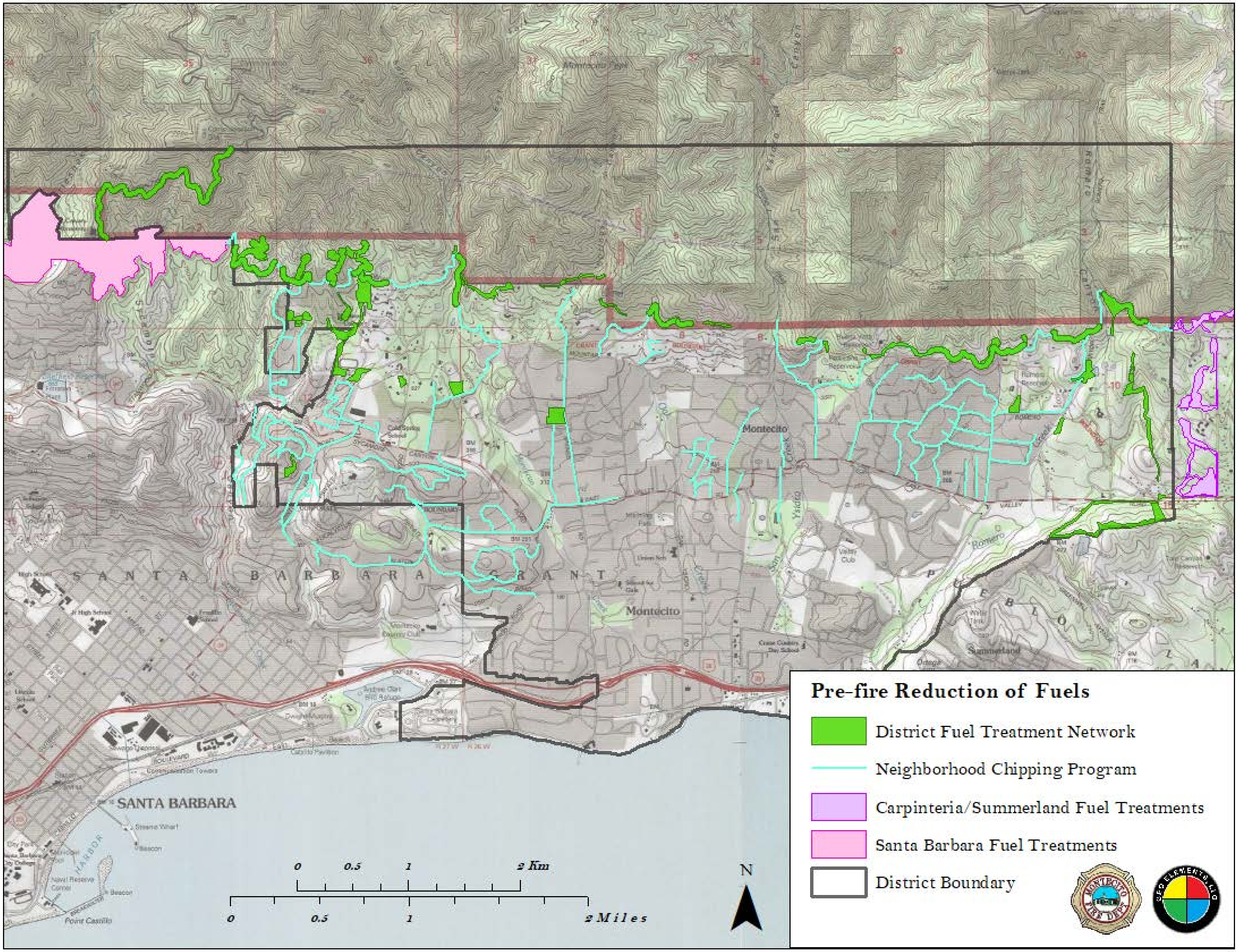


Figure 4 Fuel Treatments Completed Prior to the 2017 Thomas Fire

in the Thomas Fire, using fire intensity is no longer an appropriate methodology for setting fuel treatment priorities. The priorities presented below use many of the same principles as the existing CWPP while introducing a new tool, fire flow paths, to help identify priority fuel treatment locations. The priorities presented were vetted with the District's Wildland Fire Specialists.

The fire modeling software FlamMap and WindNinja were used for the purpose of this exercise. FlamMap, a spatially explicit fire model, was used to determine the major flow paths of a wildfire into the community. These flow paths can provide some guidance as to where fuel treatments may be most effective in disrupting the spread of a fire into the community from the north. The weather parameters used to determine these flow paths was similar to that observed on the fire ground during the Thomas Fire. Additional details regarding the fire modeling software and the inputs used to obtain the results can be found in the Appendix of this document. Using existing guidance from the CWPP and evaluating main flow paths for fires that may burn into the community in the future, the following priorities are recommended to guide the District's fuel treatment activities within the Thomas Fire footprint. Prescriptive guidelines outside of the Thomas Fire perimeter remain the same from the 2016 CWPP.

1. Maintenance of existing fuel treatments: This is the same high priority found in the existing CWPP. Many of these treatments were burned in the Thomas Fire and represent a unique opportunity for maintenance with considerably less effort and lower cost than under pre-fire conditions. The focus of this maintenance program should be the northern reaches of the community and the connected network of individual property-owner fuel reduction projects and those previously carried out by the District. The use of major fire paths should assist the District in identifying locations where fuel treatments may be most effective in providing community protection.

   Given that much of the fuel is gone in these areas as a result of the Thomas Fire, new fuel treatment guidelines serve to guide property-owners and the District within the Thomas Fire footprint (Table 2). These new treatment standards provide an opportunity to limit fuel loading over the long term by manually removing the root structure of burned chaparral vegetation using hand tools. The careful application of herbicide on freshly cut chaparral stumps is also an effective treatment to limit regrowth of vegetation.

2. Roadside Fuel Treatments. During post-Thomas Fire interviews, fire personnel noted that having clear travel routes and adequate turn-around areas for firefighting apparatus was key to the ability to engage in structure defense actions. These features also helped to promote a safe and efficient evacuation, therefore enhancing community fire safety. Maintaining these clear travel routes and looking for opportunities to improve turn-around space, especially for large fire apparatus is an important element of the overall fuel treatment program. The *high drives* provide the greatest challenges, particularity when considering turn-around space. Oak Creek Canyon Road, West Park Lane, Park Hill Lane and the high drives off of East Mountain Road provide little opportunity for larger engines to access structures or to establish safe operational space for structure defense. These locations should be priority for improving firefighting access and safe operational space.

Table 2 Fuel Treatment Prescriptive Guidelines within the Thomas Fire footprint

Location → **Fuel Type ↓**	**Primary Zone (A)** **(up to 50')*** (distance varies with terrain & accessibility)	**Secondary Zone (B)** **(50' – 100')*** (distance varies with terrain & accessibility)
Grass/ Forbs	Reduce fuel depth to 3 inches.	Treatment may not be needed.
Surface dead/down material (primarily correlated with tree and chaparral overstory)	Remove all large (>3-inches diameter) dead/down material.	Remove up to 75 percent of >3" diameter dead/down material.
Chaparral/Shrub	Remove all chaparral vegetation within this zone. Manually remove root balls to limit resprouting of chaparral. Property owners may consider the use of a commercial herbicide applied to freshly cut stumps to limit resprouting.	Remove up to 75 percent of chaparral vegetation. Manually remove root balls to prevent resprouting and to limit the density of the chaparral that does reoccupy this zone. Homeowners may consider the application of a commercial herbicide to freshly cut stumps to limit resprouting. Create an open stand characteristic with up to 40 feet spacing between chaparral plants. Any chipped or masticated material may be "blown" back onto the slope where feasible to enhance soil coverage.
Trees Overstory (without chaparral/shrub understory)	Limb all trees to 6-feet or ½ of the live crown in this zone, whichever is less. Trim branches protruding over the roadway or driveway to a minimum height of 13-feet 6 inches. Thin/remove smaller trees leaving larger trees (6-inch DBH specs) with crown spacing up to 20-feet.	Same treatment as Zone A; may decrease crown spacing to 10 feet in tree overstory.
Trees Overstory (with chaparral/shrub understory)	Thinning specifications, same as Trees Overstory (without understory), but remove all understory chaparral/shrubs below trees in this zone.	Same treatment as Zone A leaving occasional small, less dense chaparral/ shrub clumps and pockets in openings without canopy is acceptable.
* Treatment is subject to Architectural Design Standards and Oak tree guidelines in Montecito Community Plan.		

The same selective and manual removing of root structures and careful application of herbicides on regrowth is an effective treatment for improving access along the long drive ways. Fuel treatment prescriptive guidelines remain that same as presented in the 2016 CWPP.

3. The foot prints of the Tea and Jesusita fires. These areas have the highest potential fire intensity within and adjacent to the community. Both areas proved resilient during the Thomas Fire and did not support fire spread, even under severe fire weather conditions. This will change as the vegetation continues to grow, becoming denser and while also generating a larger dead fuel component within the chaparral.

   Because the Tea and Jesusita footprints support the oldest fuels, VMUs 101-105 in the 2016 CWPP should be considered priority locations for maintenance and when considering new projects. The fire flow path analysis provides a useful tool for identifying where new projects have the greatest potential for interrupting future fire spread. Fuel treatment prescriptive guidelines remain the same as presented in the existing CWPP.

4. Wildland enclaves and vacant parcels. Enclaves of wildland vegetation that exist within the community remain unchanged after the Thomas Fire and remain a wildfire threat. Locations along Eucalyptus Hill Road, Sycamore Canyon, Arcady Road, Barker Canyon Road, and the Hale Park should be considered priority locations when evaluating the urban enclaves. These areas remained relatively untouched during the fire and flood event and the wildfire hazard in the area persists. These locations are best represented by VMUs 117, 118 and 119 in the existing CWPP.

5. Where possible and appropriate, implement a shaded fuelbreak concept along the northern portion of the District using native shrubs and/or introducing oak trees or agricultural vegetation (citrus, avocado).

   a. Pros – Shading from trees and tall shrubs can help reduce soil erosion, depending on the amount of canopy – it may provide a somewhat cooler and moister understory, can reduce the potential for re-growth of shrubs, and can hinder the growth of some invasive species. Shaded fuelbreaks can be more aesthetically pleasing than unshaded fuelbreaks while still breaking up the fuel continuity that helps facilitate fire suppression and structure defense.

   b. Cons – Shaded fuelbreaks need to be much wider than unshaded fuelbreaks and spatial distribution of vegetation will need to change across a landscape based on topography and adjacent vegetation, an increased fuel loading, radiated and convective heat will likely be greater than an unshaded fuelbreak potentially affecting fire suppression resources, taller vegetation provides a source for ember development, is more costly and requires more maintenance than an unshaded fuelbreak. As with any fuel treatment or vegetation modification, ongoing maintenance is required.

6.4 POST-FIRE SOIL MITIGATION ACTIVITIES

When addressing post-fire soil erosion mitigation activities, consider the impacts for the future wildfire threat. As with wildfire, the greatest threat to the community from debris flows come from outside the District boundary. A common soil erosion mitigation strategy is planting trees or woody shrubs across hillside slopes, as root systems can stabilize slopes over time. Any such plantings should consider whether the species selected have fire-resistant characteristics, and whether the fire-resistant characteristics can feasibly be maintained over years to decades. Fire resistant characteristics include:

- High moisture content in leaves (these ignite and burn more slowly).
- Little or no seasonal accumulation of dead vegetation.
- Open branching habits (they provide less fuel for fires).
- Fewer total branches and leaves (again, less fuel for fires).
- Slow-growing, so less pruning is required (to keep open structure as noted above).
- Non-resinous material on the plant (i.e. stems, leaves, or needles that are not resinous, (oily, or waxy). Cypress, junipers, pines, spruces, and firs are resinous and highly flammable.

The pros and cons for shaded fuelbreaks identified above in 6.3.2 should be considered for planting any vegetation. Given that the Santa Barbara Front Country will inevitably see more wildfire, it will be critical to assess the trade-offs between short-term slope stabilization (on the order of 3-5 years) and long-term reduced wildfire potential in a future fire (on the order of 10-50 years).

SECTION 9. CWPP AMENDMENT RECOMMENDATIONS

The following opportunities and recommendations are provided in this Amendment to assist the District as they move forward with their community wildfire protection actions. Most of the recommendations were also identified in the *A Defensible Community? A Retrospective Study of Montecito Fire Protection District's Wildland Fire Program during the 2017 Thomas Fire* report.

- Continue to promote basic FireWise concepts concerning structure hardening and the management of vegetation within the Home Ignition Zone.
- Continue coordinating with property owners, designers, and builders during the construction process to ensure that the issuance of Fire Protection Certificates and related condition letters address the components outlined in the Montecito Fire Protection Plan.
- Continue to require property-owners to use the *Knox Box* system with back-up power for driveway access.
- Continue to educate the public and discourage the use of flammable landscaping within 200-feet or more of a structure.
- Based on the fire behavior observed during the Thomas Fire and the need for greater safe operational space for life safety by firefighters, consider extending fire code defensible space to 200- feet utilizing the prescriptive guidelines in the 2016 CWPP.
- Since most of the wildland vegetation above Montecito was burned off during the Thomas Fire, now is the time to design projects that significantly limits regrowth and breaks up the continuity of chaparral within 300-feet of the upper most structures along the northern perimeter of the District. These projects will serve as a buffer between the community and the wildland vegetation of the Los Padres National Forest, while also encompassing more remote structures on private land within treated fuel beds.
- Work with property owners to connect any gaps and widen the fuel treatment buffer north of East Mountain Drive/Bella Vista Drive.
- Support property-owner initiated fuel treatments and include such treatments within the database of the greater Montecito fuel treatment network.
- Typically, one wildfire in the Santa Barbara Front Country threatens multiple jurisdictions simultaneously. Consider working with cooperators to establish a holistic approach to the wildfire threat by developing a comprehensive strategic landscape level fuel treatment plan across the entire Santa Barbara Front Country.
- Consider working with local cooperators to utilize the Los Padres National Forest Strategic Fuel Break Assessment for the Santa Barbara Front to expand the existing Camino Cielo fuel treatment system and identify critical lateral ridgelines, such as the maintenance of the Horseshoe Fuel Break, where additional fuel treatment systems could be established to further enhance community protection.

- Develop a monitoring plan to track chaparral growth and invasive species in disturbed areas. This information should inform the timing of maintenance treatments within the fuel treatment network of the community.
- Efforts to mitigate post-fire erosion should consider potential long-term impacts to the community related to wildfire. Considerations should include an increased fuel loading, the use of vegetation with fire resistant characteristics, fire safe design and spatial distribution of vegetation, water use in the drought-prone area, long-term maintenance of any planted vegetation (up to 50 years), and potential environmental impacts.
- Consider working with a biologist to develop *Best Management Practices* in riparian areas and ESHAs to create more fire resilient habitat especially when necessary to accomplish appropriate defensible space and reduce fire intensities in strategic locations.
- Seek innovative structure hardening programs and methods to enhance structure defensibility.
- Consider seeking opportunities to develop a cost-share grant program to share the costs of structure hardening or replacing flammable vegetation with more fire-resistant vegetation.
- Consider establishing a program that recognizes property-owners for implementing fuel treatments and structure hardening projects, as well as utilizing fire safe landscaping.
- Review lessons learned from recent wildfires and consider updating the evacuation plan for the community of Montecito.
- Develop educational material based on lessons learned from the Thomas Fire. Consider using portions of the structure damage assessment of the *A Defensible Community? A Retrospective Study of Montecito Fire Protection District's Wildland Fire Program during the 2017 Thomas Fire* report as an educational tool when working with property owners on improving the wildfire resilience of their property.
- Consider establishing a formal site visit for the Thomas fire. The incident provides an opportunity to educate local residents and other interested stakeholders on the importance of prefire preparedness actions and how they were used specifically in the defense of the community of Montecito.
- In five years, the District should consider updating the wildfire hazard assessment and CWPP Amendment.

SECTION 10. REFERENCES

Abatzoglou JT, Williams AP (2016) Impact of anthropogenic climate change on wildfire across western US forests. Proc Natl Academy Sci USA 113:11770–11775

Abatzoglou, J. T. (2013), Development of gridded surface meteorological data for ecological applications and modelling. Int. J. Climatol., 33: 121–131.

Bowman, D.M., Moreira-Muñoz, A., Kolden, C.A., Chávez, R.O., Muñoz, A.A., Salinas, F., González-Reyes, Á., Rocco, R., de la Barrera, F., Williamson, G.J. and Borchers, N., 2018. Human–environmental drivers and impacts of the globally extreme 2017 Chilean fires. Ambio, pp.1-13.

California Natural Diversity Database; Generated by Crystal Abatzoglou using <www.wildlife.ca.gov/Data/CNDDB>, (09 August 2018).

Diffenbaugh, N.S., Swain, D.L. and Touma, D., 2015. Anthropogenic warming has increased drought risk in California. *Proceedings of the National Academy of Sciences*, p.201422385.

Keeley, Jon & Fotheringham, Cj. (2001). Historic Fire Regime in Southern California Shrublands. Conservation Biology. 15. 1536 - 1548. 10.1046/j.1523-1739.2001.00097.x.

Kolden, C.A.; Abatzoglou, J.T. (2018). Spatial Distribution of Wildfires Ignited under Katabatic versus Non-Katabatic Winds in Mediterranean Southern California USA. Fire 2018, 1, 19.

Miller, N. L., and N. J. Schlegel (2006), Climate change projected fire weather sensitivity: California Santa Ana wind occurrence, *Geophys. Res. Lett.*, 33, L15711, doi:10.1029/2006GL025808.

Rolinski T, Capps SB, Fovell RG, Cao Y, D'Agostino BJ, Vanderburg S (2016) The Santa Ana wildfire threat index: methodology and operational implementation. *Weather and Forecasting* **31**, 1881–1897.

van Mantgem, E.F., Keeley, J.E. & Witter, M. fire ecol (2015) 11: 128. https://doi.org/10.4996/fireecology.1103128

Van de Water, K.M and Safford, H.D. Presettlement Fire Regimes. Fire Ecology (2011) 7: 32.

Fire Behavior Notes

The objective of this fire behavior modeling exercise was to determine fire spread pathways under north/northeast wind conditions and identify areas most vulnerable to its effects. This information can be used in prioritizing future fuel treatment locations. The computer programs FlamMap and WindNinja were used for the purpose of this exercise.

FlamMap is a fire behavior mapping and analysis program that computes potential fire behavior characteristics (such as spread rate, flame length, and fireline intensity) over an entire landscape using constant weather and fuel moisture conditions for an instant in time. The minimum travel time (MTT) feature in FlamMap is a two-dimensional fire growth model (Finney, 2002). It calculates fire growth and behavior by searching for the set of pathways with minimum fire spread times from point, line or polygon ignition sources.

WindNinja is a computer program that computes spatially varying wind fields for wildland fire and other applications requiring high resolution wind prediction in complex terrain. Outputs of the model are ASCII Raster grids of wind speed and direction (for use in spatial fire behavior models such as FARSITE and FlamMap), a GIS shapefile (for plotting wind vectors in GIS programs), and a .kmz file (for viewing in Google Earth).

For the purpose of the exercise wind direction and speed are averages derived from Montecito #2 RAWS on December 16, 2017. The wind speed uses the peak hourly gusts between 1:00 AM and 12:00 AM on December 17. The dead and live fuel moisture inputs are from the fire danger analysis completed in the Montecito Community Wildfire Protection Plan. These were computed from historical weather data from the Montecito RAWS located on Montecito Peak. FlamMap Inputs:

90th Percentile Weather Thresholds – Montecito RAWS, 1997-2014

Maximum Fuel Moistures			
1 Hour	**10 hour**	**100 hour**	**Live**
5%	6%	7%	76%

WindNinja Input		
Wind Direction (degrees)	Wind Speed	Wind Duration
17	30 mph	16 hours

Two runs were executed in FlamMap, one run (ninja_poly_path2) uses wind fields generated in WindNinja. A second run (ninja_poly_direction) does not use WindNinja data instead uses a direct input of wind direction and speed to determine fire spread pathways. The outputs of the two runs are similar and are best used in the field as a baseline for determining treatment location. On-site interpretation considering actual terrain, fuels and values at risk will aid in prioritizing fuel treatment locations.