ARABIAN ACRES

COMMUNITY WILDFIRE PROTECTION PLAN

PHOTOS COURTESY: DAVID K. JOHNSON

WILDFIRE PROTECTION GROUP

COMMUNITY WILDFIRE PROTECTION PLAN ACCEPTANCE

This management plan is a collaborative effort to guide our stewardship management activities, including wildfire protection. The activities recommended in this plan are appropriate to meet our objectives and will benefit the natural resources and reduce the risk from wildland fire. This plan is voluntary, and where possible, we intend to apply the recommended practices, thus improving our community and increasing public safety.

This document has been approved by the following:

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Larry Long, Colorado State Forest Service

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Chuck Buckley, Divide Fire Protection District

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Teller County Commissioner

PREFACE TO THE ARABIAN ACRES COMMUNITY WILDFIRE PROTECTION PLAN

Around 2:00 pm on June 11, 2013, El Paso County 911 received a report of a small fire on Falcon Lane in Black Forest. Weather that afternoon was hot, dry and windy. Even worse, the forest at the point of origin was neglected and unnaturally dense. Given these conditions, the fire quickly spread to the canopy of the forest, was driven by the wind and burned the homes and forest in its path.

That is until the fire reached the Cathedral Pines subdivision, where it dropped from the forest canopy to the ground. Although the fire burned through two-thirds of the subdivision, all homes in Cathedral Pines, except for one, survived the fire. At the request of Governor Hickenlooper, the Pikes Peak Wildfire Prevention Partners studied both the communities lost and the communities that survived the Black Forest Fire, and concluded that:[1]

Cathedral Pines about one month after the Black Forest Fire. The fire burned through the litter on the ground, but the trees, except for some scorched needles, remain green. The developer wisely chose to thin and restore the forest to historic densities preventing major losses when the fire came.

- In Cathedral Pines, forest restoration to pre-settlement tree density significantly reduced the fire intensity and gave firefighters a chance to protect the homes.
- Community forest restoration and fuel reduction were the most effective way to reduce wildfire risk, improve forest health and provide for firefighter safety.
- A mindset of "willful blindness" among may Black Forest residents contributed to the loss of homes and compromised firefighter safety.

The entire report and a companion video can be found at: www.ppwpp.org

[1] Pikes Peak Wildfire Prevention Partners et.al. (2014) *Black Forest Fire Assessment Team Report to the Governor of Colorado.* https://docs.wixstatic.com/ugd/4a6926_c45d665b78b0417bbfede7f0a846f4e6.pdf

The Arabian Acres Community Wildfire Protection Plan (CWPP) is intended to, first, analyze the wildfire hazard within the community and devise an orderly method to reduce our risk. As the plan notes, reduction of wildfire risk requires removal of fuel from the forest by cutting some trees, but the way that fuel is reduced greatly affects the values that make Arabian Acres a place we want to live.

This home in Cathedral Pines survived the fire. Forest restoration saved both the home and the forest setting prized by the community.

Thus the CWPP committee has taken the view the wildfire risk reduction is inseparable from the proper care and maintenance of our forests. The plan makes recommendations that not only remove fuel from the forest, but reflect the principles of proper forest stewardship. The CWPP is ultimately a plan to preserve the forest and the community for the future.

Forest restoration on the Black Forest School Section dramatically altered the fire behavior. Two months after the fire, the school section on the left is rapidly recovering.

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I. COMMUNITY IDENTIFICATION AND DESCRIPTION

LOCATION AND GENERAL DESCRIPTION

Arabian Acres is a Community of 374 residents located about four miles southwest of Divide in Teller County, Colorado. The Teller County CWPP identifies it at extreme risk for damage by wildfire.[1]

Several tributaries to Grape Creek bisect the community running to the west. These form a series of north and south facing slopes that have different vegetation. South slopes are usually dominated by ponderosa pine and the trees are more open. North facing slopes are forested with Douglas-fir and Engelmann spruce, and tend to dense forests with closed canopies. As will be noted later, these differences in forest type require different strategies of forest management and fuel reduction.

The drainages also create steep topography that will influence fire intensity and spread in several ways. Frist, wildfires would be expected to follow these drainages due to a natural chimney effect as warm air rising from the fire pulls air up the drainage. Second, also due to warm air rising, fuels uphill from the fire would dry out, and the fire would burn with greater intensity on steep slopes.

A drive through assessment of Arabian acres in April of 2017 brought to light the following hazards:

- In the event of a wildfire, travel into, out of and within Arabian Acres would be hazardous. The evacuation routes all have potential hazards. During a wildfire, evacuation by residents or access by firefighters could be blocked.

RESIDENTIAL SAFETY CHECKLIST

GET READY

___Dispose of or relocate combustible material from around your home.
___Trim trees and bushes allowing ample space between your home and landscape vegetation.

BE PREPARED

___Arrange your 'Go-Kit' with prescription medication, emergency supplies, important documents, and other essential items.
___Create your own action plan; involve your family and practice exit plans from the home and neighborhood frequently.
___Be sure you're familiar with local emergency notification systems and evacuation systems.

ACT EARLY

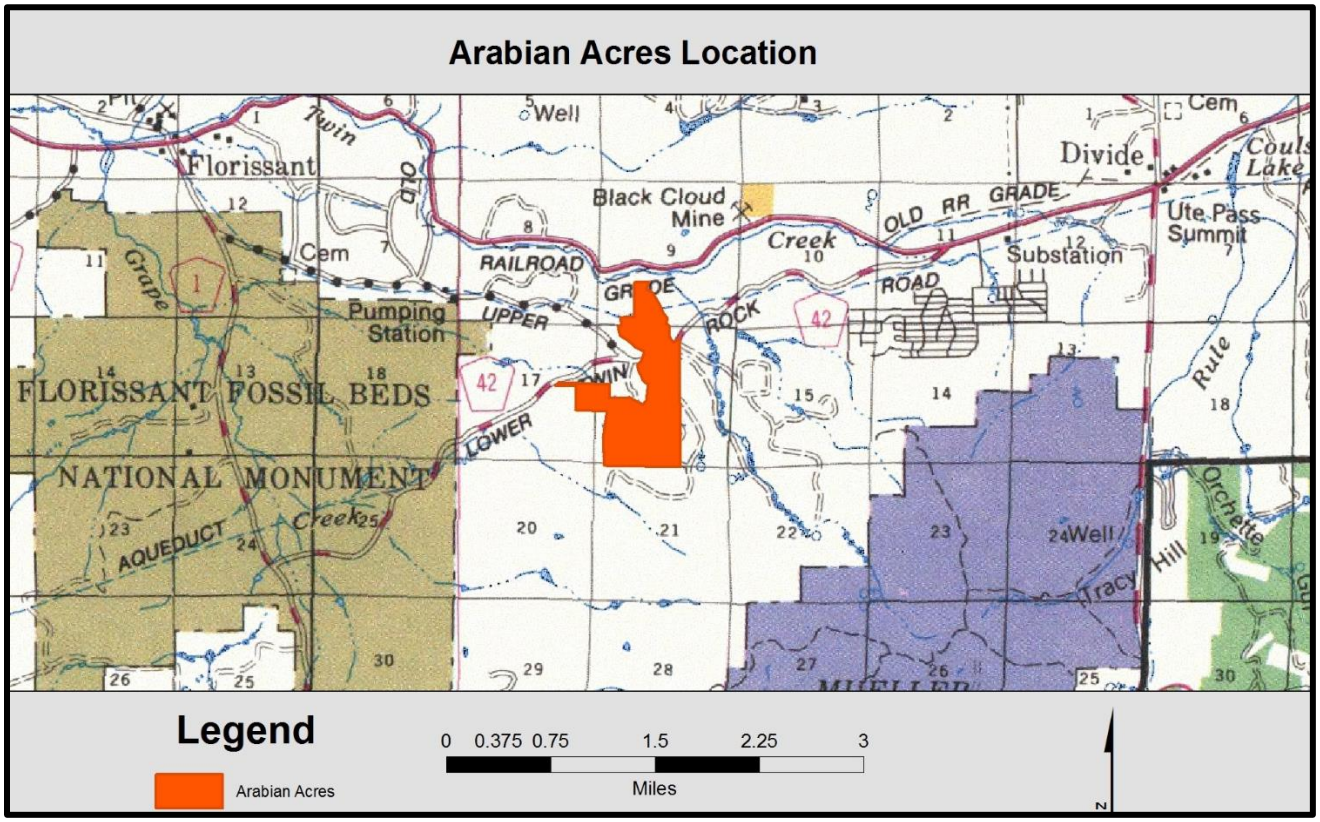
___Get your 'go-kit' and leave well before the threat approaches following a planned accessible route.
___Stay aware of the situation and follow your plan.
___Cooperate with local authorities during evacuation and re-entry

Source: Ready, Set, Go

[1] Campbell, Marti, et. al. 2011. *Teller County Community Wildfire Protection Plan Update.*

- Dense fuels crowding subdivision roads make evacuation by residents or access for firefighters dangerous or impossible.
- Roads often lack adequate street signs making navigation through the community difficult for emergency responders, especially in thick smoke.
- Many homes lack adequate address signage, and it would be difficult for firefighters to see homes in dense smoke, especially at night.
- Also, lack of adequate address signs makes homes difficult to locate in an emergency medical response.
- Wildfire risk is variable throughout the community. The most extreme risk is on north facing slopes where dense stands of Douglas-fir, spruce and pine make the possibility of an intense crown fire likely, but homes in grassy areas are also at risk.
- Many homes lack adequate defensible space and are extremely vulnerable to wildfire.
- Some homes with defensible space are compromised by manmade hazards in the yards, especially firewood piles and wooden fences attached to homes.
- Many propane tanks are unprotected against wildfire.

Arabian Acres is located a few mile west of the summit of the Hayden Divide. This high ridge separates the watersheds of the South Platte and Arkansas Rivers. Over twenty years both watersheds, which provide domestic water to households along the Colorado Front Range and beyond, have been severely degraded by large wildfires. A severe wildfire in the area will impact millions of households far from Arabian Acres.



Lands adjoining Arabian Acres are all privately owned land. Trout Haven and Whispering Pines subdivisions border the community to the east. Twin Rock and Palmer Village subdivision border Arabian Acres to the northwest. Private lands on the other borders are large, generally undeveloped tracts.

The Florissant Fossil Beds National Monument lies about one mile west of Arabian Acres. The Monument is administered by the U.S. Department of the Interior, National Parks Service. Mueller State Park is about a mile south and east of Arabian Acres, and is managed by the Colorado Department of Parks and Wildlife. Both are heavily visited attractions, drawing thousands of visitors each year. Both the Park and the Monument have active programs of fuel reduction and forest management in place.

Fire History

Many forces shape a forest. Among them are soil, climate, weather, fire and man. Wildfires have been part of the forest ecosystem since it began. Before European settlement our native forests burned frequently. With little time for fuels to accumulate between fires, most were low intensity fires that maintained forest as open stands with an understory of grasses and forbs.

Reconstruction of fire history and forest dynamics in the neighboring upper South Platte landscape, which is located immediately north and west of the community, reveal: (1) an average fire interval of about fifty years during the period 1300-1880, but no major fires between 1880 and 2002; (2) a mix of non-lethal surface fire and lethal, stand replacing fire in the historic burns (mixed severity fire regime); and (3) a striking increase in forest density from 1900-2002.

The extent of the high-severity Hayman burn in 2002 was unprecedented in the last 700 years, in part because of the dense forest conditions that had developed during the twentieth century, and in part because of the extreme drought and fire weather conditions that existed in 2002. Similar drought conditions contributed to the Waldo Cañon and Black Forest fires a decade later.

As forest lands were settled and fires were suppressed, forests became denser with closed canopies that choked out the grasses on the forest floor. Fuels accumulated in amounts large enough to maintain intense fires. Fires have become less frequent, but more damaging. As once open lands became subdivisions, all the requisite elements for a disaster were in place.

From observations of dense forests during the Firewise Community Assessment, it is clear that there have been no significant fires in Arabian Acres for many decades. The Hayman Fire of 2002 burned about six miles north of the community. In the ensuing years several significant fires burned to the south west, but did not directly impact Arabian Acres.

In 2012, the year of the Waldo Cañon Fire an arsonist was active in southern Teller County. Given the fuel conditions to the southwest and the prevailing southwesterly winds, any fire to the south or west of Arabian Acres would threaten the community.

II. COMMUNITY ASSESSMENT

GOALS AND OBJECTIVES OF THE CWPP

1) Creation of a Community Wildfire Protection Plan (CWPP):
   --Include objectives and priorities to address wildfire hazards.
   --Update and revise the plan as conditions change.
2) Partnerships:
   --Partner with federal, state, county and local agencies for expertise and assistance.
3) Create a spirit of community involvement:
   --create a spirit of participation and commitment in the community toward a common goal for the common good.
4) Ongoing education:
   --Increase individual and community awareness pertaining to wildfires, home and property protection, safety, sanctity of all life, and forest health.
5) Identify objectives that need to be addressed and prioritize projects to put them into action.

EMERGENCY INGRESS AND EGRESS

NOTICE TO EVACUATE. In case of a fire or other emergency, the primary notification to evacuate will be issued by the Teller County Sheriff by means of a reverse 911 call. Residents should follow directions provided in the recorded message. Other notifications may come from local TV and radio stations.

Reverse 911 calls are not automatically routed to cellular phones. Residents who rely only on cellular phones should register their cell phones with the El Paso-Teller County 911 Authority to be certain of emergency notifications. The website for notifications can be reached with the link below:

Reverse 911 calls are not automatically routed to cell phones. . .

Register cell phones with the El Paso-Teller County 911 authority to be sure of notifications.

http://www.elpasoteller911.org/246/Emergency-Notification-System

EVACUATION ROUTES. The southern part of the community has two exits onto Lower Twin Rock Road. The main exit is Denwood Drive. The second, Deer Ridge Trail, meets Lower Twin Rock Road with poor lines of site, and could be hazardous in the smoke of an evacuation. Evacuation routes from The Daniwood portion of Arabian Acres would be via Daniwood Grove to Upper Twin Rock Road. The Daniwood area has a potential evacuation route to County Road 42, but this is currently blocked by two locked gates.

Residents should follow the evacuations instructions and route given by the sheriff without delay!

Egress and access within the community is further hampered by dense fuels adjacent to subdivision roads posing a high risk to residents and firefighters alike.

In advance of a wildfire, it is impossible to know what the exact evacuation plan for Arabian Acres would be. Depending on the location and expected direction of wildfire spread, evacuation would likely be east on Lower Twin Rock Road toward Divide, or west on this road toward the Florissant Fossil Beds National Monument. Many other subdivisions may also evacuate on Lower Twin Rock, and it would likely be clogged with traffic. Access by firefighters will also be more difficult as a result of the number of people evacuating.

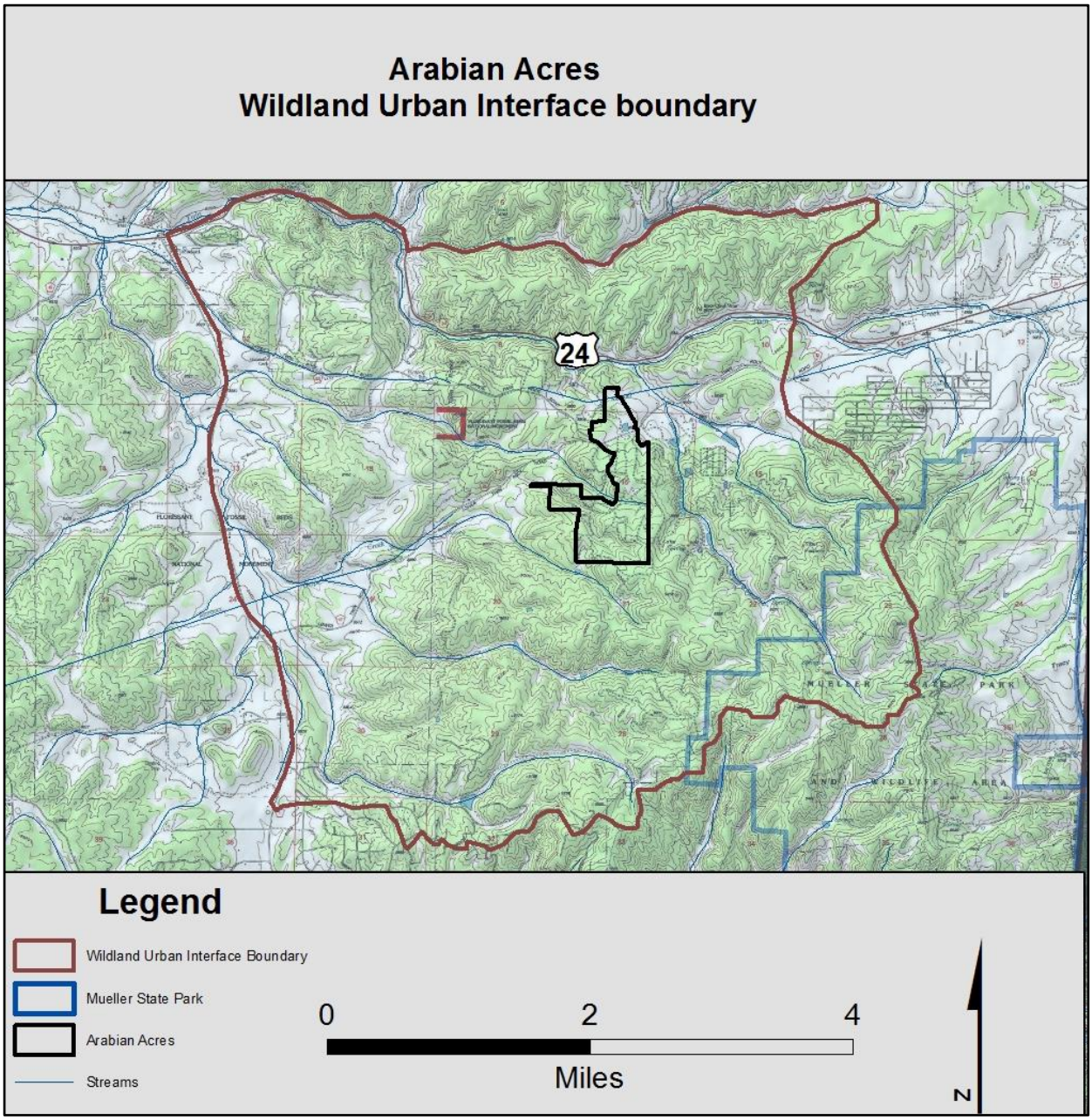
It is important to note that the fatalities in both the Waldo Cañon and Black Forest Fires were residents who did not evacuate in time. In the event of a fire, the Teller County Sheriff will determine the best evacuation routes and procedures based on expected fire behavior. Residents should follow the evacuations instructions and route given by the Sheriff without delay! If a fire is threatening the area, it is not necessary to wait for an evacuation order to leave.

WILDLAND URBAN INTERFACE BOUNDARY

The wildfire threat does is not only from within Arabian Acres, but from the surrounding area as well. For example fire brands (embers) can be carried by winds for more than a mile from the flaming front, starting new fires. The wildland urban interface (WUI) boundary is the area where a wildfire would be a threat to the community. The boundary was determined by analysis of surrounding fuels, potential fire intensity and terrain.

The Colorado Wildfire Risk Assessment Portal (CO-WRAP) wildfire behavior analysis program indicates that high intensity fires are likely to the south west of Arabian Acres. This hazard is increased by the weather patterns of prevailing winds from the

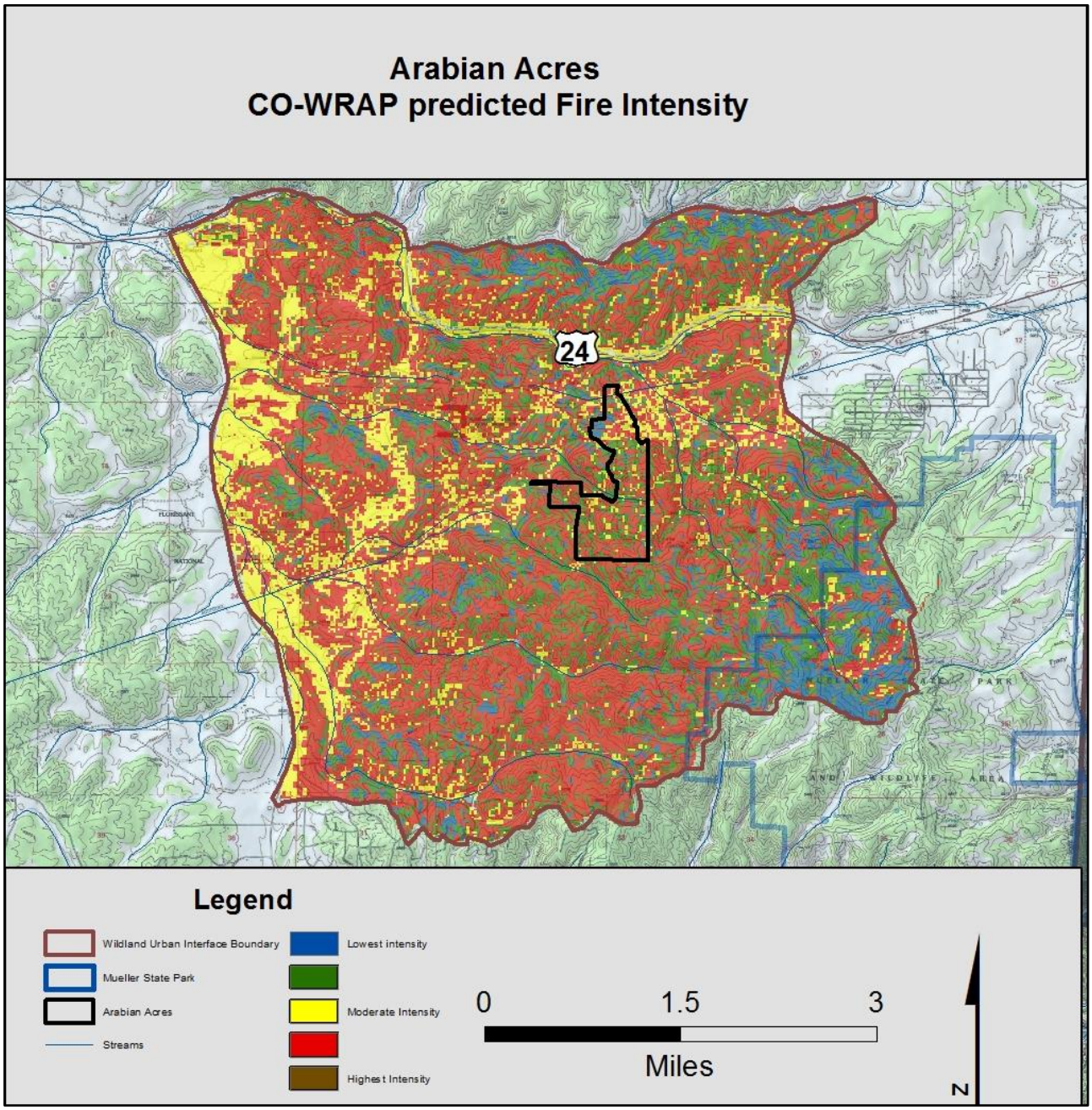
southwest. The southern WUI boundary was established along the ridge separating Grape Creek and Hay Creek.



The topography is characterized by drainages than flow across the community from east to west emptying into Grape Greek in the Florissant Fossil Bends National Monument. Fires to the west of Arabian Acres would tend to move up these drainages, especially when pushed by the prevailing southwesterly winds. The western WUI boundary was established along Teller County Highway 1. On the north, the WUI boundary follows U.S. 24 and the Twin Creek drainage to a point about 2.5 miles east of Florissant (where U.S. 24 turns south) then it follows an unnamed stream east. Several drainages flow into this creek from the south, and a fire burning

into one would reach one-half mile of Arabian Acres where firebrands (embers) could be blown into the community.

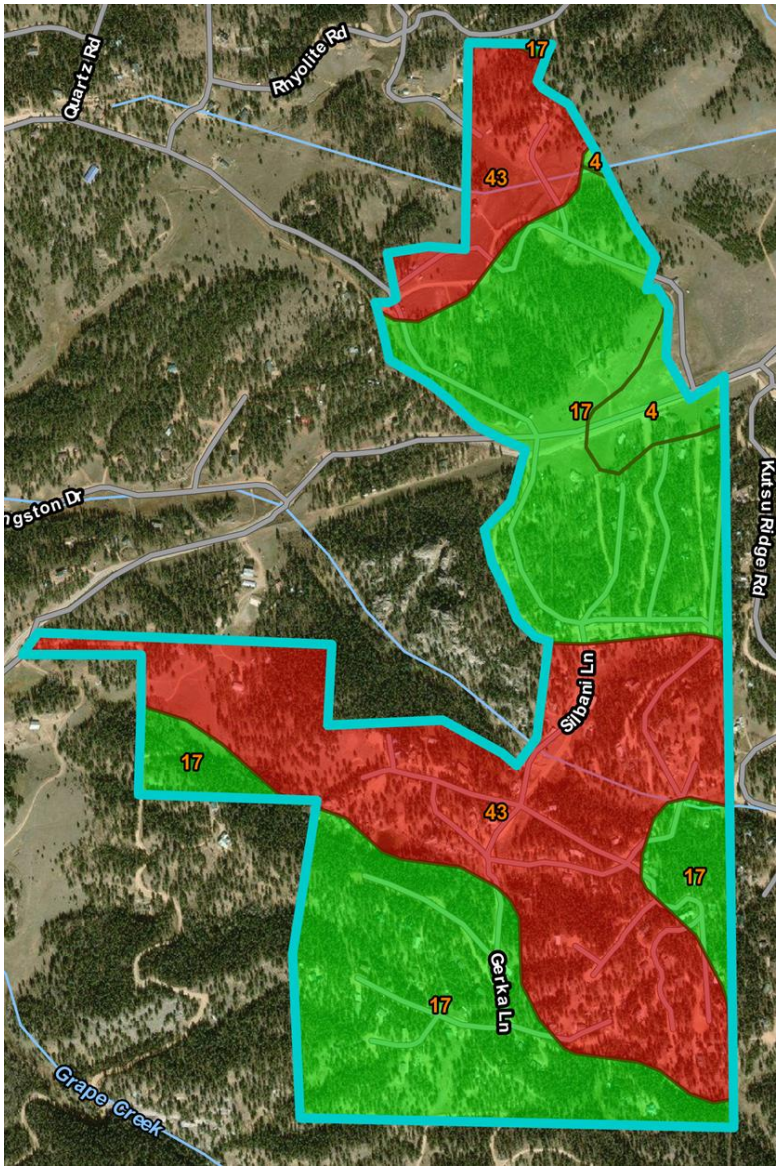
The eastern boundary follows the edge of the Grape Creek watershed. Although a fire above Arabian Acres would, under normal weather conditions, be expected to move away from the community, post fire flooding and erosion from drainages above Arabian Acres pose a threat. The section on soils explains this reasoning further.



WILDFIRE RISK

Fuels vary through the community, and tend to be related to aspect. North facing slopes are dense mixed conifer forests with a high risk for crown fires. South slopes are more open ponderosa pine with a grass understory and less risk for crown fires. Fires in these areas would be expected to burn in the grass. Higher winds in open forest areas would push the fires rapidly through the grass and the flaming front would move quickly.

Residents should know that rapid moving fires in grass can burn and damage homes. Risk reduction in grass fuels is as necessary as in forested areas. The wildfire intensity map on the previous page represents the CO-WRAP analysis of the wildfire risk in Arabian Acres. Wildfire risk is the chance that a fire might start or spread into the area. Most of the community is at a high risk for wildfire occurrence. When interpreting CO-WRAP data it should be noted that CO-WRAP predictions are based on the average of historical weather over time. Thus, CO-WRAP does not predict fire behavior on any given day, and weather conditions at the time of a fire greatly influence actual fire behavior and spread. For example both the Waldo Cañon and Black Forest fires burned during the most severe fire weather and not on average days. The effect of weather conditions on fire behavior is further explained in the section on fire behavior



POTENTIAL FOR SOIL DAMAGE FROM WILDFIRE IN ARABIAN ACRES. RED INDICATES HIGH HAZARD, YELLOW IS MODERATE AND GREEN IS LOW. SOURCE: NRCS SOIL SURVEY OF TELLER AND PARK COUNTIES, COLORADO

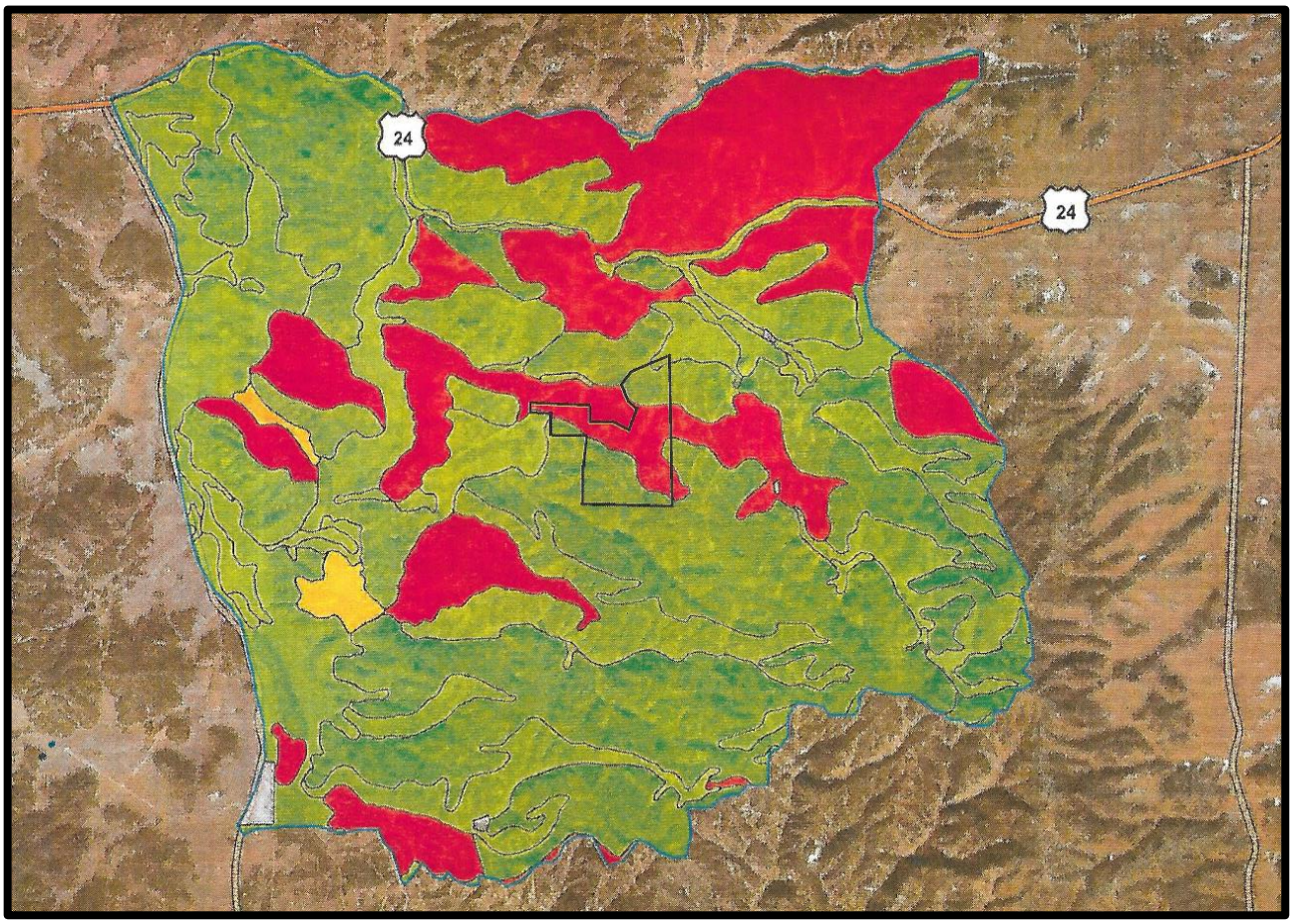
These fuels have high rates of spread under relatively mild weather conditions.

Local topography influences fire behavior and control. Prevailing west winds are funneled through the community. Slopes range from ten to over fifty percent with most hillsides ranging from twenty to thirty percent.

Potential Soil Damage by Fire: Severe wildfires damage not only the living resources, but soil as well. Heat from wildfires creates a thin layer of soil that is impervious to water called hydrophobic soil. When rain falls on hydrophobic soil, it will not penetrate, and runs downhill causing flash flooding and severe erosion. Small amounts of rainfall are sufficient to create major flooding for years after a fire.

Long after the flames and smoke are gone, the danger of flash floods and erosion continue. The threat should be considered on two scales: within Arabian Acres itself and from a broader scale of the drainages that pass through the community. Natural Resource Conservation Service soil data predicts the potential for damage to soils from wildfire.

Within Arabian Acres itself, 44%, the Guffey Rofork Association soils (Number 43 on the map) are high hazard for post fire erosion. Most of this soil type is concentrated



POTENTIAL FOR SOIL DAMAGE SURROUNDING ARABIAN ACRES IN THE ARABIAN ACRES WUI BOUNDARY. SOURCE: NRCS SOIL SURVEY OF TELLER AND PARK COUNTIES, COLORADO

in the intermittent drainages in the southern part of the community. The remaining soils, Catamount Guffey complex (number 17) and Altman gravelly loam (number 4), are low hazard.

Looking on the larger scale of the wildland urban interface, the threat of flash floods and erosion extend outside Arabian Acres along the intermittent streams mentioned above. Even a fire outside the community would still be a long term threat to Arabian acres.

Post fire flooding would also threaten to wash out roads in the area cutting off access into and out of the community. Emergency medical and law enforcement might not be able to reach residents.

PREPAREDNESS TO RESPOND

Arabian Acres is in the Divide Fire Protection District. The Divide Fire Protection District is responsible for providing fire suppression, emergency medical and rescue services within the one hundred square miles of area in north central Teller County, Colorado. The Divide Volunteer Fire Department is the primary service-provider for the District which was formed in 1999 by splitting the existing Divide/Florissant Fire Protection District.

The District covers significant portions of Pike National Forest and Mueller State Park, along with several large commercial structures such as the Teller County Sheriff's office and jail complex, Summit Elementary School and the Highlands Shopping Center. Approximately 2200 residences are scattered throughout the District in fourteen major subdivisions.

The terrain is mountainous and most of the District is comprised of mixed conifer forest with occasion expanses of grassy meadows. The Divide Fire Protection District is considered an "urban/wildland interface area" with most residential structures nestled into the wooded hillsides.

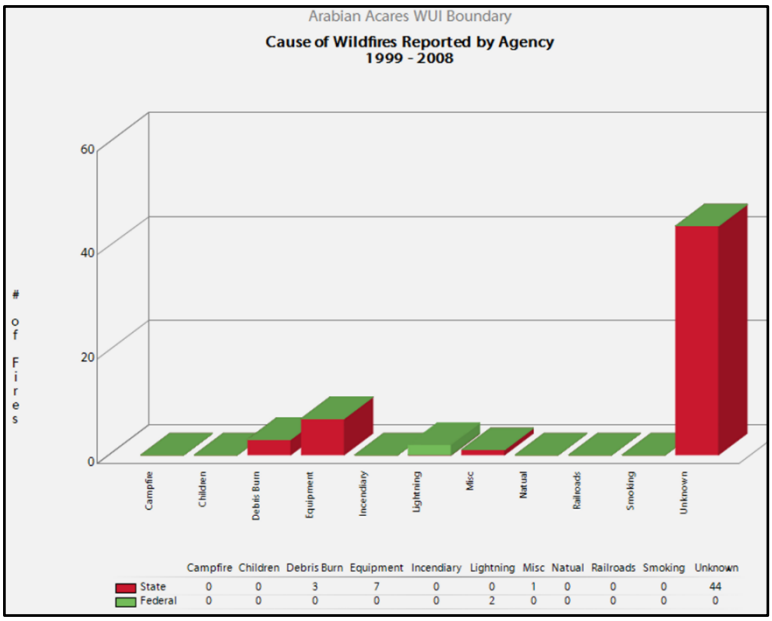
The District is currently served by a single centrally-located fire station located at 103 Cedar Mountain Road and a sub-station in the Rainbow Valley area at 18602 Highway 67 South.

The Divide Fire Protection District is proud to participate in a Mutual Aid agreement will all of our neighbors and cooperates with both the Division of Fire Prevention and Control and the U.S. Forest Service. Through this agreement, fire departments within Teller County are dedicated to assisting each other and providing resources for incidents such as wildland fires, structure fires, hazardous materials incidents and traffic accidents. Divide Fire receives and provides responses to Florissant, Northeast Teller County, Mountain Communities, Cripple Creek, Victor, 4 Mile and Lake George Fire Districts.

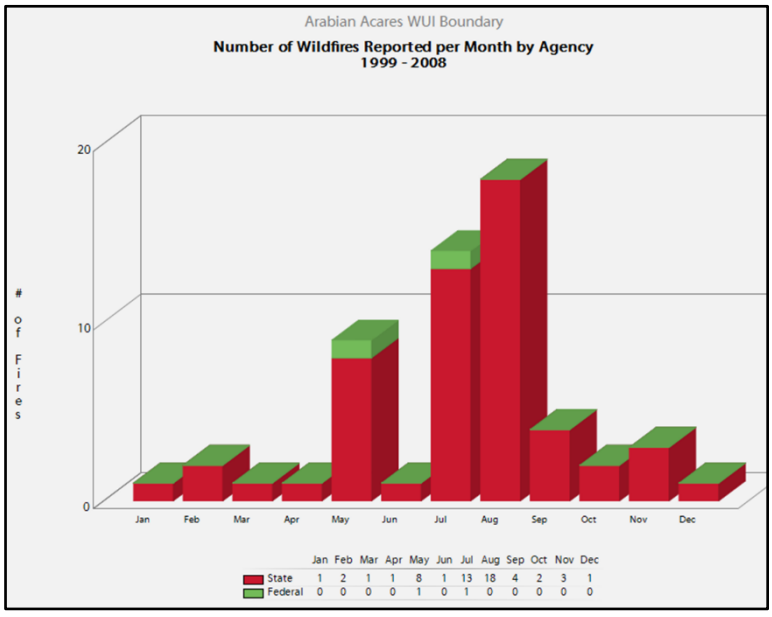
III Risk of Ignition and Wildfire Occurrence

CAUSES OF WILDFIRE IGNITIONS

CO-WRAP data collected from wildfire responding agencies between 1999 and 2008 indicate that the cause of most wildfires within the Arabian Acres WUI boundary was unknown. The most likely causes of wildfire ignitions are, equipment and debris burning.



CO-WRAP also provides data on the time of year wildfires are started. As would be expected, most fires are reported during the warm months, but fires are reported during every month of the year proving the fire season in Arabian Acres is twelve months of the year.



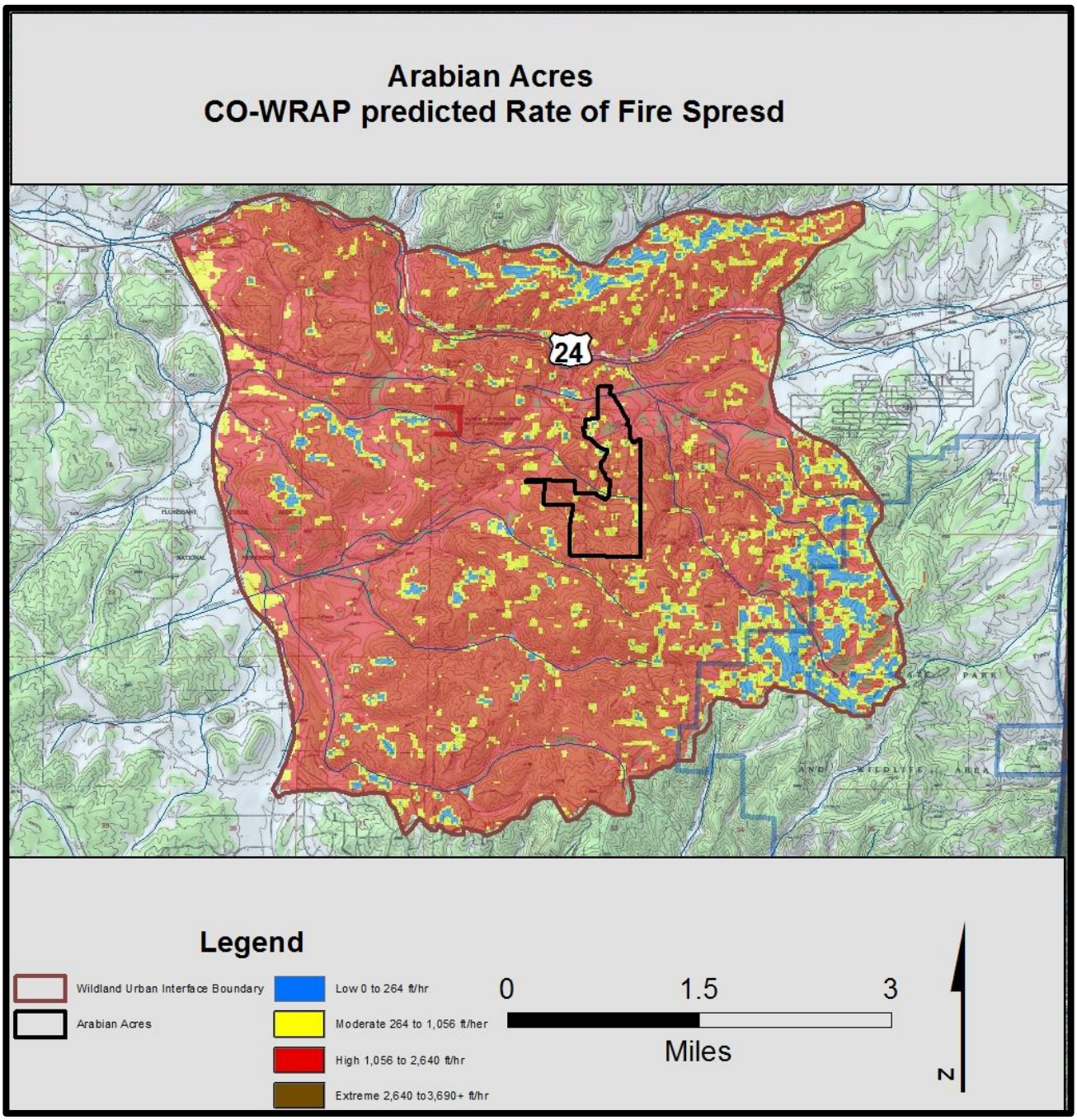
Low fuel moistures and relative humidity are common in the area, as are periods of high winds. When hot, dry and windy conditions coincide the stage is set for large wildfires. All recent large fires were caused by humans, and population continues to increase. Numerous fires are ignited each year by lightning. Except for portions of Florida, this area has some of the highest occurrence of lightning in the continental US.

Wildfires originating in or near communities cause the most concern, but fires starting well beyond the boundaries of the planning area can have profound effects upon the communities. Rapid rates of spread and long distance spotting are common for fires in the area. Areas with high to moderate fuel loading are the most worrisome.

FUEL HAZARDS

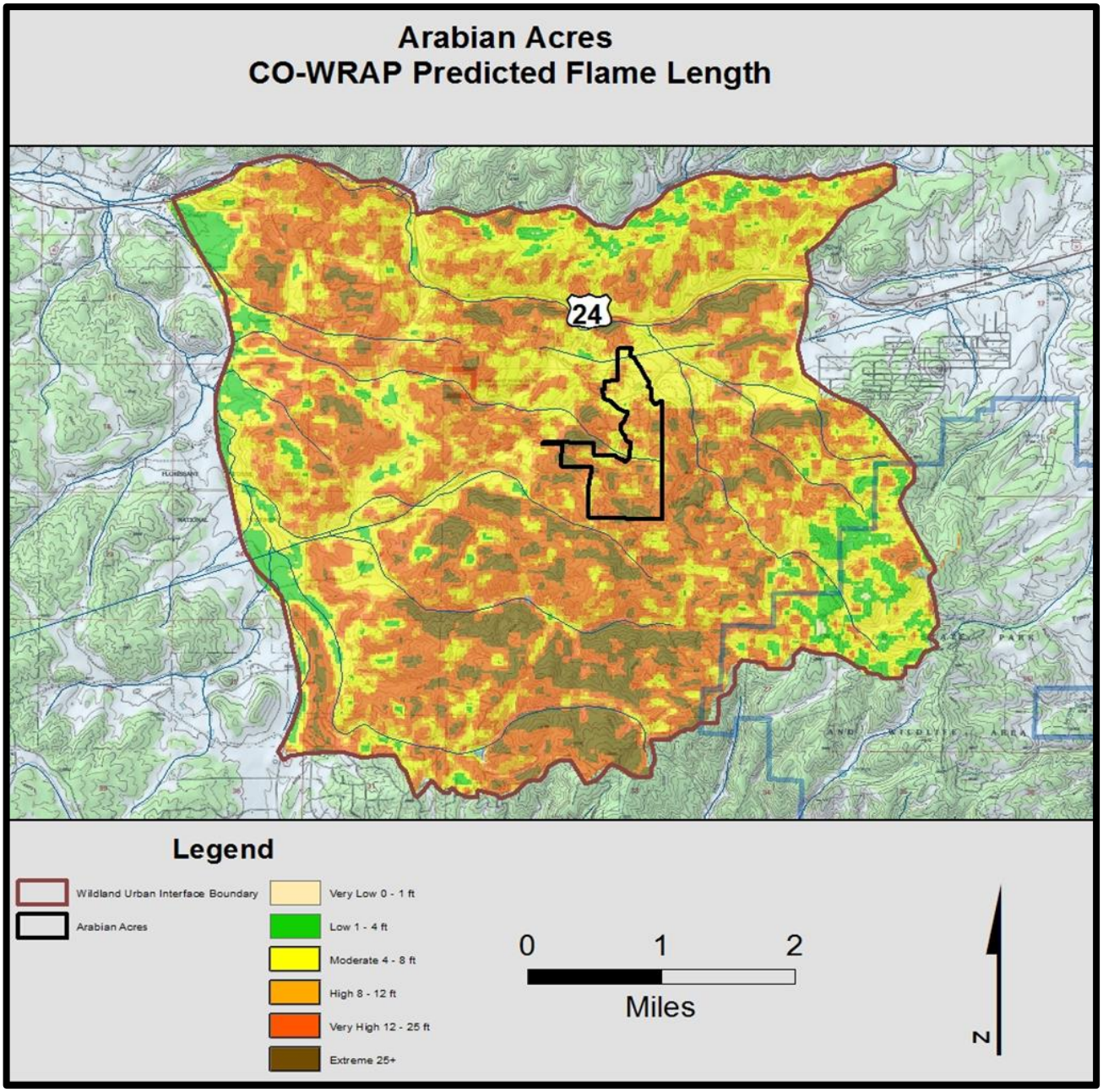
FACTORS AFFECTING HOMES IN THE WILDLAND/URBAN INTERFACE:

As noted in the Teller CWPP, wildfire risk to the community is extreme. This section will discuss the factors considered that led to the overall rating. The map below represents the CO-WRAP predicted rate of spread in feet per hour. The majority of the WUI boundary would have a high rate of spread (between ¼ to ½ mile per hour) under the average fire weather assumed by CO-WRAP.



The high rate of spread applies to areas in all fuel types, forest or grass. In fact, fires in open grass lands often have higher rates of spread than fires in trees because stronger winds in treeless areas push wildfires. In grass fuels the flame front has passes quickly, but flames and firebrands will still ignite homes. Fire Risk reduction is as important for homes in open areas as it is for homes in forested areas.

The length of flames is directly correlated with the amount of heat a fire produces. Flame lengths less than four feet can be attacked directly by hand crews. Flame lengths greater than four feet produce lethal amounts of heat, and require indirect attack methods where firefighters must work a safe distance away from the flaming front. As seen in the map below, CO-WRAP predicts four to twelve foot flame lengths



over most of the area. Fuel modification in defensible spaces and fuel treatments is designed to reduce the amount of heat produced by a wildfire.

There are 374 residents in Arabian Acres and the homes have various risks of being destroyed by a wildfire. The amount of risk depends on the vegetative fuels, topography, weather events, and the construction and site of the home itself. It is important to understand these conditions and factors in order to make appropriate decisions about vegetative fuels reduction.

WEATHER: Weather influences fire behavior as both a long term and transient phenomenon. Long term weather trends such as extended drought increase the possibility of ignition and increase the rate of fire spread.

Large plants, trees and larger shrubs, recover moisture content slowly after a prolonged drought, and may remain drier than normal for several years after a drought ends. Grasses and herbaceous fuels may recover moisture quickly after a short rain, but also loose moisture quickly after short dry periods.

The intensity and spread of a wildfire is also affected by the weather conditions existing at the moment. For example, a large thunderstorm about 20 miles north of the Waldo Cañon Fire was responsible for pushing the fire down downslope into the Mountain Shadows neighborhood. High temperatures, low humidity, and strong winds increase the probability of ignition, intensity and rate of spread. Wind direction at any given moment is the primary determinant for the direction of fire spread.

TOPOGRAPHY: Topography includes the steepness of slopes and the shape of the terrain. Hot gases rise in front of the fire along the slope face, pre-heating and drying the vegetation above a fire. On steeper slopes, the effect of the preheating and faster fire spread increases, and fires on slopes may move up to four times faster with flames twice as long than a fire on level ground.

Drainages act as chimneys that funnel heat and winds up the drainage. Homes in drainages, or at the tops of drainages, are particularly vulnerable to wildfires, and owners must increase the amount of defensible space. The direction a slope faces, or its aspect, also influences fire behavior. South and west facing slopes tend to be drier and thus, exhibit more intense fire behavior than cooler, moist east and north facing slopes.

FUELS: The two fuel types in a WUI are vegetative and structural. Vegetative fuels consist of living and dead trees, bushes, and grasses. Typically, grasses ignite more easily and burn more quickly but with less intensity than trees. Fires can move quickly through grass and herbaceous vegetation, and these smaller fuels are often the kindling that moves fires to larger size fuels.

Any dead or living branches on the lower eight feet of trees or shrubs beneath trees are called ladder fuels. Ladder fuels help convert a ground fire to a crown fire (fire in the tree tops) that moves much more quickly with longer flame lengths and more heat.

Non-vegetative fuels include houses, ancillary buildings, fences, and firewood piles. Structures in the WUI can be considered as additional fuel. In fact a burning structure can ignite a wildfire, and defensible space can prevent a burning structure from spreading fire to the surrounding vegetation as well as preventing a wildfire from igniting a structure.

ONLY FUELS CAN BE MANIPULATED BEFORE A WILDFIRE TO REDUCE FIRE INTENSITY OR INFLUENCE THE FIRE SPREAD.

Nor are hazardous fuels around a home limited to natural vegetation. Landscaping is often a fire hazard, and many homes are lost because of ornimental vegetation planted around the structure. Shrubs planted near foundations, landscape timbers, wood mulches and wood fences are often sources of home ignitions. Landscapes should be planned with the threat of wildfire in mind.

The important point to remember here is that neither typography nor weather can be altered. Only fuels can be manipulated before a wildfire to reduce fire intensity or influence the fire spread.

HOW STRUCTURES CATCH FIRE

There are three ways that a wildfire can transfer itself from natural vegetation, or burning homes, to other homes. They are through radiation, convection, and firebrands.

RADIATION: Wildfires can spread to a home by radiating heat in the same way a radiator heats rooms in the wintertime. Radiated heat is capable of igniting combustible materials from a distance of 100 feet.

CONVECTION: Direct contact with flames, or the wildfire's convective heat column—the hot air and gasses rising from the flames--may also ignite a home. This will most likely occur when trees, debris or brush near a structure ignite and the flames touch a flammable part of the structure.

FIREBRANDS: Firebrands are burning embers that are carried on winds from strong convection drafts in the burning zone. In most cases, the flame front passes quickly, but a shower of firebrands, impinges on the structure before and after the flame front passes. Firebrands are most often the cause of home loss, and can be carried long distances – more than a mile – by the winds associated with a wildfire. Many homes in community are particularly vulnerable to firebrands.

A 2006 report by Traci Weaver emphasized the danger of home ignitions from burning embers.[2] Multiple wildfires raged across prairie and shrub land in north central Texas from Dec. 27, 2005 to April 30, 2006. They killed 17 people, burned 1.6 million acres, and destroyed 440 homes. Many of the destroyed homes were made of brick, stone, and had metal roofs. Investigators pin-pointed the main cause of home destruction to burning embers that fell on top of, or were blown under, wooden porches without screening. Other losses were linked to firebrands entering attic vents, eaves and soffits, or radiant heat of burning grass that ignited wood decks.

The 2002 Hayman Fire burned 138,000 acres and 132 homes in 20 days. After Hayman, the homes burned were thoroughly studied to determine the manner in which they were burned. USDA Forest Service scientists Jack Cohen and Rick Stratton reported on the causes of home destruction in the *Hayman Fire Case Study*.[3] Surprisingly, 662 homes within the perimeter of the fire were not destroyed. Many of the homes that survived did so without intervention by firefighters. The study objective was to determine if there were common factors among these surviving homes that might be helpful in preventing loss of homes in future wildfires.

They found that "torching" or intense crown fires within 30 feet of a structure destroyed 70 homes. If a house was destroyed but the surrounding trees did not burn, they assumed that embers or firebrands ignited it. Based on this logic, they concluded that 62 (47%) of the 132 homes destroyed in the Hayman Fire were ignited by surface fires or firebrands.

Cohen and Stratton found that home destruction was related more to a house and its site-specific surroundings than to the context of the larger Hayman Fire. If the vegetation around a house allowed high intensity fires to burn near them, they did not survive. If the vegetation permitted only low intensity fires, the structures had a good probability of surviving. Flammability of roofs, siding materials, and other house construction features raised or lowered the risk of flames igniting homes.

HOME CONSTRUCTION AND VULNERABILITY TO WILDFIRE:

The construction materials, location and even the shape of a structure influence its vulnerability to wildfire.[4] It is not the intent of this CWPP to suggest extensive alterations to homes that already exist in the community. Understanding how home construction affects the vulnerability of the structure to a wildfire helps residents plan defensible space projects to compensate for construction differences. When remodeling or home improvement projects are done, plans can be made to reduce the ignitability of the buildings.

Decks and roofs are the most vulnerable parts of a structure. If either burns, the home will be lost. They are most likely to catch windblown firebrands, and air

[2] Weaver, Traci, (2006): *Texas Fires Shed New Light on What it Means to be Firesafe.* Texas Forest Service.
[3] Graham, Russell T., (2003): *Hayman Fire Case Study.* USDA Rock Mountain Research Station, Report RMRS-CTR-114.
[4] Slack, Peter, (2000): *Firewise Construction: Design and Materials.* Colorado State Forest Service.

currents are more likely to form eddies that trap heat and in the irregular surfaces found in roofs and decks.

Combustible debris should be removed from roofs and gutters anytime it accumulates.

Fire restive roofs are imperative. *Wood shake roofs have been the cause of many home losses due to firebrands.* Roof material with a class A rating indicates the best resistance to fire. Many roofing materials are available to homeowners but they vary in cost, weight and longevity. Homeowners should consult with a reputable building contractor to determine which roofing material will best suit their needs.

Even the most fire resistant roofs require maintenance. Most important is to keep the roof and gutters free of debris. Combustible debris such as leaves and pine needles may ignite from firebrands and start the home on fire even with a class A roof. Combustible litter is most likely to accumulate in areas where one shape meets another such as gables and dormer windows. Gutters will also accumulate debris. These same areas are most likely to accumulate firebrands because of eddies in wind currents during a wildfire. Combustible debris should be removed from roofs and gutters anytime it accumulates.

Most homes in Arabian Acres have metal or asphalt shingle roofing that is fire resistant. However home autopsies have shown that the small ridges in metal roofs where on panel over lays another can be openings where fire brands may collect directly on the plywood sub roof, leading to ignition of the plywood. The holes underneath such ridges should be plugged with caulking or a similar material.

The eves (the extension of the roof over the outside wall) are also vulnerable areas. Open eves, with the roof joists exposed, are particularly vulnerable because the irregular surfaces can trap hot gasses and fire brands. Enclosure of exposed eves (called a soffit) helps prevent this. It is best to construct soffits so that the lower edge of the soffit meets the wall at a 90^{o} angle. This reduces the amount of heated air and fire brands that might be trapped.

Vents in roofs and foundations are also areas of vulnerability, but are necessary to ventilate attics and crawl spaces to prevent moisture accumulation. During a wildfire, heated gasses and firebrands can enter attics or crawl spaces through vents. All vents should be screened with metal screening with openings of 1/8 inch or less. Soffit vents should be located as close to the edge of the eve as possible. Vegetation around foundation vents can create unintended vulnerability, particularly on the downhill side of a home. Landscaping with noncombustible mulch within five feet of the foundation and underneath decks or porches is essential.

In addition to the roof, decks are extremely vulnerable to fire. The deck surface is exposed to fire brands and fire brands can collect underneath decks. Possibly the worst mistake any homeowner can make is to store any combustible material beneath a deck. Countless homes have been lost because of firewood, scrap lumber, even gasoline stored beneath a deck. Even motorized equipment, when left under a deck, with gas in the tank has caused home losses during fires.

Possibly the worst mistake any homeowner can make is to store any combustible material beneath a deck.

Ideally the underside of decks should be enclosed with a non-combustible material. If that is not possible, covering the area under a deck with stone, concrete or rock mulch will make the deck safer. When decks are rebuilt use fire resistant materials.

Carefully consider the landscaping in the vicinity of decks as well. Avoid planting flammable shrubs, such as junipers, anywhere near decks. Potted plants or planters on decks may also increase the hazard. Even furniture with cushions or wooden frames may ignite from firebrands. The area of defensible space should be increased near decks, especially on the downhill side.

Fire resistance of windows and doors should be considered. If window glass breaks, firebrands will enter the house. The most fire resistant glass is low emissivity, tempered glass which withstands the heat of a fire for the longest period. Double pane windows last longer than single pane when exposed to the heat of a fire.

Window frames are also important. Metal frames offer the best protection. Vinyl frames usually do not burn but can melt when exposed to heat. Wooden frames will burn. Metal screening with on the outside of windows offers additional protection, but most windows are sold with nylon screening that will melt. Solid metal shutters offer the best protection, assuming the homeowner has the opportunity to close them before evacuating.

Wooden doors are obviously able to burn during a fire. The thicker the door the more resistant it will be. Metal doors are far superior, and glass in doors is subject to the same vulnerabilities as window glass. Well maintained weather stripping in outside doors will help prevent fire brands from entering a home.

IV PRESCRIPTIONS FOR WILDFIRE HAZARD REDUCTION

DEFENSIBLE SPACE VS. FUELBREAKS:

In a broad sense there are two generalized categories of mitigation. First is defensible space thinning in the home ignition zone (HIZ) around structures to increase the chance that the structure will survive a wildfire. Second, is fuel break thinning away from structures to reduce severe fire behavior and give firefighters a safer place to work and possibly halt an approaching wildfire. Both approaches require thinning of the canopy and removal of ladder fuels. The approach will vary depending of the forest conditions existing on the area in question.

THE HOME IGNITION ZONE:

Modification of vegetation around a structure to reduce fire intensity is called defensible space. The term "home ignition zone" is defined as a structure and the surrounding vegetation. A structure's vulnerability to wildfire depends on the surrounding vegetation, including landscaping, and the structure itself.

The Home Ignition Zone includes the structure and surrounding vegetation.

DEFENSIBLE SPACE:

Thinning around homes is different than thinning for fuel breaks. Thinning in the HIZ is designed to protect structures from the heat of wildfires. Defensible space includes both thinning around structures to reduce the heat from burning vegetation and reducing flammability of the structures to protect them from wind born embers, radiation and convective heat. Further information about increasing the survivability of structures is found on the CSFS website at:

http://csfs.colostate.edu/pages/pub-csfs2.html#wildfire .

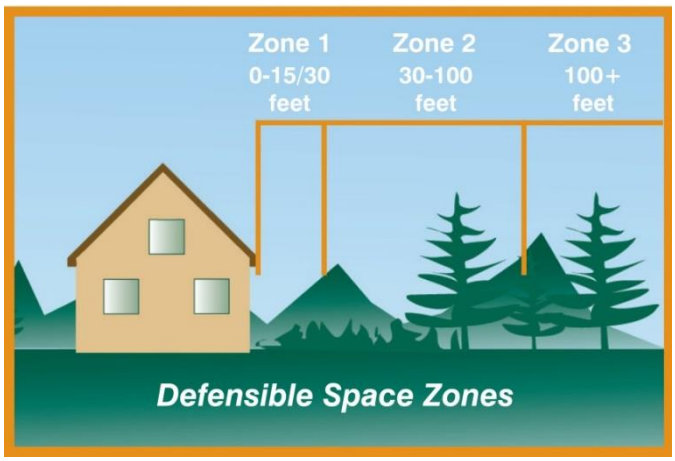


Diagram of defensible space showing the three thinning zones.

Defensible space is defined as an area around a structure where existing vegetation is modified to slow the rate and intensity of an advancing wildfire. This includes selective removal of trees around structures in two or three concentric management zones. On slopes, increase the width of each

zone on the downhill side. Fuels are reduced according to prescriptions for each zone.

ZONE ONE: This is the closest zone to a structure, and extends 15-30 feet from the outermost edge of a structure including any decks. The management goal is to reduce or eliminate most large trees or shrubs within this zone so that convective heat will not ignite the home. A few tall trees may be left in zone one if the lowest branches are pruned so that they are well above a fire resistant roof. It is best to limit this to one or two trees near a structure. Treat such trees as part of the structure and create 15-30 feet of space outside the tree.

Raking up pine needles is not a substitute for thinning and ladder fuel removal.

While it is necessary to rake up combustible material within five feet of foundations and under decks, it is pointless do to so elsewhere. Needles on the forest floor act as mulch retaining moisture in the soil, reduce erosion, and add organic matter to the soil as they decay. Raking up pine needles is not a substitute for thinning and ladder fuel removal. If regeneration of new trees is an objective, however, it is desirable to expose some bare soil since this will promote seed germination and establishment.

ZONE TWO: The width of zone two depends on the slope around the house. If the average slope angle is less than 5%, zone two extends out 70 feet from zone one (100 feet total distance around the house). As slopes increase, increase the width of zone two on the downhill side of the house, and increase the spacing between tree crowns.

The main fuel reduction guideline for zone two is to thin the trees to an average spacing of 10-feet crown separation. Clumps of two or three trees may be retained in this zone if the space between the clump and the adjoining trees is at least 30 feet. All ladder fuels under trees should be removed. The branches of large trees should be pruned to a height of 8 feet above ground, but small trees should have at least two-thirds of the green needles remaining.

Firefighters must be able to escape quickly if conditions suddenly deteriorate. Zone two should extend along both sides of driveways for a width of 30 feet from each edge of the drive. This is important to allow safe access and egress for emergency vehicles. Adequate clearance should be maintained to allow access for large structural fire trucks. Twelve feet of horizontal clearance and 13 feet of vertical clearance should be maintained. At the house end of driveways, adequate room for a large fire engine to turn around should be maintained.

ZONE THREE: The guideline for zone three is to thin the forest primarily to improve forest health. Spacing is less critical in this area but spaces should be made in the canopy. A useful rule of thumb is that a tree should receive sunlight from all four sides.

The subdivision streets in Arabian acres are usually located in zone three. To provide for safer ingress and egress and to create fuelbreaks through the community, trees in zone three should be thinned to a zone two standard for 150 feet from the edge of the street.

V FOREST HEALTH AND WILDFIRE MITIGATION

Foresters manage trees not as individuals but in groups called stands. A stand of trees is defined as a group of trees that are similar with respect to age, species composition and other characteristics. Each stand is different from the ones nearby, and each landowner may have other forest management objectives in addition to fuel reduction.

Thus, the information that follows is intended to be a general and highly simplified summary of the basic concepts of fuel reduction and forest health improvement. It is only intended to give the reader an idea of how foresters approach the process of prescribing treatments for fire mitigation. When planning fuel reduction, an initial consultation with a forester is recommended. Specific prescriptions for any forest stand are best developed when the existing conditions of the stand and the landowner's specific objectives are observable.

Although foresters may use many characteristics to categorize trees, the most common--and useful when discussing fuel reduction--is the tree's tolerance to shade. Shade tolerance means the ability of a tree to germinate and grow in the shade of other trees. Species of trees vary in their tolerance to shade, but they can be grouped by those that require sunlight for germination and establishment and those that require shade.

SHADE INTOLERANT TREES

Shade intolerant trees are those that require full sunlight to sprout and grow to maturity. Shade intolerant trees are those that first colonize a site after a disturbance, such as wildfire, removes the existing trees. For this reason, ecologists call these pioneer species. Aspen, the most shade intolerant of local species, will send up new sprouts within days after a fire destroys the old trees. Shade intolerant trees common to this area include aspen and ponderosa pine.

It follows that if the trees in a particular area germinate following a disturbance, all the trees in a stand will be of roughly the same age. As the trees compete for sunlight, water and nutrients, the most vigorous become the dominant trees in the new stand. The dominant tree soon outgrows its siblings, yet the weak

The ponderosa sections in this photo illustrate how tree diameter is not a reliable indicator of age. The center section is 100 years old; section 2 is 99; section 3 is 101; section 4 is 90; section 5 is 85; section 6 is 130; section 7 is 81. (Sculpture by Bill Wallace. Photo by Bill Buckman, courtesy of the Black Forest Slash & Mulch Program)

trees remain in the understory stunted and overtopped. Thus in shade intolerant stands, small trees are not young trees, but merely suppressed.

Following are some important species of shade intolerant trees with respect to fuel reduction and forest health:

PONDEROSA PINE: Of all the species of trees in the local area, ponderosa is the best adapted to survive a low intensity wildfire. First, the thick bark of the tree acts as insulation from the heat of the fire. Second, as the upper branches shade the lower branches, the low branches die, and in time, are broken off. Thus there are fewer low hanging branches to act as ladder fuels. Low intensity fires burning in grass and litter under a mature ponderosa rarely harm the tree.

ASPEN: As noted earlier, aspen are the most shade intolerant of local trees. Unlike the ponderosa, aspen bark is thin and the tops of the trees are killed by even the coolest fire. The root system however is insulated from the fire's heat by the ground, and when the tree tops die, the roots respond by vigorously resprouting.

As a deciduous tree, aspen will not carry a fire in the tree crowns, thus fires drop to the ground in aspen stands. For this reason, aspen are desirable trees to retain in fuel breaks and defensible spaces. Furthermore, aspen are desirable wildlife trees, and many stands are becoming shaded out by more shade tolerant conifers after years of fire suppression.

Since fuel reduction almost always requires thinning, many landowners assume that aspen should be thinned as well, but they should not. Thinning aspen is rarely recommended since the falling trees wound the remaining trees. The bark on aspen is so thin that any wound will expose the tree to many different fungal diseases that are eventually fatal. Fuel reduction in aspen should be limited to removal of dead trees if care is taken to avoid wounding live trees, cleaning up down dead wood, and removing conifer regeneration from the aspen understory.

SHADE TOLERANT TREES

Shade tolerant trees are those that will sprout and grow in the shade of the existing forest canopy. Shade tolerant trees are usually found on the cooler moister north facing slopes of hillsides and in moist drainages. In fact, most shade tolerant trees require shading for the seedlings to survive. A seedling in direct sunlight will often be burned by the sun. As a result, stands of shade tolerant trees contain trees of many ages. The most common shade tolerant trees in the area are Colorado blue spruce, Engelmann spruce and Douglas-fir.

SPRUCE: Colorado blue and Engelmann spruce are so similar that they may be considered together for discussion of fire mitigation. Colorado blue spruce is usually found in lower altitudes (below 9,000 ft) while Engelmann spruce is usually found above 9,000 feet. The ability of seedlings to survive in the shade of mature trees usually creates dense forests with a closed canopy above and thickets of ladder fuels below.

Spruces tend to be shallow rooted, and excessive thinning of the upper canopy can result in wind-throw in the remaining trees.

Spruces tend to be shallow rooted and excessive thinning of the upper canopy can result in wind-throw in the remaining trees. Typical fuel prescriptions for spruce require creating openings of one tenth acre or larger with clumped trees between the openings. Removal of small trees in the understory of the clumped trees reduces ladder fuel. Where aspen clumps are mixed with spruce, it is often a good strategy to cut the spruce around the edges of aspen clumps to promote aspen regeneration and enlarge openings between spruce clumps.

DOUGLAS-FIR: Typically Douglas-fir are found on cooler north facing slopes in lower elevations and mixed with spruce in higher elevations. It is in the lower elevation ponderosa pine forests where Douglas-fir has become the most serious concern as a wildfire hazard. After a century of fire suppression in lower elevation ponderosa pine stands, the canopy has closed, shading the forest floor. Douglas-fir has invaded the understory of the ponderosa stands creating dense thickets of ladder fuels.

Douglas-fir are firmly rooted trees and can be thinned much the same as ponderosa pine. In lower elevation ponderosa stands, most Douglas-fir should be eliminated, especially the ladder fuels. There is an important exception to this general rule where the ponderosa are infected with dwarf mistletoe. In such situations the landowner may choose to favor the Douglas-fir since they are immune to the ponderosa pine dwarf mistletoe. Special attention should be given to providing adequate separation between the crowns of larger trees and pruning the lower branches from the Douglas-fir to reduce ladder fuels.

Where Douglas-fir is intermixed with less wind firm spruce, they can be favored to maintain forest cover. It is still important to prune the trees to remove ladder fuels.

VI THINNING AND FUEL REDUCTION

Foresters use many methods of thinning depending on the specific objectives of the landowner. Fuel break thinning is most often accomplished by a process called thinning from below. Trees are usually removed or remain based on their height in the canopy.

This fuel reduction demonstration in Black Forest was burned during the fire. In this photo, taken two months after the fire, rapid forest recovery is obvious. CSFS photo by Dave Root.

For simplicity, trees can be divided in levels in the forest canopy. The largest trees at the highest level of the canopy are called dominants. These are usually the most vigorous since they have the largest root systems, most leaf area and receive the most sunlight. Next are the co-dominant and intermediate trees. These occupy the middle level of the canopy, but tend to be crowded and of smaller diameter. They are less vigorous with smaller root systems and fewer leaves as the result of crowding by the dominant trees. At the lowest level of the forest canopy are the overtopped trees. These are completely shaded by the dominant and co-dominant trees.

As noted earlier, it is a common misconception in shade intolerant stands that the diameter of a tree is an indicator of its age. Often the co-dominant and overtopped trees are as old as or older than the dominant trees. In pure shade intolerant stands young trees are usually found in openings in the canopy, and can be recognized by having a diameter proportionate to the tree height, and a conical shape. If there are truly young trees in the stand it is desirable to leave some to increase diversity. Thickets of young trees should be thinned to give adequate growing space.

Thinning from below removes all of the overtopped and most of the codominant trees. It is essential when thinning for fuel breaks to remove ladder fuels and create enough openings in the forest canopy to reduce the crown fire risk. Thinning from below is desirable in fuel reduction projects because it 1) leaves the most vigorous trees on the site, 2) creates openings in the forest canopy by removing the less vigorous co-dominants, and 3) eliminates ladder fuels by removing the overtopped trees, shrubs, and pruning lower limbs of remaining trees.

VII SLASH TREATMENTS

Slash is the unusable branches and tree tops that remain after the useable wood has been removed from any forest management project. Slash treatments will always be needed to clean up the residue from forest thinning. Untreated slash will only increase the fire hazard—possibly undoing all the good of thinning. It can also attract undesirable insects to the area, primarily ips beetles, turpentine beetles or spruce beetles. Slash treatment may be the most labor intensive, and, thus expensive, part of any fuel mitigation project.

LOP AND SCATTER This treatment consists of using saws or equipment to cut the slash into smaller pieces so that the height of the remaining slash is reduced. Usually the slash is cut into pieces less than 12 inches high by 24 inches long. It may be the only practical treatment in areas where chippers are unavailable, prohibitively expensive, or in inaccessible locations. It is usually the lowest cost treatment since no special equipment, other than a chainsaw, is required.

The treated slash is left to decompose, and until it breaks down it will be unsightly. Over the course of several winters, snow pack pushes the slash down and it decomposes. Decomposition usually requires three to five years, or longer if larger material was present. It also creates an extremely flammable fuel bed until the slash decomposes, which can be easily ignited, and burns quickly, but with high intensity. It should not be used adjacent to high values, such as homes, or areas prone to regular fire occurrence.

Lopped and scattered slash can also lead to problems with ips, turpentine or spruce beetles. The beetles may lay eggs in green slash and the brood may emerge to attack living trees. This problem can be alleviated by doing any forest restoration treatments in the fall and winter when the beetles are not active and by cutting slash into small pieces that dry out before spring.

CHIPPING: Chipping is the grinding up of the slash into small pieces, usually less than a few inches in diameter. Material can be chipped and left, or removed for off-site disposal or as a product.

It requires mechanized equipment to perform the chipping. The slash must be brought to the chipper, unless it is an expensive mobile chipping piece of equipment. Either way, it can quickly become a very expensive and labor intensive operation.

Chipping is a common method of slash disposal in the defensible zones around structures. Chips do not significantly contribute to fire hazard around structures since they produce low intensity fire behavior. Large piles of chips should be avoided as they could smolder for a significant amount of time. Chips should be spread along the ground to a depth of less than four inches.

Chipping is an effective means of treating wood infested with bark beetles since the insects will not survive in the small bits of wood. Green slash that is promptly chipped

will not harbor infestations of ips, turpentine, or other bark beetles.

Any form of open burning requires a permit from the county sheriff. Burning must be done only under the conditions of the permit.

COMMUNITY CHIPPING PROJECTS: Many communities have found that an effective way to promote mitigation is to sponsor a community chipping program. Landowners are quite willing to undertake the effort of thinning trees if there is a simple low cost way to remove the slash. Community chipping usually consists of one of two approaches.

First, is the community slash site where landowners may drop of the slash at a designated area. The slash is then ground and given away as mulch or used in some sort of reclamation activity. Most sites are open on designated days and manned by volunteers from the sponsoring community. Some slash sights that are not gated and are unmanned have reported some problems with illegal dumping, although this seems to be a rare occurrence. Rather than collection sites other communities have paid for roll off dumpsters to be placed at certain locations for collection of slash.

The second method is the drive by chipping program. The community contracts with a tree service or mitigation contractor to bring a chipper to the community on a certain day. Residents with slash to dispose of may drag it to the curb for the contractor to chip it on site. Commonly the chips are blown back onto the property. Usually an official from the homeowner's association or mitigation committee coordinates the program, and records the location of slash piles for the contractor.

TRAMPLING, CRUSHING, OR ROLLER CHOPPING: This is using heavy equipment, usually a dozer, to run over the slash, breaking it down in both size and height. It can be done with just the tracks or by also pulling a heavy, water filled drum with cutting blades welded on it.

It is very effective and can also crush and break up heavy fuels such as down logs. However, the slash must dry, usually for several seasons, to make this treatment truly effective. There is an increased fire hazard in the interim.

There is an additional benefit to crushing or trampling. The material is not only broken down, but also driven into the soil. This can add nutrients to the soil faster, create small pockets in the soil surface for holding water, and decrease the potential for erosion.

PILE BURNING: Any form of open burning requires a permit. The sheriff in each county is by law the county fire marshal, but often the authority to issue burn permits

is delegated to the local fire protection district. Anyone contemplating pile burning should check with the sheriff's office in the early planning stage to determine the proper procedure to obtain a burn permit. Burning must be done only under the conditions stipulated in the permit.

Piles can be constructed with equipment or by hand. Piling with heavy equipment should only be done with a brush rake and not a regular blade. Piling with a regular blade will include significant amounts of dirt, which will make the pile harder to burn, create more smoldering and smoke, and will hold heat longer which adds to the risk of an escape at a later date.

For most landowners, the slash is piled by hand and burned when conditions are safe—usually several inches of snow on the ground that will persist for a couple days. This will depend on what type of material is contained in the pile. Material greater than five inches will take longer to burn and will hold heat for more time. Piles burn best when they are relatively compact, contain material less than one inch in diameter, and the height is greater than the diameter. This arrangement promotes hotter burning and less smoke.

It is important that burn piles should not be located directly adjacent to or under the canopy of trees or other flammable material. Separation should be greater on the downwind side. It is easy to scorch living trees from the heat of the burning pile, even in winter. Avoid making burn piles on top of stumps since stumps will smolder for extended periods of time.

Often piles must sit through the summer in order to dry, or piles from one season may be left over the next summer if proper burning conditions do not occur during the winter. In each case the dry woodpiles will sit through a burning season with the risk of ignition.

The fire should be monitored during the day and for several days thereafter. The center of a pile usually burns completely, but often wood around the edges does not. To ensure that the slash at the edge of each pile burns it is necessary to "chunk in" the piles periodically. This means that as the fire at the middle of the pile burns down to a low flame, wood from the edges should be thrown into the center to insure complete burning of all slash.

The burned slash pile must be monitored and may need to be cooled below the point of combustion, a process called "mopping up." This is especially important on south and west slopes where the snow melts off quickly and may be followed by dry windy weather.

For several years after a pile is burnt, an unsightly black ring remains where the heat of the fire scorched the soil. Many landowners find these unpleasant to look at. They may also present an opportunity for noxious weeds to colonize the bare soil. Breaking up the burned soil with a rake and reseeding with native plants is recommended.

VIII MAINTENANCE

Defensible space, fuel break thinning, or any type of forest management, does not end when the initial project is finished. Continual maintenance is an essential part of any forest management program. Even in well managed forests trees will die, storms and wind will damage trees, and new trees will germinate.

Trees should be inspected every spring for any sign of damage from winter or spring snows or wind. Prune any broken branches if they are not too high in the tree, and trees bent by heavy winter snows should be removed. Check for any signs of insect activity or disease.

Late October is the best time to inspect trees for attack by mountain pine beetles. Beetles have finished attacking trees at this time, and there is adequate time to cut and treat the tree before the adult beetles fly the next July.

At five years, check the canopy closure, especially in zones one and two. Remove any trees necessary to maintain openings in the canopy. Do any additional pruning or removal of trees and shrubs to eliminate ladder fuels.

After ten years, dense thickets of young trees (regeneration) may become established, and these will need to be thinned. Not all regeneration should be cut since trees of various ages are important for forest diversity. Regeneration that is likely to become ladder fuel or crowded by other trees should be removed. Young trees in openings with adequate room to grow should remain. Depending on their objectives, landowners may want to consider removing some of the larger trees to make room for the younger ones.

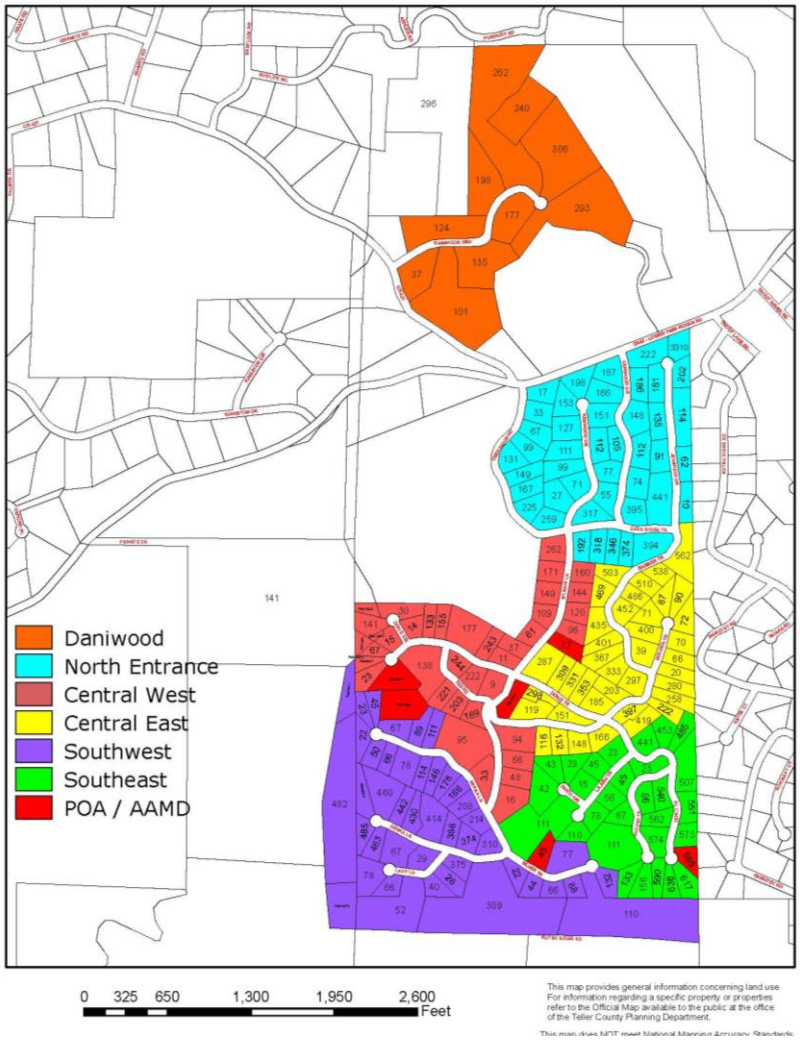
IX IMPLEMENTATION AND MONITORING

ACTION PLAN FOR ARABIAN ACRES

The Wildfire Protection Group (WPG) believes that community risk reduction will be most effective when neighbors work together. Close neighbors share common relationships and concerns that bring them together. In relation to wildfire, close neighbors share common risks as well.

The map on this page proposes zones where neighbors share common boundaries, risks and concerns. The zones are communities within the community and will form the basic units of cooperative risk reduction. Each zone will have a captain who will promote and organize Firewise activities in each zone.

Arabian Acres Zones



Wildfire Education: The Wildfire Protection Group will partner with the CSFS, CUSP and the Divide Fire Protection District to create understanding of how wildfire risk reduction relates to all aspects of forest stewardship. The focus of the effort will include all aspects of forest stewardship including insect and disease, watershed preservation and forest health.

The partners will work with the WPG to provide material and programs that promote wildfire risk reduction and forest health information to Arabian Acres residents. The CSFS, CUSP and Divide Fire Protection District are available to visit landowners and make recommendations for wildfire and forest health issues.

The WPG will work with the Arabian Acres POA to create a link on the POA website to provide Fire Committee information, including the CWPP and pertinent information for property owners.

The WPG will encourage participation in the *Ready, Set, Go* program to help residents be prepared for an evacuation during a wildfire. Use of calling trees and mock fire drills or evacuations will also be considered.

The WPG will also consider the establishment of a volunteer committee with representation from all parts of the community to promote and encourage resident participation.

Defensible space in the home ignition zone: Among the highest priority of most home owners, second only to the value of life. Is to protect their homes and possessions in the event of a wildfire. If in doubt, the CSFS, CUSP, Divide Fire District and private contractors are available to help. Removal of some trees close to a structure may require the services of a knowledgeable contractor, while other activities may be within the realm or ability of the homeowner. "Neighbors helping neighbors" is encouraged whenever possible and whenever feasible. As close as possible to 100% compliance is desirable and within our initial fires five year timeline.

Completion of an Arabian Acres Community Wildfire Protection Plan will make the community eligible for cost share programs for wildfire risk reduction. The WPG will work with partners to pursue such cost share grants as opportunities arise.

The POA will work with CUSP to schedule and promote one or more community chipping days through CUSP's Neighborhood Chipping Program. Landowners who are working on fuel reduction on their properties stack the unusable branches and wood (slash) at the road, and CUSP brings a chipper and crew to chip the slash. CUSP suggests a donation to pay for the cost of the program, and the donation is much less than renting a chipper or paying a contractor. This service will encourage landowner participation in defensible space projects by providing a convenient way of disposing of slash created by the work.

Roads within the subdivision: All roads within the subdivision (with the exception of Daniwood Grove) are county maintained and thus county property. This also includes a right of way which is not clearly defined by property markers. According to the Teller County CWPP, the county is responsible for the removal of dead trees and fuel reduction where needed within the right of ways. Representatives from Arabian Acres (POA and WPG) will meet with the Teller County Road Department in order to determine what type of collaborative actions might be done in order to address the situation.

This will be a large project which will cover parts of all areas within the subdivision and benefit every property owner since all properties have some road border. It will also be a considerable expense and also require exploration into obtaining grants or cost sharing agreements; most likely a necessity. The completion of this project will be dependent on when fuel reduction efforts begin. Optimistically, some land owners could voluntarily initiate mitigation on an adjacent zone alongside the roads which would not only show community interest in the project but also reduce the overall costs. In any case, the goal would be to have some projects finished by 2022, if not

before.

Arabian Acres POA has made contact with one of the Cole Lot owners who has discussed the possibility of a route that could be used in an emergency that includes his willing "Hidden Forest" neighbor.

Extreme forest hazard areas: The risk posed by these areas cannot be ignored. Some of these areas contain multiple vacant lots whose owners do not live in the area. Attempts will be made to communicate the severity of the problem with all effected property owners to discuss the severity of the problem. Consultation with CSFS and CUSP will also be sought for both advice and to the possibility of grants and cost sharing opportunities. These areas are not only a property owner problem, they pose a significant threat to the entire community and another opportunity for "neighbors to help neighbors" for the good of all.

MONITORING

Monitoring is an important part of follow-up to the implementation of projects. The legislation enabling CWPPs and fuel reduction cost sharing, the Healthy Forests Restoration Act, instructs participants to establish, where interest is expressed by the communities, a collaborative multiparty monitoring process. This process should address reporting of accomplishments, need for maintenance of treated areas, tracking of burned areas and the positive and negative ecological and social effects of the projects.

Monitoring in the Arabian Acres Community Wildfire Protection Plan calls for an annual field review by the partners (participants) of accomplishments and need for maintenance. Based on this review, it calls for needed adjustments in the next years plan, as appropriate. Thirdly, it calls for a determination of interest and meeting by the partners for monitoring the ecological and social effects of projects. These tasks are identified in the table on the next page.

Action	Description	Estimated Timeline
Cost Share Funding	In Partnership with CUSP and CSFS pursue all opportunities for fuel reduction cost share for Arabian Acres.	2018 and yearly thereafter.
Community Wildfire Protection Plan:	Complete Arabian Acres Community Wildfire Protection Plan and receive approval of the CSFS, Divide FPD and Teller County	2018
Recruit Zone Captains	Captains will be leaders for fuel reduction within each zone	2018
Community Home Ignition Zone Assessments	In cooperation with the Coalition for the Upper south Platte assess all homes in Arabian Acres	2018 through 2019 (Contingent on cost share funding)
Establish firewise link on Arabian Acres Website	Pertinent information about Firewise, *Ready ,Set, Go* and CWPP	2018 with updates as required
Community Education Day	Include topics such as fuel reduction and d-space, current fire conditions, zone updates, chainsaw safety & etc.	Yearly
Community Chipping Day	Contract with CUSP for "Drive by Chipping"	Yearly
Defensible Space	Complete 5 to 10 D-spaces per year	2018 and yearly thereafter
Ingress & Egress Improvement	Contact landowners in Cole Subdivision regarding additional egress from Arabian Acres	2019
Ingress & Egress Improvement	Complete shaded fuel breaks along community roads with an objective of ¼ mile yearly	2018 and yearly thereafter
Community Wildfire Protection Plan	Five year review and update of the CWPP	2022.

Fuel Treatment Table Arabian Acres Community Wildfire Protection Plan

Task	By whom	Date	Complete	Comment
Community Wildfire Protection Plan				
Finalize Plan	Arabian Acres	Dec 31, 2017		
Review Draft Plan	CSFS	Jan. 10 2018		
Review Draft Plan	Divide FPD			
Review Draft Plan	Teller BOCC			

APPENDIX A

INSECT AND DISEASE CONDITIONS

Literally thousands of insect and diseases are present in the forests surrounding the community--or any other forested area. Fortunately, like the common cold, most do no serious or lasting damage. But when in poor health, trees, like humans, are more prone to infection from other causes; the concept of preventive medicine applies to forests, as well. Maintaining forests in good health will prevent problems in the future. For the most part, forest insect and disease issues are typical for the region.

Well maintained forests have a multitude of benefits. They are resistant to catastrophic fires, insect and disease, sustain wildlife populations and are pleasant places to be. Colorado State Forest Service Photo by Dave Root

Every summer, insect and disease specialists from the USDA Forest Service and Colorado State Forest Service (CSFS) survey Colorado's forests from the air to monitor insect and disease outbreaks. These flights are an excellent means of finding new areas of insect and disease activity and monitoring trends in existing outbreaks. Maps of the previous year's findings are published in January and can be found on the CSFS website at http://csfs.colostate.edu/pages/common-insects.html.This link also contains more detailed information on the insect and disease issues presented here.

The unnaturally dense forest conditions that cause the potential for hazardous fire also create the potential for cyclical insect and disease outbreaks. Trees weakened by overcrowding and severe competition for water and sunlight are susceptible to invasion by insects and disease. When planning wildfire hazard mitigation projects, it is important to address current insect or disease issues and prevent those that are likely to become a problem. Following is information on some of the common forest insect and disease problems that have been identified in the region.

WESTERN SPRUCE BUDWORM

The western spruce budworm (WSBW), a defoliating insect of Douglas-fir and spruce, is a growing threat in northern Teller County. Depending on the intensity of defoliation, budworm may damage or kill the host tree.

A severe outbreak of WSBW in the late 1980s damaged or killed large areas of Douglas-fir throughout the region. Trees with dead branch tips or those with forked or dead tops are legacies of the previous epidemic. Many of the dead Douglas-fir were first weakened by budworm and then killed by Douglas-fir beetles.

The grayish, mottled adult moths are active in July and August when females lay eggs on the underside of needles. Eggs hatch within days and the larvae migrate to bark scales where they overwinter. The following spring, larvae invade the new buds and feed on the emerging needles. Webbing around the new growth is an obvious sign of budworm activity and if heavy defoliation continues for three to five years, the tree will die. If shorter-term defoliation occurs, the branch tips or the entire top of the tree could die.

Natural predators or severe winter weather helps control budworm populations, which keeps them at non-threatening levels. Spraying with *Bacillus thuringensis* may be useful to protect high value trees, but is not practical on a large scale.

WSBW larva feeding on the needles of Douglas-fir. Note the typical webbing in the bottom of the photo. *Colorado State Forest Service photo by David Leatherman.*

DWARF MISTLETOE

Dwarf mistletoe is a parasitic plant that robs moisture and nutrients from the host tree. Over many years, it causes the tree to decline in vigor and eventually may cause death. More commonly, the tree declines to the point where bark beetles attack and kill it.

Three common species of dwarf mistletoe are found in the region, each named after its principle host – ponderosa pine, lodgepole pine and Douglas-fir. Locally, ponderosa and lodgepole varieties grow on any pine species, but Douglas-fir dwarf mistletoe is exclusive to Douglas-fir trees. Spruce, true firs and deciduous trees are immune to all three species of dwarf mistletoe.

The most obvious symptom of dwarf mistletoe infection is the dense, distorted growth of the branches, called witch's brooms because they appear to be twisted or tied in knots. The shoots of ponderosa and lodgepole dwarf mistletoe are visible on the branch as thick fingerlike growths extending out of the branch or trunk. The shoots of ponderosa and lodgepole dwarf mistletoe are long and obvious to casual observation, but Douglas-fir dwarf mistletoe shoots are shorter than the needles and are not easy to see.

Mistletoe shoots are only reproductive structures with no photosynthetic function. Removing the shoots from a branch does not control dwarf mistletoe, except to

A ponderosa pine with advanced dwarf mistletoe infection. Note the heavy contorted "witch's brooms" in the lower branches. After long periods of infection, the needles at the top of the tree become sparse and shorter. Colorado State Forest Service photo by Dave Root.

temporarily halt seed production. Structures called sinkers, (analogous to roots in plants) embedded in the wood cause the damage, and the mistletoe plant continues to absorb the host tree's water and nutrients. Shoots that are removed grow back in two or three years.

During the growing season, dwarf mistletoe shoots develop berries containing a seed. In August, the berries fill with water and explode, shooting the seed as far as 40 feet. Most seeds strike branches of the host tree and do not travel the full 40 feet, so the expansion of dwarf mistletoe pockets averages two feet per year. When the seed strikes a branch, it germinates and the sinkers penetrate the bark into the tree's conductive tissues. The growing mistletoe begins to steal the tree's food and water. The first visible symptom of infection is swelling in the branch at the site of the growing mistletoe plant, but nubs of the emerging shoots won't be visible for three years and a shoot won't bear its first seeds until seven years after. As seeds spread, all susceptible trees in the vicinity may become infected; it is extremely rare to find an isolated infected tree in the forest.

The tendency of mistletoe to infect all trees in a stand makes eradication difficult. No effective chemical treatment exists for mistletoe, and the only way to kill the parasite is to kill the host. In stands where only the susceptible species of tree exists, total eradication of the mistletoe would require a clearcut, which is unacceptable to most landowners.

Fortunately, mistletoe kills trees slowly, so it is not necessary to eradicate the parasite. The disease can be controlled by a program of thinning to increase tree vigor. Pruning the more heavily infected branches also helps, even if not all the mistletoe is eliminated. The final step in the process is to replant with non-susceptible species so that new trees will grow before the mistletoe kills the remaining trees.

The spread of mistletoe can be halted by a minimum 40-foot buffer zone between infected and non-infected trees. In this situation, cut 20 feet into non-infected trees to remove any mistletoe that is not yet visible; cut the remaining 20 feet into the infected stand. Non-infected trees outside the buffer should be checked each spring for mistletoe and any infected branches should be immediately pruned before seeds develop.

In forest stands with mixed tree species, it may be possible to eliminate all mistletoe by retaining only non-susceptible trees if they are in good health.

Dwarf mistletoe treatment is a complicated process that depends on the site conditions and the landowner's tolerance for cutting trees. In most cases, a combination of treatment methods will best suit the landowner's objectives. Consultation with a qualified forester is recommended to develop an effective and acceptable treatment plan.

MOUNTAIN PINE BEETLE

Due to the massive mountain pine beetle (MPB) epidemic in the western United States and Canada, MPB is the most feared insect in the forest. Unlike the Western Slope, mountain pine beetle is at normal levels in the area. The beetles have crossed the Continental Divide in northern Park County and northern Larimer County, and activity currently is confined mostly to higher altitude lodgepole pine. It presently is not known if or when the beetles will reach into the lower-elevation ponderosa forests, but where they have reached ponderosa, heavy mortality has occurred.

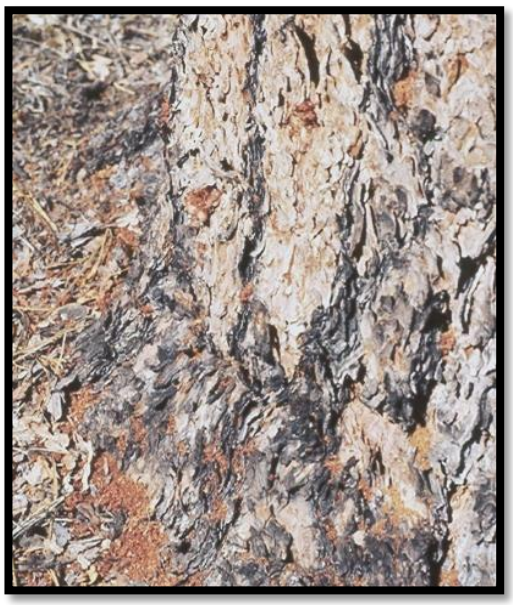
Adult beetles fly from midsummer through the first frost, although the vast majority fly between mid-July through the middle of September. Females seek a large, weak tree in which to mate and lay eggs. Vigorous trees generate enough pitch to prevent the female from burrowing through the bark, and this attempt by the tree to prevent entry creates the pitch tubes symptomatic of beetle attack. Pitch tubes are **not** a particularly reliable indicator of a successful attack. If pitch tubes are seen, check for reddish boring dust (fine sawdust) at the base of the tree and in the bark crevices. Boring dust is a more reliable indicator of successful attack.

Once a female penetrates the bark, she hollows out a circular mating chamber between the bark and the wood, releasing a pheromone (scent) to attract a mate. The pheromone also attracts additional females to the tree and the tree is attacked en masse. After mating, the female burrows up the trunk between the bark and wood laying eggs. She inoculates the tree with spores of bluestain fungus, which provides food for the larvae. The fungus clogs the tissues that conduct water throughout the tree, leading to death within a few weeks.

Eggs hatch within a few days. The developing larvae feed horizontally from the maternal gallery over winter. The vertical maternal gallery and horizontal larval galleries are characteristic of the mountain pine beetle. The feeding larvae spread the bluestain fungus horizontally through the tree, and it becomes visible in the wood around February. The presence of bluestain is absolute confirmation that beetles have successfully attacked a tree.

Woodpeckers feed on the larvae through the fall and winter. The holes made by the woodpeckers are a visual clue to an infested tree. Untrained observers often are confused by the holes woodpeckers make when they feed on beetle larvae and sapsuckers feed on the sap. Woodpecker feeding is characterized by random holes about one-half inch in diameter that make it appear as though the tree was peppered with a shotgun. Sapsuckers, on the other hand, make a small hole about one-eighth inch in diameter, and the holes are in straight lines or a grid pattern. Sapsuckers do not indicate the presence of beetles in the tree.

Although the tree is dead within a few weeks of successful attack, needles remain green until the following spring. Within the space of a few weeks, in late May or early June the tree will turn straw-yellow and then reddish-brown.



Boring dust on a ponderosa pine after bark beetle attack. The reddish brown sawdust at the base of the tree and in the bark crevasses is a strong indication of successful beetle attack. Colorado State Forest Service photo by David Leatherman.

Mountain pine beetle galleries under the bark. The maternal beetle burrowed straight up the tree, creating the darker central gallery. Larval beetles feed horizontally, creating the smaller galleries. A larva is in the upper right and pupae in the lower left. Note the bluestain in the wood. Colorado State Forest Service photo by David Leatherman.

Once beetles invade a tree, nothing can be done to save it; the tree must be cut and disposed of in a way that will kill the beetles. No insecticide is available to kill beetles under the bark; thus, some sort of mechanical treatment is necessary. Any wood greater than four inches in diameter may harbor beetles and must be treated.

Following are treatment options for beetle-infested trees:

- Cut the tree and move all wood greater than four inches in diameter to a designated mountain pine beetle-safe site – usually an area at least one mile away from the nearest pine tree.
- Move all wood to a landfill or bury it under at least eight inches of dirt.
- Completely debark any wood that is larger than four inches in diameter.
- Chip the tree. Many tree services have chippers capable of chipping large diameter trees. The beetles are killed when the wood is chipped.
- Cover wood with at least six-mill clear plastic. This method, known as solar treatment, warms the wood to lethal temperatures and increases moisture, encouraging mold growth in the logs, which kills the beetles. Treat the wood properly for successful control. Cut into firewood lengths and stack no more than two logs high. Be sure there are no exposed stubs or sharp edges that might tear the plastic. Trench around the pile and, if possible, wet down the pile to encourage mold growth. Cover the pile with plastic, push the edges of the plastic into the trenches, and seal the edges with dirt. Check periodically to be sure the plastic has not torn. If torn, it can be repaired with duct tape.

It is best to check for infested trees in October of each year – remember that infested trees, although dead, are still green at this time. Pitch tubes and boring dust will be the most obvious clues. If infested trees are located early, there is adequate time to treat them.

While no insecticide effectively treats infested trees, spraying with insecticides such as carbaryl or permethrine prevents attack. Preventive sprays will not kill beetles under the bark. Spray trees between May 1st and July 1st each year for maximum effectiveness. It is not practical to spray every tree on a large tract of land, so choosing which trees to spray depends on the landowner's budget and the value of individual trees to the landowner. It is advisable to solicit bids from several different spray companies, as prices can vary widely. It also is wise to request and check references.

Thinning forests for increased health and vigor by far is the best preventive measure for mountain pine beetle. Because trees require several years to respond to thinning, it is best done before beetles reach epidemic levels. Follow thinning guidelines for wildfire mitigation to reduce susceptibility to MPB.

DOUGLAS-FIR BEETLE

Douglas-fir beetles have not been observed in the Arabian Acres Community, but considering the stresses of mistletoe and drought the potential of attack is present. Some similarities exist between Douglas-fir beetle and MPB, but there are important differences that require different treatment strategies for infested trees.

Both species burrow under the bark to lay eggs and both carry blue stain fungus that kills the tree within a few weeks of infestation. Each beetle prefers dense stands with large diameter, low vigor trees; thus, thinning Douglas-fir for wildfire mitigation also reduces susceptibility to beetles.

Adult Douglas-fir beetles emerge in mid-June, and a few adults may overwinter in trees and emerge as early as April. There are no insecticides available for treatment of beetle infested trees. Infested trees should be treated prior to April of each year to prevent emergence of overwintering adults. Effective treatments are whole tree chipping, debarking of all wood greater than four inches in diameter, transportation to a safe site or landfill, and burying under eight inches of dirt. Solar treatments should begin in the fall, preferably early fall.

Preventative spraying is an option for high value trees. Permethrin or carbaryl are effective as Douglas-fir beetle preventatives, but, because of the earlier emergence of overwintering adults, spraying should be done in April. Preventative sprays are not an effective treatment for infested wood.

Unlike MPB-infested trees, Douglas-fir trees do not form pitch tubes when attacked, so there may not be an obvious visual indication of infestation. Some Douglas-fir bleed sap when attacked, resulting in rivulets of sap on the trunk; however, this does not occur in all infested trees. Trees should be checked carefully for boring dust in early October. Later in the year, woodpecker holes may provide a visual clue that trees are infested.

Pitch streamers on the bark of a beetle-infested Douglas-fir. Not all infested trees will exhibit pitch. Trees should be checked for boring dust in the early fall. Colorado State Forest Service photo by Dave Root.

Trees partially defoliated by western spruce budworm are particularly susceptible to attack by Douglas-fir beetles. Injury, overcrowding or any conditions that adversely affect the vigor of the tree will make it more susceptible. Managing the forest for open, vigorous stands of Douglas-fir is the best prevention.

IPS (ENGRAVER) BEETLES

There are several species of these small bark beetles that may infest ponderosa pine piñon pine or spruce. Piñon ips is active along the Highway 115 corridor south of Colorado Springs. The other species are always present in the forest, but are not currently at epidemic levels. Ips beetles usually attack trees less than four inches in diameter and, in such circumstances, may be useful in thinning dense stands of young trees. Thus, it usually is not considered as threatening as its larger cousin. Ips will attack larger trees if they are severely weakened by disease (most often dwarf mistletoe), or are damaged by construction, lightning strikes or in horse corrals where soil compaction injures the roots. Like the mountain pine beetle, ips burrow beneath the bark and inoculate the tree with bluestain fungus, often following mountain pine beetles into larger trees.

The differences between mountain pine beetle and ips are significant to anyone implementing a forest management program. In contrast to MPB, which produce one generation per year, ips may produce up to four. Ips become active in spring when the weather exceeds 50 degrees F, developing from egg to adult within eight weeks. They continue to attack trees until the first fall frosts. For this reason, preventive spraying should be done with permethrin or carbaryl in April and repeated in July. When spraying preventively for ips, it is important to spray the branches, as well as the trunk.

Ips attack causes no pitch tubes to form on live trees, so the only visual clue is boring dust or woodpecker holes in the trunk. Smaller trees quickly turn reddish-brown, but when they attack larger trees, ips often infest only the upper portion of the tree. The first symptom is browning of the top, but subsequent generations emerge and continue down the tree.

The reddish-brown sawdust on this freshly cut ponderosa pine slash indicates it has been invaded by ips beetles. Adult beetles will emerge in eight weeks if the slash is not properly treated. Colorado State Forest Service photo by Dave Root.

Ips will infest green slash and downed logs from forest management projects. If slash is not promptly treated, ips will emerge to attack living trees; treat slash within four to six weeks after cutting. If weather conditions permit, thinning trees in winter when ips are dormant will prevent problems with beetles in slash. However, slash cut after March 1 may still be green enough to attract ips when the weather warms.

Chipping slash will kill ips beetles. Lopping and scattering slash into lengths less than 24 inches promotes rapid drying and prevents infestation. Slash cut late in fall that is subsequently infested can be treated or piled and burned over the winter, but untreated slash left over the winter will produce live broods the following April. Due to their short lifecycle, solar treatment of ips-infested logs is ineffective. Bucking larger diameter logs and promptly splitting them into firewood accelerates the drying process and usually is effective in preventing ips infestations.Many high value trees have been lost as a result of the common, and ultimately costly, practice of stacking firewood against green trees. Ips beetles will burrow out of infested firewood directly into standing trees.

Spruce Beetle

No current infestation of spruce beetle exists within the Arabian Acres area, but small pockets this bark beetle has been observed within Teller County. Spruce beetle is currently the most

damaging insect in the state. In 2016 136,000 new acres were infested in the state, with the southwestern portion of Colorado hardest hit. Engelmann spruce are most often infested, but Colorado blue spruce may be infested as well. Spruce beetles will often infest windthrown trees of trees that have recently been cut.

Trees killed by spruce beetle in southwest Colorado. Infested trees slowly turn pale green and the needles fall away. CSFS photo

Spruce beetles differ from other bark beetles by their two year lifecycle. Adult beetles are active from May through July. Females burrow through the bark mate and lay eggs. For the next 18 months, larvae feed in the conductive tissue just beneath the bark interrupting the flow of water throughout the tree. Larvae then pupate and emerge from the tree as adults in the spring. Often trees attacked in one year can be infested by other adults in the second year, and several stages of spruce beetles can be found in a single tree. Symptoms of attack are streamers of pitch, much like those seen on Douglas-fir beetle infested trees, small pitch tubes, boring dust in the bark crevices or woodpecker feeding. Trees may not fade until tow or even three years after the initial attack. When they do fade, the needles slowly turn a light green color and as the needles fall dead trees give the forest a graying appearance.

Treatments are the same as for other bark beetles. Solar Treatment is effective as long as the wood is placed in an opening where it receives direct sunlight. Wood piled in shady areas of spruce forests will not heat up the 101 degrees required to kill the beetles. Chipping, debarking, burying the wood or burning with proper permits are also effective.

Solar treatment of beetle infested trees is effective only if the logs are placed in a sunny area, and the 6 mil clear plastic is sealed with dirt at the edges to create a greenhouse. CSFS photo.

Preventative spraying of non-infested trees will prevent attack, but there is no insecticide that is effective or currently registered for infested trees. Preventative spraying is not necessary unless there are active beetle infested trees in the immediate vicinity.

As with all insect or disease threats, the best strategy is to manage the forest for tree health and vigor. Managing forest for diverse species and for diverse ages of trees offers the best prevention for all insect and disease epidemic.

References

Colorado State Forest Service, Colorado Department of Natural Resources, Warner College of Natural Resources. (2016) *2016 Report on the Health of Colorado's Forests.* Colorado State Forest Service.

Cranshaw, Whitney, David Leatherman, Boris Kondratieff, Paul Opler, and Casey Sclar. Nd. *Insects and Diseases of Woody Plants of the Central Rockies.* Bulletin 506A, Colorado State University Cooperative Extension.

Furniss, R.L., and Carolin, V.M. (1977). *Western Forest Insects.* Miscellaneous Publication No. 1339 USDS Forest Service.

Johnson, Warren T., and Lyon, Howard H. 1991. *Insects that Feed on Trees and Shrubs.* Comstock Publishing Associates, Cornell University Press.

USDA Forest Service, Forest Health Management Rocky Mountain Region. 2009. *Sudden Aspen Decline in Colorado*

Appendix B

Further Information

Websites:

Cost Share Assistance Database: http://nrdb.csfs.colostate.edu/
Colorado State Forest Service: http://www.csfs.colostate.edu/
CSFS, Woodland Park District: http://csfs.colostate.edu/pages/woodlandparkdist.html
Colorado Division of Parks & Wildlife: http://cpw.state.co.us/
Firewise Communities: http://www.firewise.org/
El Paso County: http://www.elpasoco.com/Pages/default.aspx
Park County: http://www.parkco.us/
Teller County: http://www.co.teller.co.us/
Colorado State University Extension: http://www.extension.colostate.edu/chaffee/
Pike National Forest: http://www.fs.usda.gov/psicc
Bureau of Land Management, Royal Gorge Field Office: http://www.blm.gov/co/st/en/fo/rgfo.html
Natural Resources Conservation Service: http://www.co.nrcs.usda.gov/
Colorado Tree Farmers: http://csfs.colostate.edu/tree-farm/
National Woodland Owners Association: http://woodlandowners.org/
Pikes Peak Wildfire Prevention Partners: http://ppwpp.org/
Fire Adapted Communities: http://www.fireadapted.org/
Ready, Set, Go: http://www.wildlandfirersg.org/

Publications:

Community Wildfire Protection Planning

How to evaluate a community Wildfire Protection Plan: http://csfs.colostate.edu/pdfs/eval_9-8-08_web.pdf
All Colorado CWPPs: http://csfs.colostate.edu/pages/CommunityWildfireProtectionPlans.html

Wildfire Mitigation

***CO Dept. of Revenue Tax Subtraction*:**
http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1251915899901&ssbinary=true
Fuel Break Guidelines for Forested Communities: http://csfs.colostate.edu/pdfs/fuelbreak_guidellines.pdf
Protecting Your Home from Wildfire: Creating Wildfire Defensible Zones:
http://csfs.colostate.edu/pdfs/FIRE2012_1_DspaceQuickGuide.pdf
Firewise Landscaping: http://csfs.colostate.edu/pdfs/06303.pdf
Firewise Plant Materials: http://csfs.colostate.edu/pdfs/06305.pdf
Forest Home Fire Safety: http://csfs.colostate.edu/pdfs/06304.pdf
Grass Seed Mixtures to Reduce Wildfire Hazard: http://csfs.colostate.edu/pdfs/06306.pdf
Firewise Construction: Site Design and Building Materials:
http://csfs.colostate.edu/pdfs/firewise-construction2012.pdf

Forest Health and Management

Gambel Oak Management: http://csfs.colostate.edu/pdfs/06311.pdf
Landowner's Guide to Thinning: http://csfs.colostate.edu/pdfs/landowner_g4thin_scr.pdf
Landowner's Guide to Living With Bark Beetles: http://csfs.colostate.edu/pdfs/MPB_Newspaper_Insert_Final.pdf
Landowner Assistance Programs in Colorado:
http://csfs.colostate.edu/pdfs/Landowner-Assistance-Programs-rev112610.pdf

Forest Insect and Disease Information

Dwarf Mistletoe Management: http://csfs.colostate.edu/pdfs/DMT.pdf
Mountain Pine Beetle: http://csfs.colostate.edu/pdfs/MPB.pdf
Solar Treatment for Mountain Pine Beetle:
http://csfs.colostate.edu/pages/documents/Solar_Treatment_for_Mountain_Pine_Beetle_April_2009.pdf
Products used to Prevent Mountain Pine Beetle:
http://csfs.colostate.edu/pdfs/Web__Revision_June6_MPB_Prev_Products_QG.pdf
Ips Beetles: http://csfs.colostate.edu/pdfs/Ips.pdf
Western Spruce Budworm: http://csfs.colostate.edu/pdfs/05543.pdf
Firewood and House Log Insects: http://csfs.colostate.edu/pages/documents/firewood_insects.pdf
Protecting Trees During Construction: http://csfs.colostate.edu/pdfs/construction.pdf
Spruce Beetle: http://csfs.colostate.edu/media/sites/22/2014/02/Spruce-Beetle-QuickGuide-FM2014-1.pdf

Post Wildfire Recovery:

Insects and Disease Associated with Forest Fires: http://csfs.colostate.edu/pdfs/06309.pdf
Vegetative Recovery after Wildfire: http://csfs.colostate.edu/pdfs/06307.pdf
Soil Erosion Control After Wildfire: http://csfs.colostate.edu/pdfs/06308.pdf
Replanting in Burned Areas: Tips for Safety & Success:
http://csfs.colostate.edu/pdfs/FINAL-Post-FireReplanting-andSafetyTips-2013Feb11.pdf
Aspen Survival After Wildfire: http://csfs.colostate.edu/pages/documents/How-to-Aspen.pdf
Douglas-fir Survival After Wildfire: http://csfs.colostate.edu/pages/documents/How-to-Aspen.pdf
Gambel Oak and Serviceberry Survival After Wildfire:
http://csfs.colostate.edu/pages/documents/How-to-gambel-oak-and-serviceberry.pdf
Piñon Pine and Juniper Survival After Wildfire: http://csfs.colostate.edu/pages/documents/How-to-PJ.pdf
Ponderosa Pine & Lodgepole Survival After Wildfire:
http://csfs.colostate.edu/pages/documents/How-to-Ponderosa-and-lodgepole.pdf

Appendix C
Glossary

Aerial fuels: Standing and supported live and dead combustibles not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stems, cones, bark, and vines: typically used in reference to the crowns of trees.

Cambium: A single layer of cells between the woody part of the tree and the bark. Division of these cells result in diameter growth of the tree through formation of wood cells (xylem) and inner bark (phloem).

Canopy: The forest cover of branches and foliage formed by tree crowns.

Chimney: A topographical feature such as a narrow drainage on a hillside or the upper end of a box canyon that could channel wind, smoke or flames up the slope; acting as a fireplace chimney would to draw smoke and heat upward.

Class A Roof: Effective against severe fire test exposures, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a fairly high degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Class B Roof: Effective against moderate fire test exposures, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a moderate degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Class C Roof: Effective against light fire test exposure, as classified by the Universal Building Code (UBC). Under such exposures, roof coverings of this class are not readily flammable, afford a measurable degree of fire protection to the roof deck, do not slip from position, and are not expected to produce flying brands.

Clearcut: An area of forest land from which all merchantable trees have recently been harvested.

Commercial Thinning: A silviculture treatment that "thins" out an overstocked stand by removing trees that are large enough to be sold as poles or fence posts. It is carried out to improve the health and growth rate of the remaining crop trees.

Competing Vegetation: Vegetation that seeks and uses the limited common resources (space, light, water, and nutrients) of a forest site needed by preferred trees for survival and growth.

Conifer: Cone-bearing trees having needles or scale-like leaves, usually evergreen, and producing wood known commercially as "softwoods."

Conservation: Management of the human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. It includes the preservation, maintenance, sustainable utilization, restoration, and enhancement of the environment.

Crown fire / Crowning: A form of extreme wildland fire behavior consisting of fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as running or dependent to distinguish the degree of independence from the surface fire.

Deciduous: Perennial plants that are normally leafless for some time during the year.

Defensible Space: An 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 herein 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. In simplest terms, it is adequate space between structures and flammable vegetation which allows firefighters a safe working area from

which they can attack an oncoming wildfire. Defensible Space is the best element of fire protection for individual property owners.

Defoliator: An agent that damages trees by destroying leaves or needles.

Dripline: The outer most leaves on a tree defines its dripline and the ground within the dripline is known as the drip zone; also defined as the area defined by the outermost circumference of a tree canopy.

Eave Opening: A vent located in an eve or soffit which allows airflow into the attic and/or walls of a structure.

Ecosystem: A functional unit consisting of all the living organisms (plants, animals, microbes) in a given area, and all 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 a log, pond, field, forest, or the earth's biosphere but it always functions as a whole unit. Ecosystems are commonly described according to the major type of vegetation; for example, forest ecosystem, old-growth ecosystem, or range ecosystem.

Escape route: A preplanned and understood route firefighters take to retreat from an unsafe or fire-threatened area and move to a safety zone or other low-risk area.

Extreme fire behavior: A level of fire behavior that ordinarily precludes firefighting methods involving direct attack on the fire. One or more of the following is usually involved: high rate of spread, prolific crowning and/or spotting, 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.

Felling: The cutting down of trees.

Firebrands: Flaming or glowing fuels lofted into the air during intense burning by strong upward convection currents. Also referred to as airborne embers.

Fire break: A natural or constructed fuel-free barrier used to stop or check fires that may occur, or to provide a control line from which to work.

Fire front / Flame front: The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified, the fire front is assumed to be the leading edge of the fire perimeter.

Fire Hazard Mitigation: Various methods by which existing fire hazards can be reduced in a certain area, such as fuel breaks, non-combustible roofing, spark arresters, etc.

Fire Management: The activities concerned with the protection of people, property, and forest areas from wildfire and the use of prescribed burning for the attainment of forest management and other land use objectives, all conducted in a manner that considers environmental, social, and economic criteria.

Fire Suppression: All activities concerned with controlling and extinguishing a fire following its detection.

Firewise: A National Fire Protection Association's (NFPA) program encouraging local solutions for wildfire safety by involving homeowners, community leaders, planners, developers, firefighters, and others in the effort to protect people and property from wildfire risks.

Forest Fire: Any wildfire or prescribed burn that is burning in forest, grass, alpine, or tundra vegetation types.

Forest Type: A group of forested areas or stands of similar composition (species, age, height, and stocking) which differentiates it from other such groups.

Fuel: Any living or dead material that will burn.

Fuel break: An existing barrier or change in fuel type (to one that is less flammable than that surrounding it) or a wide strip of land on which the native vegetation has been modified or cleared, that acts as a buffer to fire spread so that fires burning into them can be more readily controlled. Often selected or constructed to protect a high value area from fire.

Fuel Management: The act or practice of controlling flammability and reducing resistance to control of wildland fuels through mechanical, chemical, biological, or manual means, or by fire in support of land management objectives.

Fuel reduction zone: An area similar to a fuel break but not necessarily linear, in which fuels have been reduced or modified to reduce the likelihood of ignition and/or to reduce fire intensity thereby lessening potential damage and resistance to control.

Germination: The development of a seedling from a seed.

Home Ignition Zone (HIZ): An area including the home and its immediate surroundings within which burning fuels could potentially ignite the structure; usually considered to be an area extending out roughly 100 feet from the home. The HIZ is often used to describe the area in which fuel modification measures should be taken to protect the home.

Ladder Fuels: Fuels that provide vertical continuity between the surface fuels and crown fuels in a forest stand, thus contributing to crown fires.

National Fire Protection Association (NFPA): A private, non-profit organization dedicated to reducing fire hazards and improving fire service.

Pitch Tubes: A tubular mass of resin that forms on bark surface at bark-beetle entrance holes.

Prescribed Burning: Controlled application of fire to wildland fuels, in either their natural or modified state, under certain conditions of weather, fuel moisture, soil moisture, etc. as to allow the fire to be confined to a predetermined area and at the same time to produce results to meet planned land management objective.

Ready, Set, Go (RSG): A program, managed by the International Association of Fire Chiefs (IAFC), seeking to develop and improve the dialogue between fire departments and residents. The program helps fire departments teach individuals who live in high-risk wildfire areas how to best prepare themselves and their properties against fire threats.

Regeneration: The act of renewing tree cover by establishing young trees, naturally or artificially note regeneration usually maintains the same forest type and is done promptly after the previous stand or forest was removed.

Saddle: A depression, dip or pass in a ridgeline; significant in wildland firefighting because winds may be funneled through a saddle, causing an increase in wind speed.

Safety zone: An area essentially cleared of flammable materials, used by firefighters to escape unsafe or threatening fire conditions. Safety zones are greatly enlarged areas in which firefighters can distance themselves from threatening fire behavior without having to take extraordinary measure to shield themselves from fire/heat.

Shaded fuel break: A fuel break built in a timbered area where the trees within the break are thinned and limbed up to reduce crown fire potential, yet retain enough crown canopy to provide shade, thereby making a less favorable microclimate for surface fires.

Silviculture: The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

Snag: A standing dead tree or part of a dead tree from which at least the smaller branches have fallen.

Stand: A continuous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit.

Spot Fire / Spotting: Fires ignited beyond control lines or outside the perimeter of a fire by firebrands landing on/among flammable material. Spot fires/spotting are a form of extreme fire behavior typically resulting from high wind conditions.

Structure protection: A defensive strategy in wildland firefighting in which firefighters are assigned to evaluate, prepare and, when possible, defend structures/homes that may be threatened by a wildfire.

Succession (or Ecological Succession): The replacement of one plant and/or animal species over time by another in progressive development toward climax vegetation.

Surface fuels: Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low-lying live vegetation.

Thinning: A cutting made in an immature crop or stand primarily to accelerate diameter increment, but also, by suitable selection, to improve the average form of the tree that remain.

Torching: The burning of the foliage of a single tree or a small group of trees, from the bottom up. Sometimes, also called candling. Torching is an extreme form of fire behavior, similar to but less extreme than crowning in that crowning affects larger numbers, even entire stands of trees.

USDA-FS: United States Department of Agriculture - Forest Service, what is commonly known as just "The Forest Service"

Wildland-Urban Interface or Wildland-Urban Intermix (WUI): The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. Although ***Interface*** is the more general, more commonly used term; it technically refers specifically to the area where development and wildlands meet. ***Intermix*** indicates the presence of wildland vegetation/fuels intermingled throughout the developed area.