La Veta Fire Protection District

Fire Behavior Analysis

2021

Table of Contents

General Information

The La Veta Fire Protection District (FPD) is located in the southwest portion of Huerfano county. It is comprised of approximately 145,000 acres and ranges in elevation from 6,700 to the 13,626 foot West Spanish Peak. The greater majority of the lands within the FPD are privately owned properties with some limited Bureau of Land Management and U.S. Forest service lands. The largest town in the district is La Veta and to the south is the small incorporated town of Cuchara. There are several subdivisions within the district such as Wayatoya valley, Cuchara West, Tres Valles and Pinehaven.

Fuel Model Information

The first step in this analysis was to use a Geographic Information System (GIS) based program to generate a landscape layer that included a fuel model layer for the area surrounding the subdivision. The basic characteristics of the layer can be scaled depending on the size of the landscape needed for analysis. The landscape is cut into squares (pixels) for analysis but is still a fairly coarse filter. In this case the pixels are 90 meters square, primarily due the size of the landscape. Several outputs are generated that can be overlaid on a base layer, such as a Google Earth satellite image. This does not generate a fire growth model nor does it imply that fire in one pixel influences fire in the adjoining pixels. Simply put, it is a way to see fire behavior calculations over a landscape in a spatial manner, rather than as numerical outputs.

Basic fire behavior runs were created using the Wildland Fire Decision and Support System (WFDSS) created by the Missoula Fire Lab and an inter-agency staff at the National Fire and Aviation Executive Board. The basic fire behavior outputs from the model use an extension of FlamMap to compute potential fire behavior characteristics (such as spread rate, flame length, and fireline intensity) over an entire landscape using constant weather and fuel moisture conditions for an instant in time. (https://wfdss.usgs.gov/wfdss/pdfs/intro_flammap3_(desktop).pdf)

The following fuels information is taken from Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model, Scott & Bergen, published by the USDA Forest Service, General Technical Report RMRS-GTR-153.

Within the FPD, each fuel model that carries fire, have specific fire behavior characteristics that can be measured; flame length, rate of spread (measured in chains per hour, ch/h) and crown fire activity, to name a few. The fuel model layer shows examples of plant communities that are present within the subdivision.

The following list are descriptions of the fuel models that are present within the La Veta Fire Protection District.

GR1 - 101 Sparse grass that is generally short, either naturally or by grazing. Spread rate is low (2-5 ch/h); flame length low (1-4 ft.). Primarily grasses that have been mowed or are just sparse in continuity. (Light Straw Yellow)

GR2 - 102 Moderately coarse continuous grass, average depth about 1 foot. Spread rate high (20-50 ch/h); flame length moderate (4-8 ft). (Medium Sunshine Yellow)

GR4 - 104 Moderately coarse continuous grass, average depth about 2 feet. Spread rate very high (50- 150 ch/h); flame length high (8-12 ft.). (Bright yellow)

GS1 - 121 Shrubs are about 1 foot high, low grass load. Spread rate moderate; flame length low. (Light Olive Drab)

GS2 - 122 Shrubs are 1 to 3 feet high, with a moderate grass load. Spread rate high (50-150 ch/h); flame length moderate (4-8 ft). Primarily a mixed shrub community with rabbit brush, greasewood and ornamental shrubs such as ground juniper. (Dark Olive Drab)

SH1 - 141 Low shrub fuel load, fuelbed depth about 1 foot; some grass may be present. Spread rate very low (0-2 ch/h); flame length very low (0-1 ft.). (Light Brown)

SH2 - 142 Moderate fuel load (higher than SH1), depth about 1 foot, no grass fuel present. Spread rate low (0-2 ch/h); flame length low (0-1 ft.). (Medium Brown)

SH5 - 145 Heavy shrub load, depth 4 to 6 feet. Spread rate very high (50-150 ch/h); flame length very high (12-25 ft.). (Medium Maroon)

SH7 - 147 Very heavy shrub load, depth 4 to 6 feet. Spread rate high (20-50 ch/h); flame length very high (12-25 ft). Primarily Gambel oak and alder species. (Maroon)

TU1 - 161 Fuelbed is a low load of grass and/or shrub with leaf and needle litter. Spread rate low (2-5 ch/h); flame length low (1-4 ft.). Primarily mixed conifer and aspen species. (Light Green)

TU5 - 165 Fuelbed is high load conifer litter with shrub understory. Spread rate moderate (5-20 ch/h); flame length moderate (4-8 ft). Mixed conifer species with Douglas fir and white fir intermixed with an occasional ponderosa pine. (Dark Green)

TL1 - 181. Light to moderate load, fuels 1 to 2 inches deep. Spread rate very low (0-2 ch/h); flame length very low (0-1 ft.). (Light Baby Blue)

TL2 - 182 Low load, compact timber litter. Spread rate very low (0-2 ch/h); flame length very low (0-1 ft). Broadleaf litter from Aspen stands. (Bright Cyan Blue)

TL3 - 183 Moderate load conifer litter. Spread rate very low (0-2 ch/h); flame length low (1-4 ft). Ponderosa pine and other mixed conifer species. (Denim Blue)

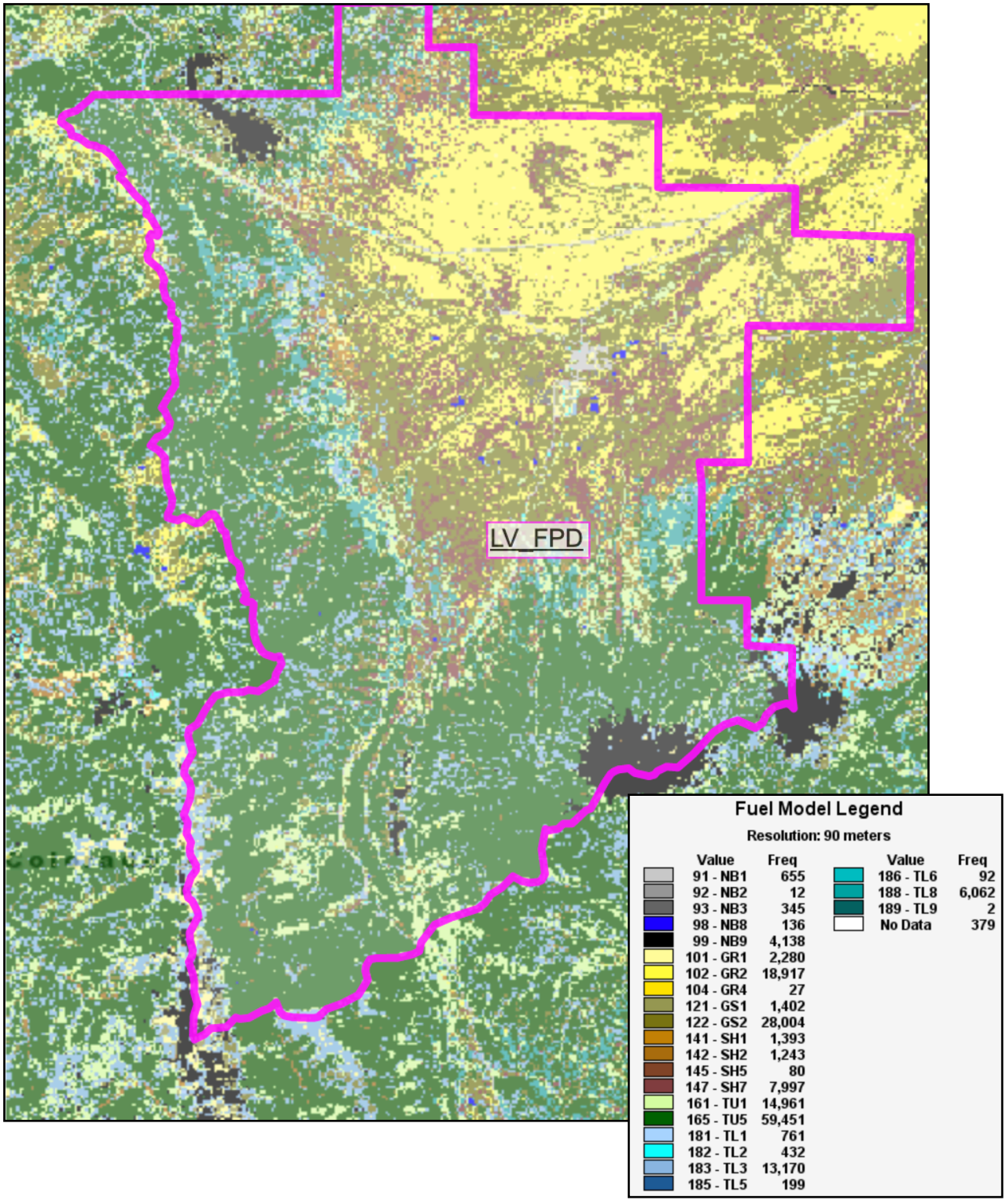
TL5 - 185 High load conifer litter; light slash or mortality fuel. Spread rate low (2-5 ch/h); flame length low (1-4 ft.). (Dark Denim Blue)

TL6 - 186 Moderate load, less compact. Spread rate moderate (5-20 ch/h); flame length low (1-4 ft.). (Light Turquoise Blue)

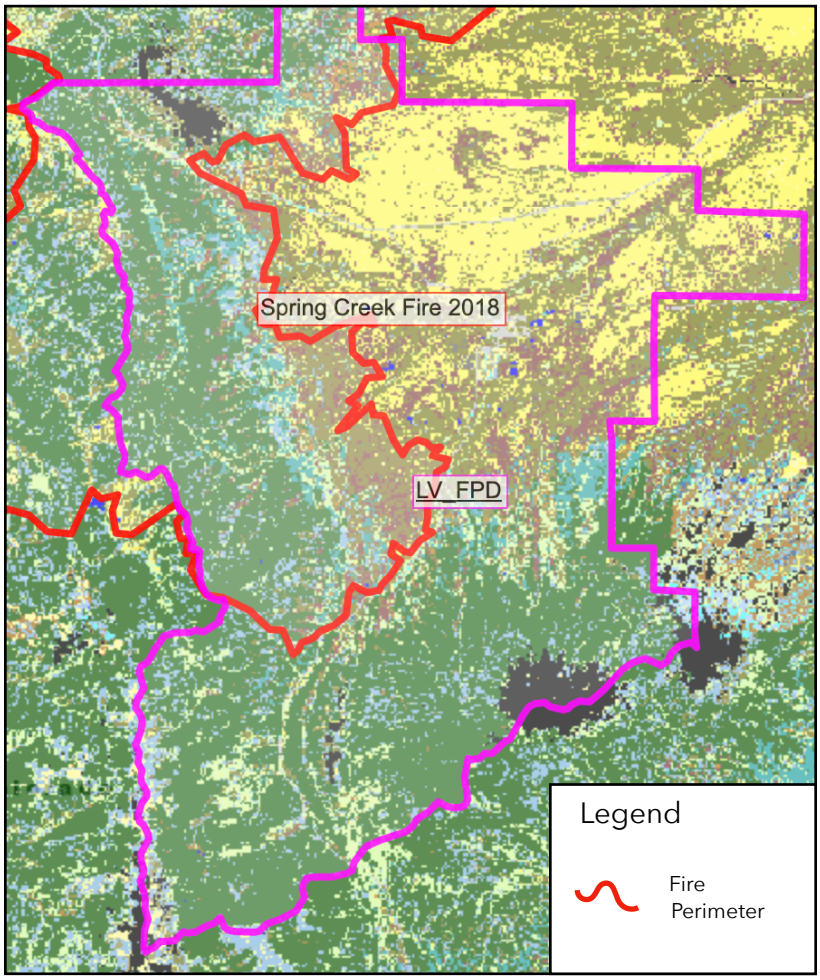
TL8 - 188 Fuelbed composed of long-needle pine litter with moderate load and compactness may include small amount of herbaceous load. Spread rate moderate (5-20 ch/h); flame length low (1-4 ft). Primarily ponderosa pine leaf litter. (Medium Turquoise Blue)

TL9 - 189 Very high load broadleaf litter; heavy needle-drape in otherwise sparse shrub layer. Spread rate moderate (5-20 ch/h); flame length moderate ((4-8 ft.). (Dark Blue Green)

When viewing the fuel model information in the graphic below, one thing to note is that the landscape has not been updated within LandFire for the Spring Creek fire of 2018. The upper left quarter of the FPD should have much more altered fuel models than is shown.



These can be altered within WFDSS when doing these types of analyses but it is not extremely accurate. The fire perimeter can be overlaid on the landscape and individual fuel models changed to what would be a guess as to what the current fuel model might be, but this will not account for where islands of non-burned original fuel models were left behind. Given time, updates to the fuel models will be made by the LandFire team from satellite imagery and a more accurate display of fire behavior can be made. At this point in time however it can be assumed that within the foot print of the Spring Creek fire, any fire behavior for the next several years will be less severe than predicted by this analysis.



The legend for the fuel models gives a frequency of occurrence for each fuel model that is within the rectangle. A quick glance at the distribution shows that there is a large percentage of grass and grass/shrub (yellow and light browns) in the upper right third of the FPD. The predominance of the greens in the southern third shows a large expanse of forested area that is dominated by a timber understory and timber litter fuel models. The timber understory models are primarily mixed conifer forests with a scattering of aspen mixed in. The timber litter models are mostly ponderosa pine stands.

Since fire behavior within the Spring Creek Fire was such high intensity on most of the landscape, it can be assumed that given the same weather and climate conditions, a fire might act and behave very similarly in the timber stands at the southern end of the FPD.

Baseline Modeling

Modeling for this assessment used some basic assumptions to arrive at a baseline of data and then created additional runs to try to build an array of scenarios that could lead to recommendations for mitigation work. Fuel model data is from the LandFire 2014 v.1.4.0 that is part of Wildfire Decision Support System (WFDSS). LandFire is a national database that is used to create spatial data for inputs into many modeling systems such as WFDSS. It is created using satellite images that are interpreted so as to arrive at many different parameters such as slope, crown density, and fuel models. In the process of doing satellite photo interpretation, very little is known about what if any work has been done on a particular piece of ground.

> "Predicting the potential behavior and effects of wildland fire is an essential task in fire management. Mathematical surface fire behavior and fire effects models and prediction systems are driven in part by fuelbed inputs such as load, bulk density, fuel particle size, heat content, and moisture of extinction. To facilitate use in models and systems, fuelbed inputs have been formulated into fuel models. A fuel model is a set of fuelbed inputs needed by a particular fire behavior or fire effects model. Different kinds of fuel models are used in fire science….. " (Scott and Burgan, 2005).

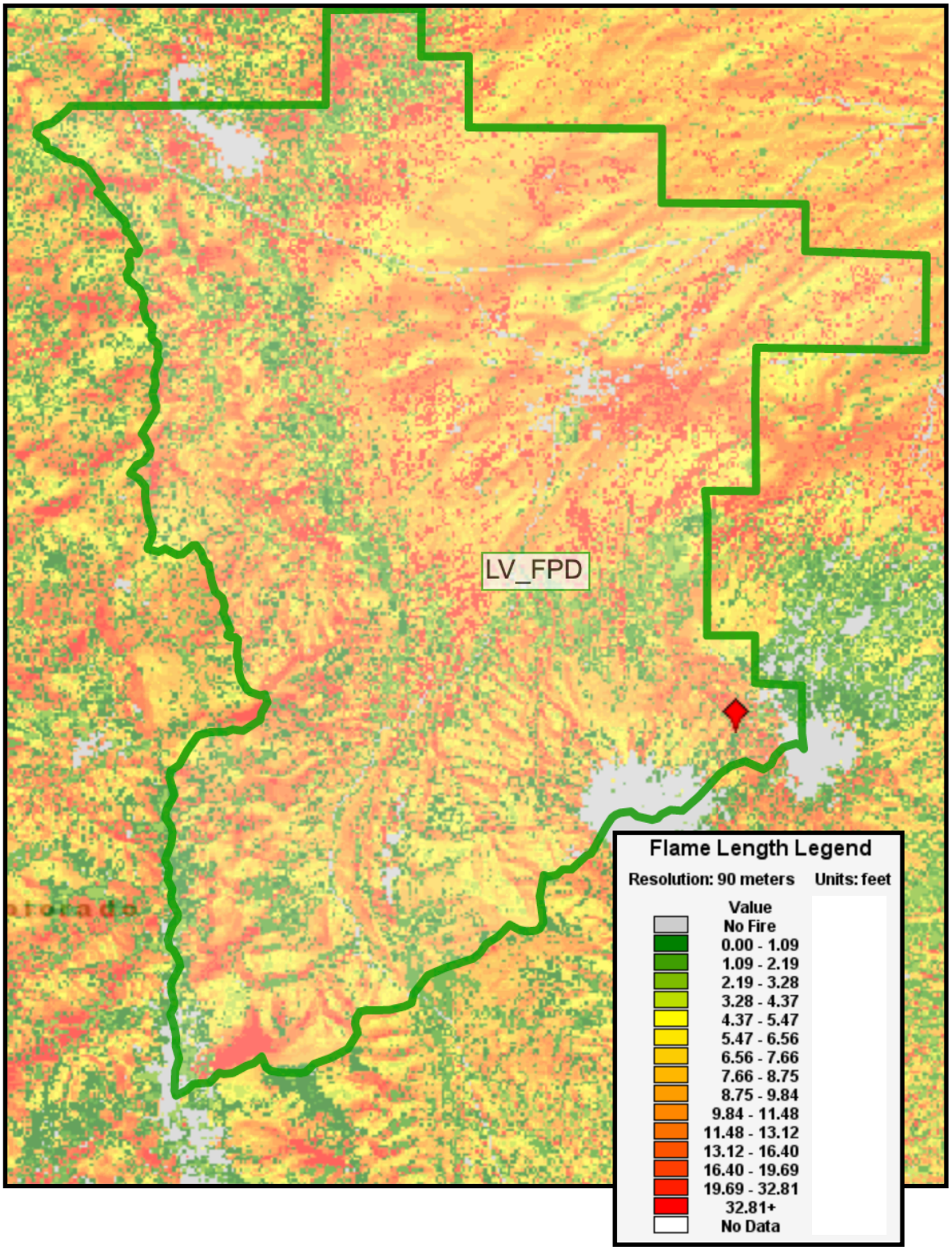
In this assessment the important assumption is that for each run of modeling no changes to structure within a fuel model has been made, such as thinning or limbing of trees.

Weather data for the baseline model tries to replicate the very dry conditions that were present very near the day the Spring Creek fire started on 6/29/2018.

Given:

Fire start date: 6/26/2018
Fire start time: 1300
Weather station data: Bosque RAWS station 23 miles south of the town of La Veta.
Foliar moisture content: 80%, down from the norm of 100%
Wind speed: 21 mph
Wind Direction: 220 degrees azimuth
Fuel Moisture: Dead fuel moisture, 1hr - 4%, 10hr - 5%, 100 hr - 6%
Live fuel moisture, Herbaceous - 40% and Woody 70%.

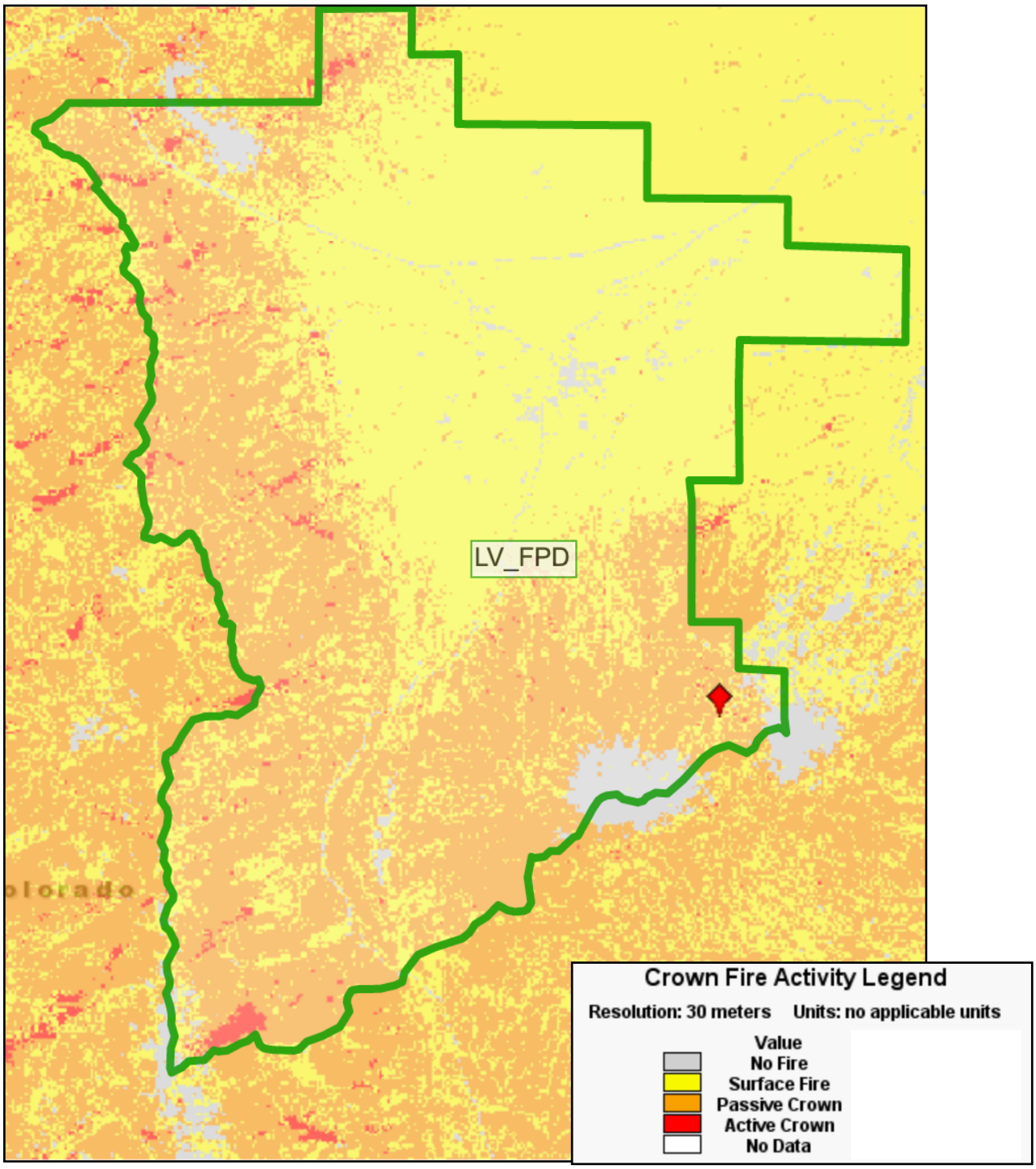
Flame length output: Flame length is one of many possible fire behavior characteristics that can be used to quantify effects on a landscape. Flame length has a fairly direct correlation for the ability to control or fight a fire. There is no simple formula for arriving at flame lengths since there are many variables that come into play to estimate the length of flames in a fire, such as wind speed, air temperature, relative humidity, dew point, and live and dead fuel



moisture content, just to name a few. Just because a fuelbed is primarily made of short grasses, doesn't mean it will have short flame lengths, quite the contrary, it could have long flame lengths but shorter duration fire. Conversely a stand of dense timber with a dense short needle bed underneath won't automatically produce longer flame lengths, just because the trees are taller than the grass, there are some fuel models that in this case might only produce 1-2 foot flames.

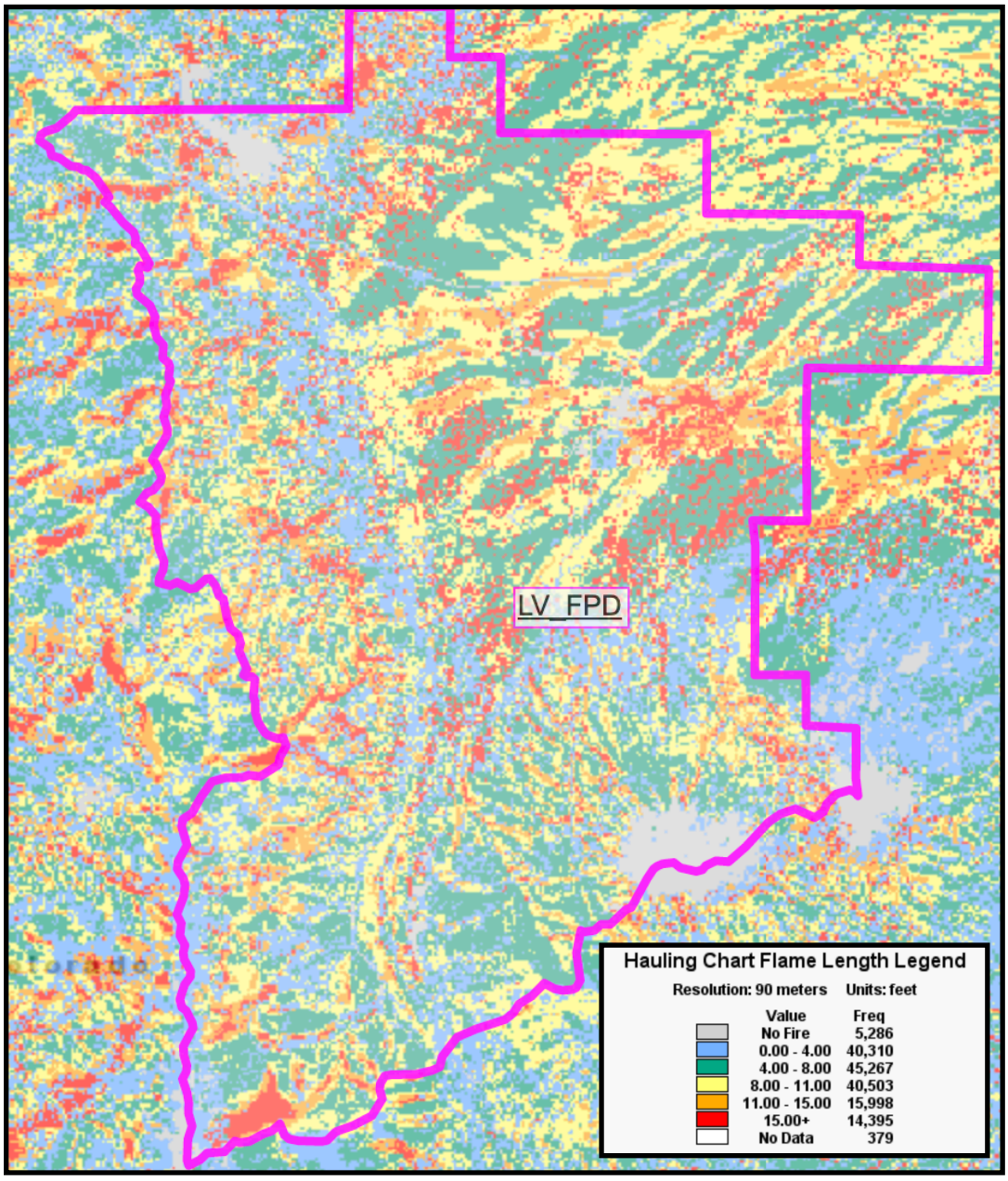
The dark green to light green colors are in the 0 to 4 foot range, the light yellow to orange are 4 to 8 foot and the reds are 8 foot and above. The output from FlamMap shows that the greater majority of the fire protection district predicts to have flame lengths in the 4 - 8 foot range and about the same number of 11 feet and higher. Flame lengths in this example are measured in feet.

Crown Fire Activity output: FlamMap shows that Crown Fire activity for the FPD is mostly in the passive and surface fire categories. Surface fire is fire that is only on the surface litter and not in the crowns of the trees. Surface fires are easily controlled by hand crews and engine crews. Passive Crown fire is a condition where trees independently torch the crowns and do not make large sustained runs from tree to tree. Passive crown fire is more problematic than



surface fire in that when a tree torches it can throw fire brands into other trees, accumulations of leaves and needles on roofs and even into the eaves of houses, setting up a condition where structures could be lost. Passive crown fires generally require the use of water to help with control and hand crews are not very effective without some sort of support.

Given that this assumes there has not been any mitigation work completed in the FPD or that the Spring Creek fire occurred in 2018, it can be assumed that depending on when a fire occurs during the day or what weather conditions that could present itself, passive crown fire activity could transition to active crown fire or only be surface fire.



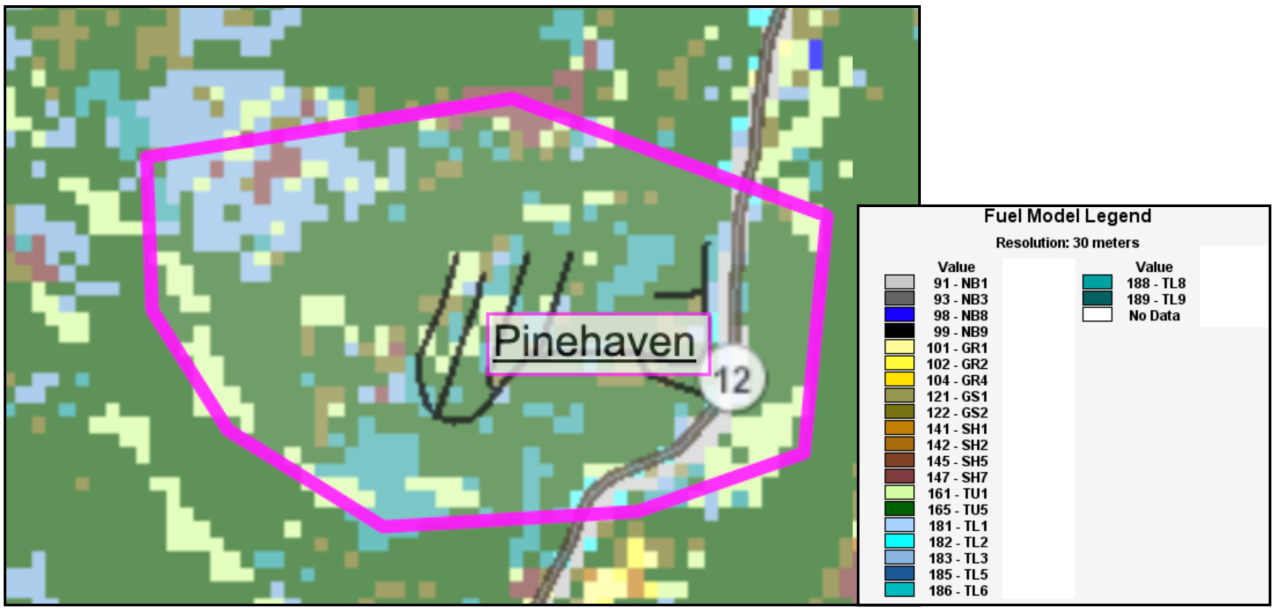
Hauling chart characteristics: One tool that fire managers use to help with analyzing what potentials a fire may have on the landscape is a chart called the Hauling chart. It is important to remember that this chart is tied back to the weather characteristics that are part of the inputs to the analysis and will change for each set of weather, time of year and fuel characteristics. In the attached analysis output one can see that there is about an equal percentage of the area in the blue or less than 4 foot flame length area, in the green or 4 - 8 foot flame lengths and the yellow or 8 - 11 foot flame lengths. The orange and red areas that are the 11 to 15 foot flame lengths and over 15 foot flames make up about 25% of the total area of the landscape. Some of these areas are within the Spring Creek fire footprint and would not be so problematic now and for the next several years.

Subdivision Specific Analysis

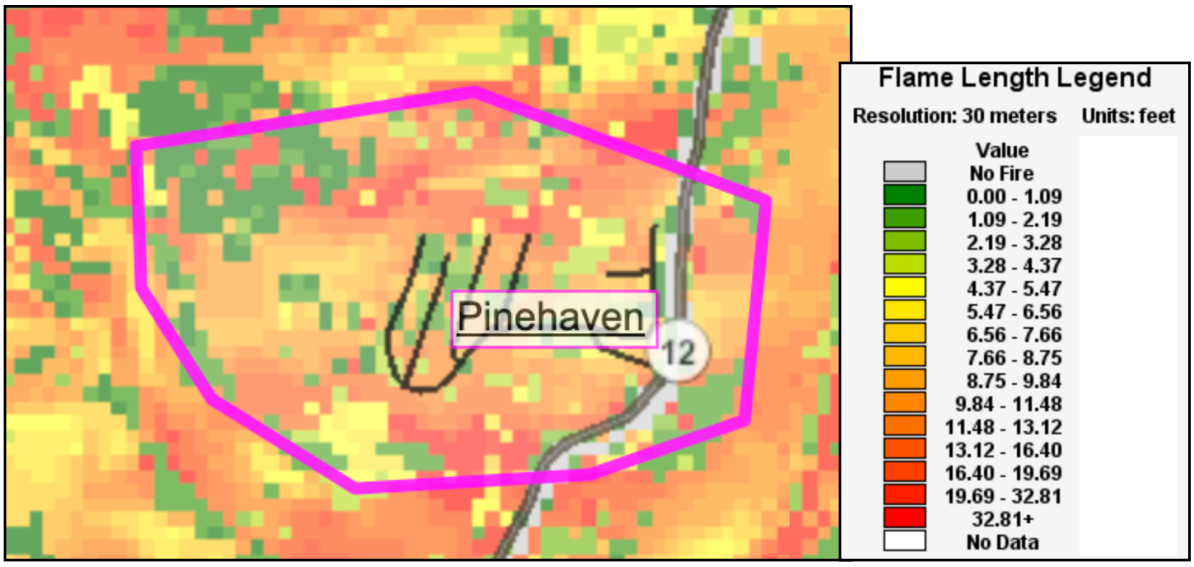
This next several sections will follow in a loose outline similar to the previous section to show the fuels in that subdivision and the subsequent fire behavior attributes but in a much more detailed manner. Each of the map outputs will be using a finer resolution, 30 meter pixels, to display the potential fire behavior within the area.

Pinehaven Subdivision

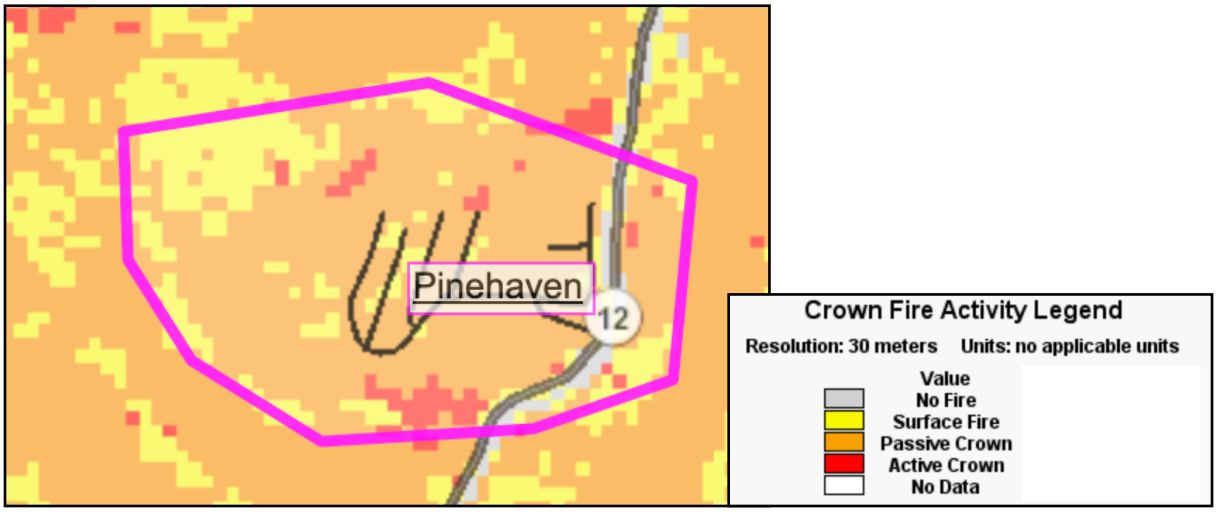
The fuel models for Pinehaven are mostly in the timber litter and timber understory models with a few exceptions of some shrub models. The greens and blues on the output shows that the timber models predominate the area. TU5 is the dominate fuel model (dark green), referring back to the initial discussion of the fuel models for the entire La Veta FPD, we see



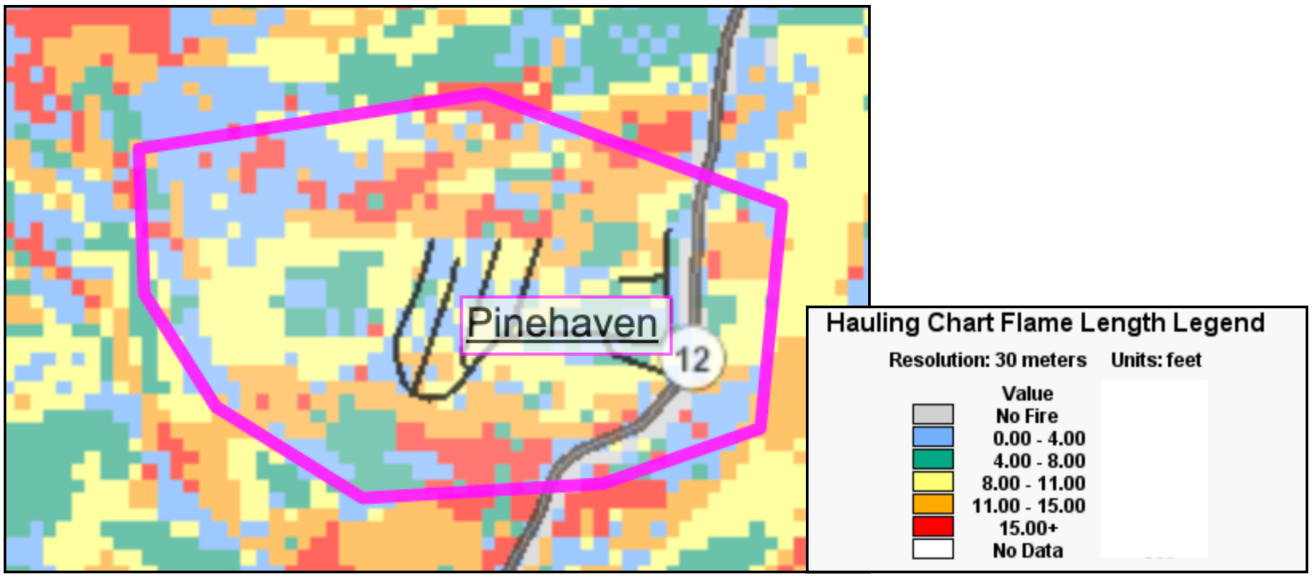
that this fuel model has a well developed shrub or small tree (white fir) understory. Its reactivity is in the moderate category, meaning it has some relatively quick rates of spread (5-10 ch/hr) and flame lengths that are in the 4-8 foot range and above. This would require engaging a fire with some form of equipment, engines, dozers and even aircraft. The few areas in the subdivision where there is a shrub component is a fairly well developed component of Gambel oak stands.



Flame Length output: The flame length output also displays, as described in the previous section, that most of the flame lengths are higher than 4 feet (this is without doing any mitigation work). Timber fuel models are easily modified by limbing trees (raising the crown base height to 10' above ground or 1/3 the tree height, whichever is less), thinning trees (decreasing density by making tree crowns spaced 10 ft. apart) and altering the surface fuels (removing shrubs close to the house and raking surface litter).



Crown Fire Activity output: Crown fire activity within Pinehaven also displays the higher flame lengths and the fact that there are possibly ladder fuels in the understory that allows for fire to transition from surface to the crowns of trees, not always in a very active fashion, but active enough to make problems for fire suppression crews. Passive crown fire is defined as: occurring where surface fire intensity is sufficient to ignite tree crowns, individually or in groups, but winds are not sufficient to support propagation from tree to tree. (NWCG, 2019)



Hauling Chart output: The hauling chart output shows that there is very small portion of the subdivision that is within the range that is easy for fire fighters on the ground to be able to handle without extra support (0-4 ft. Blue color). Most of the subdivision and surrounding area is within the green, yellow, orange and red colors, or all flames greater than 4 feet.

Recommendations

Pinehaven has done some mitigation work that is evident from Highway 12. This is good work to help other residents up the highway/valley have good ingress/egress should there be a wildfire as well as being a good model for what finished mitigation work can look like. On initial assessment it looks as though most homes have done some level of mitigation work. More can be accomplished by doing annual maintenance by mowing grasses and small shrubs as well as continuing to thin out small trees that encroach and create ladder fuels. There are a few vacant lots that have yet to be properly mitigated. This is an important piece of the puzzle in mitigation work, these unmitigated properties make those in the vicinity or even well upslope from the properties, at risk. Neighboring properties could try contacting the landowner and ask if they can do the mitigation work for them. Most mitigation work only improves the value of a piece of property.

There are at least two known creek bottoms within the analysis area, one north of the heart of the subdivision and one to the south. Mitigation work especially on the north aspects of each of the drainages would be very important to attempt to alter the fuel models to ones that might not be quite as prone to passive and active crowning. The northern drainage has a unimproved road that home owners have cleared for a second egress. Cleaning up the win-row of larger diameter fuels that was created when clearing the road would greatly improve the use of this road in the event of a wildfire.

Thinning from below and thinning the number of large trees per acre would open up the stands and make it less likely that fire could go from tree to tree. "Crown separation is a more critical factor for fuelbreaks than a fixed tree density level. A minimum 10-foot spacing between the edges of tree crowns is recommended on level ground. As slope increases, crown spacing should also increase. However, small, isolated groups of trees may be retained for visual diversity. Increase crown spacing around any groups of trees left for aesthetic reasons and to reduce fire intensities and torching potential." (Dennis)

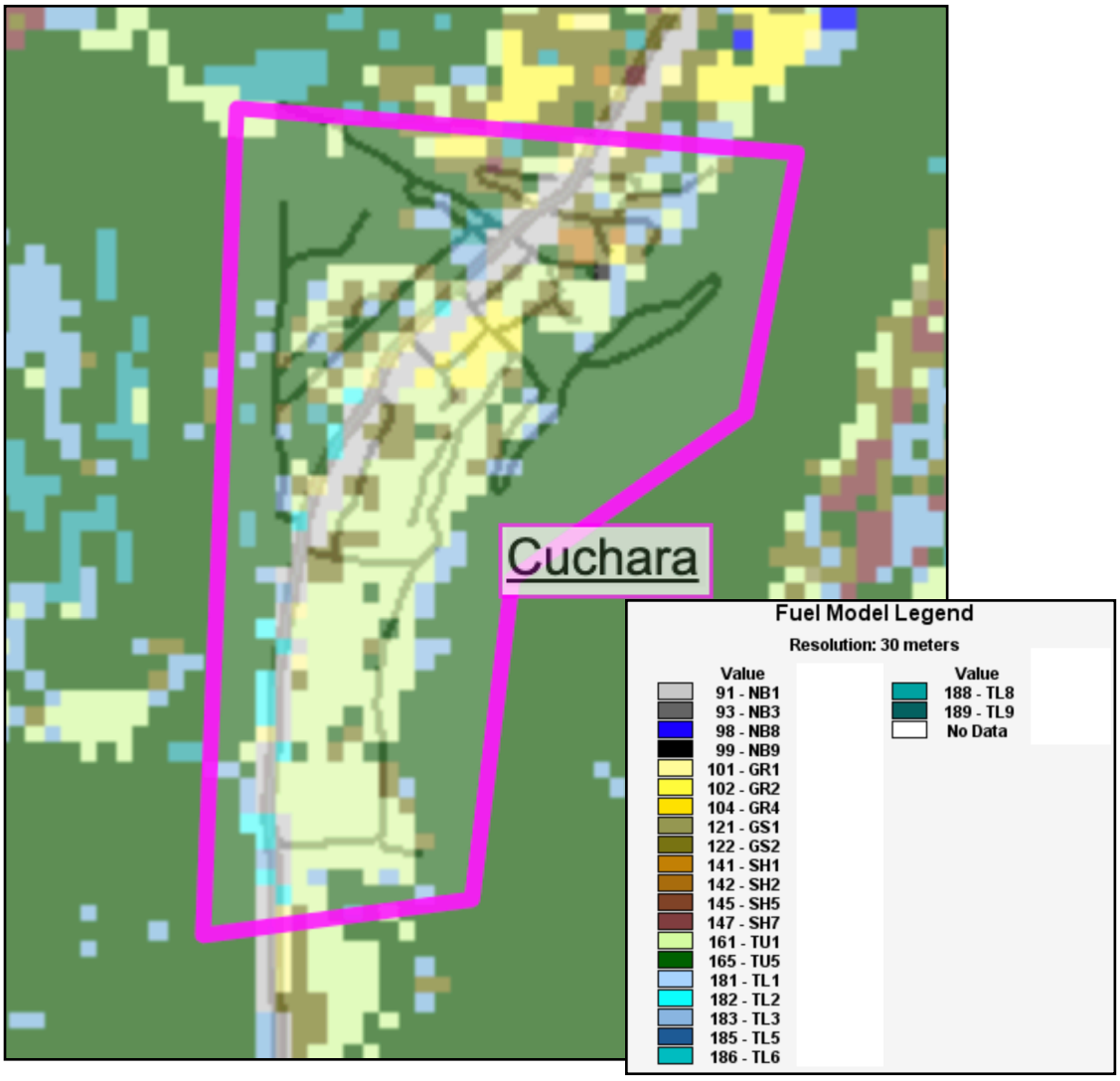
Since the roads within the subdivision are county roads, contacting the county about assisting with mitigation work along these roads might help with funding and labor issues. There are several spots where trees are thick and within the 30 foot from centerline right-of-way.

Each home needs to do as much as possible to mitigate their properties so that there are not wood piles next to structures, needles on roofs and gutters, etc. Flammable grasses and shrubs should be mowed and trimmed particularly when close to foundations, but even when out in the open to minimize flame lengths. Recommended guidelines that are laid out in the Home Ignitions Zone Checklists that the Colorado State Forest Service has prepared will help home owners answer many of their questions. These can be found at: https://csfs.colostate.edu/wildfire-mitigation/home-ignition-zone-checklists/

Appendix A is a plan for the this subdivision on how to get water delivered to roads and structures without having to put water tenders on the narrow roads within the subdivision.

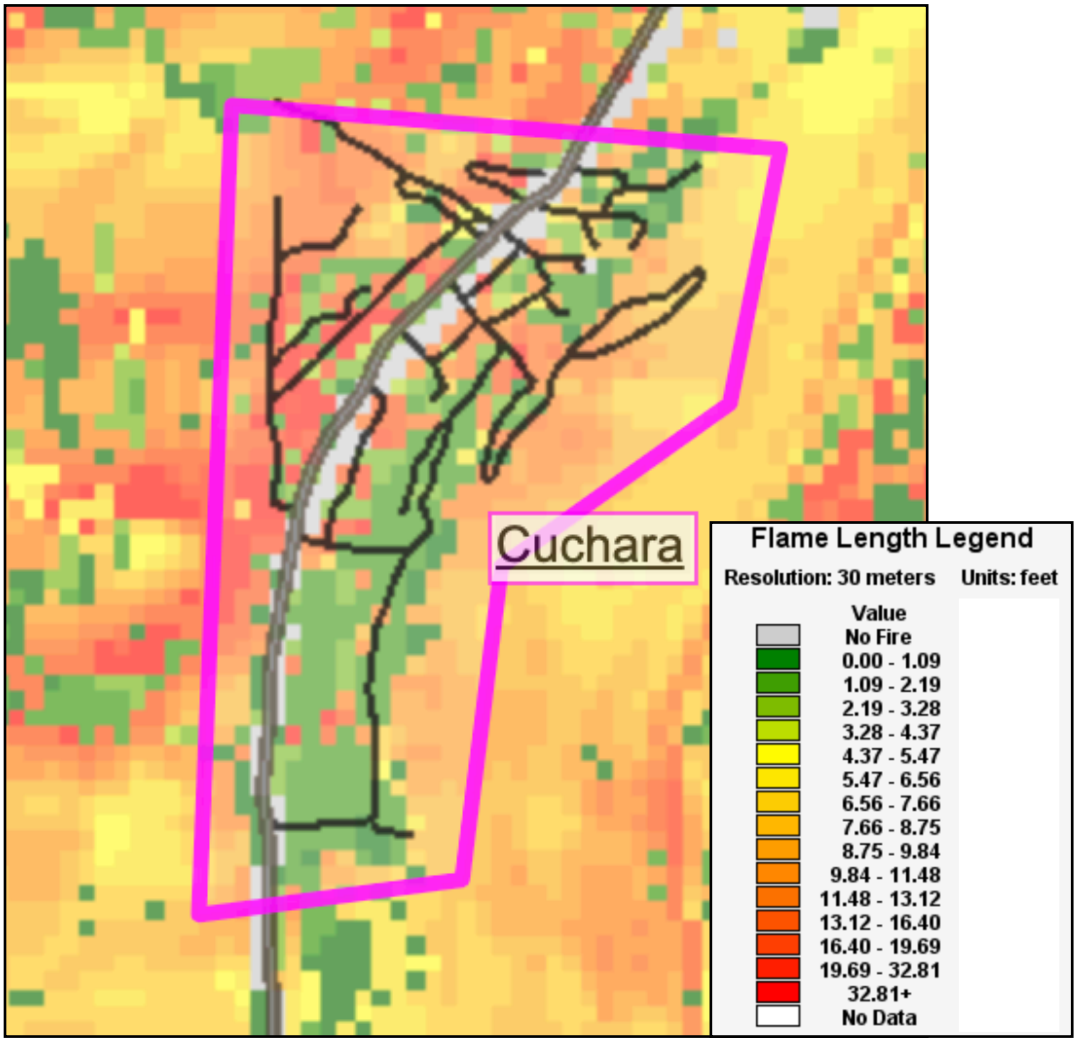
Cuchara area

The fuel models within the Cuchara town site and the adjoining Cuchara West subdivision has a very large portion of TU1 and TU5, timber understory that has low to moderate rates of spread (2-20 ch/hr) and about the same low to moderate flame lengths (1-8 foot). The landscape to the east of the town is a continuous, very mature stand of mixed conifer that is made up of mostly white fir with some very mature ponderosa pines. This is a very similar mixture of timber and surface fuels that contributed to the Spring Creek fire spread with little or no ability to stop its spread. In order to have a significant effect on the potential fire behavior that could be present in a similar situation, each land owner needs to mitigate their property as proposed in the recommendations section. Also, the adjoining lands owned by the USFS need to have shaded fuel breaks that are of a sufficient size that would give plenty of time for an approaching fire to change from a crown fire to a surface fire. This will take lots

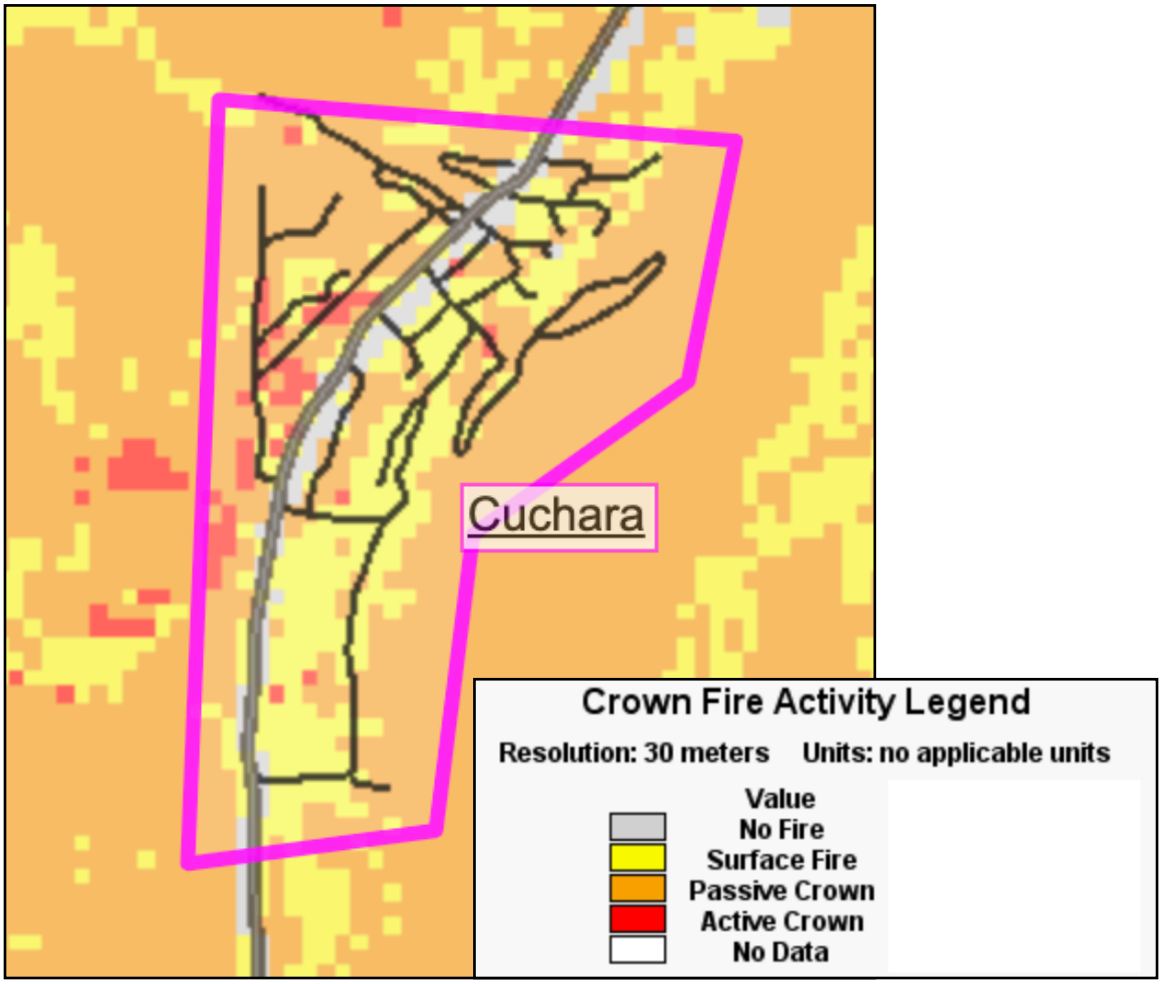


of monetary resources as well as mechanical resources. Some slopes and minor drainages will not lend itself to treatment due to the topography.

There are other fuel models on the valley floor that are mixtures of shrubs and grasses and are parts of lawns for homes. Most of the time these are not very problematic, unless they are not maintained and allowed to grow to a tall height. Flame lengths are mostly in the high range (above 4 ft.) for all of the areas that are off the valley floor.

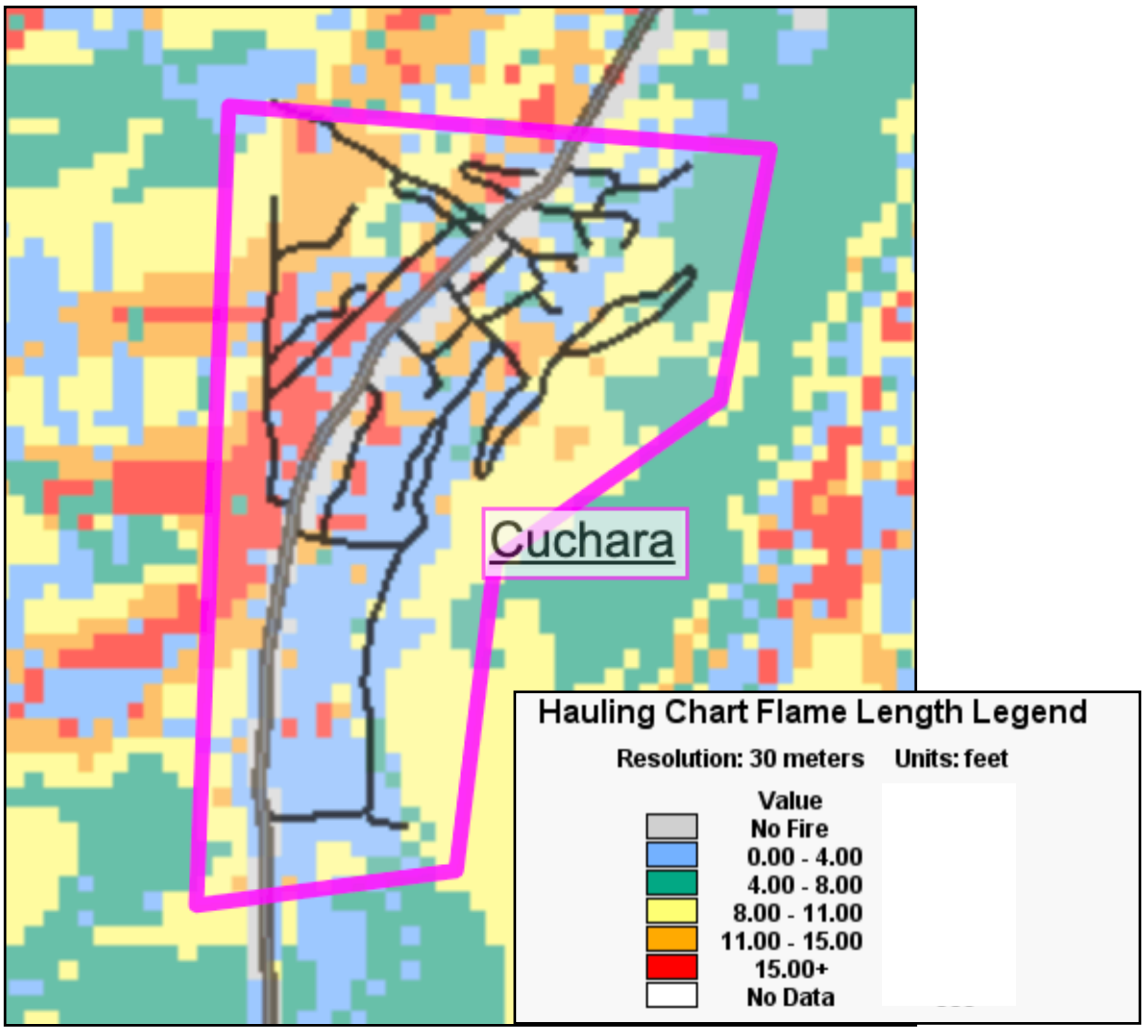


Flame Length output: The Cuchara West Subdivision has done some mitigation work that has changed some of the potential flame lengths, but that is not reflected in this output. What is important here is that anywhere there is dense timber there is the high probability of having flame lengths that are not easily dealt with by the simplest of fire suppression crews. Generally this means getting assistance from an incident management team or at a minimum using mutual aid from other neighboring fire protection districts.



Crown Fire Activity output: Most of the crown fire activity levels within the Cuchara area is passive and active crown fire, with the exception of only the very bottom of the valley and a few small meadows. These areas are predominately riparian areas along the creek and lawns around homes. Just outside of the pink line that delineates the town area is mostly passive crown fire. Passive crown fire on some of these slopes will make it difficult to control a wildfire.

Thinning stand density and raising the crown base heights of trees will help with reducing the overall amount of passive crown potential on the steeper slopes just outside the analysis area.



Hauling Chart output: The hauling chart output also shows a very similar story. The west facing slopes to the east of the town show flame lengths that are 4 to 11 feet in height with few areas that are in excess of 15 feet. The west side of highway 12 shows a real mixed bag of flame lengths, anywhere from the lowest to the highest. This is both a good thing and a bad thing, good in that it can make a fire burn in a pulsing fashion. Sometimes burning with low intensity and then pulsing to a higher intensity. Depending on the time of day when fire comes to these areas, that could help fire fighters with control methods. Bad in this case because not many of the areas are below the 4 foot flame length range; most areas are above that. Remembering that a hand crew on the ground can handle only 4 foot or less flame lengths without having further assistance for engines, heavy equipment, or even aircraft. It is not always possible to do mitigation work that can reduce the flame length to less than 4 feet, however doing some thinning, limbing and reducing surface litter can go a long way to altering the potential fire behavior of a timber stand.

Recommendations

Any work around homes that can make a property less likely to endure sustained torching of trees is work that helps not only a property owner but the subdivision as a whole. Thinning from below and thinning the number of large trees per acre would open up the stands and make it less likely that fire could go from tree to tree. Raising the crown base height to a minimum of 10 feet and/or 1/3 the height of the crown, whichever is less, would help with lessening the ability of a fire to transition from surface to passive and then in turn transition to active crown fire. Also reducing the overall density of the forested stands by thinning so that tree crowns are more than 10 feet apart.

The stands that have high percentages of white fir are particularly problematic since this is the climax species within the ecosystem and sometimes a single species stand, making it difficult to thin the stand by favoring one species over another. However, in some areas there is a component of ponderosa pines that are larger in size that can be used as reserve trees and remove the other species. White fir has a high pitch content in the bark and needles that makes for very volatile conditions. Being a climax species in an ecosystem lends itself to stand replacement fires since most are not fire adapted species and have thin bark and branches to the ground. Ponderosa pine is a fire adapted species with thick flaky bark that insulates the cambium and is self limbing, these properties make them more able to endure some level of fire.

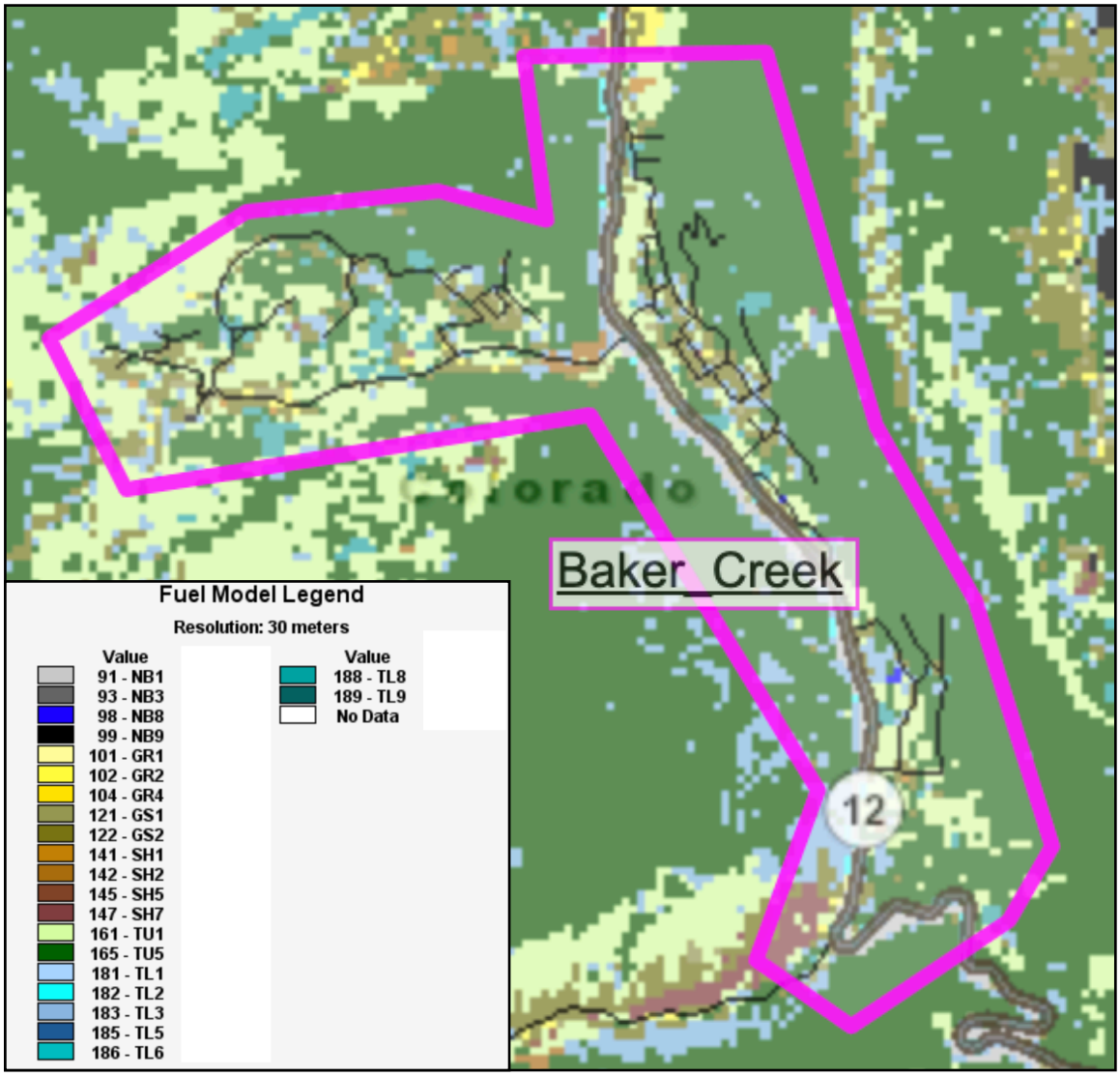
The slopes on both the east and the west sides of the canyon need attention. The slopes west of the analysis area is National Forest and will need to have coordination with the Fuels Specialist before any work can be accomplished on those lands.

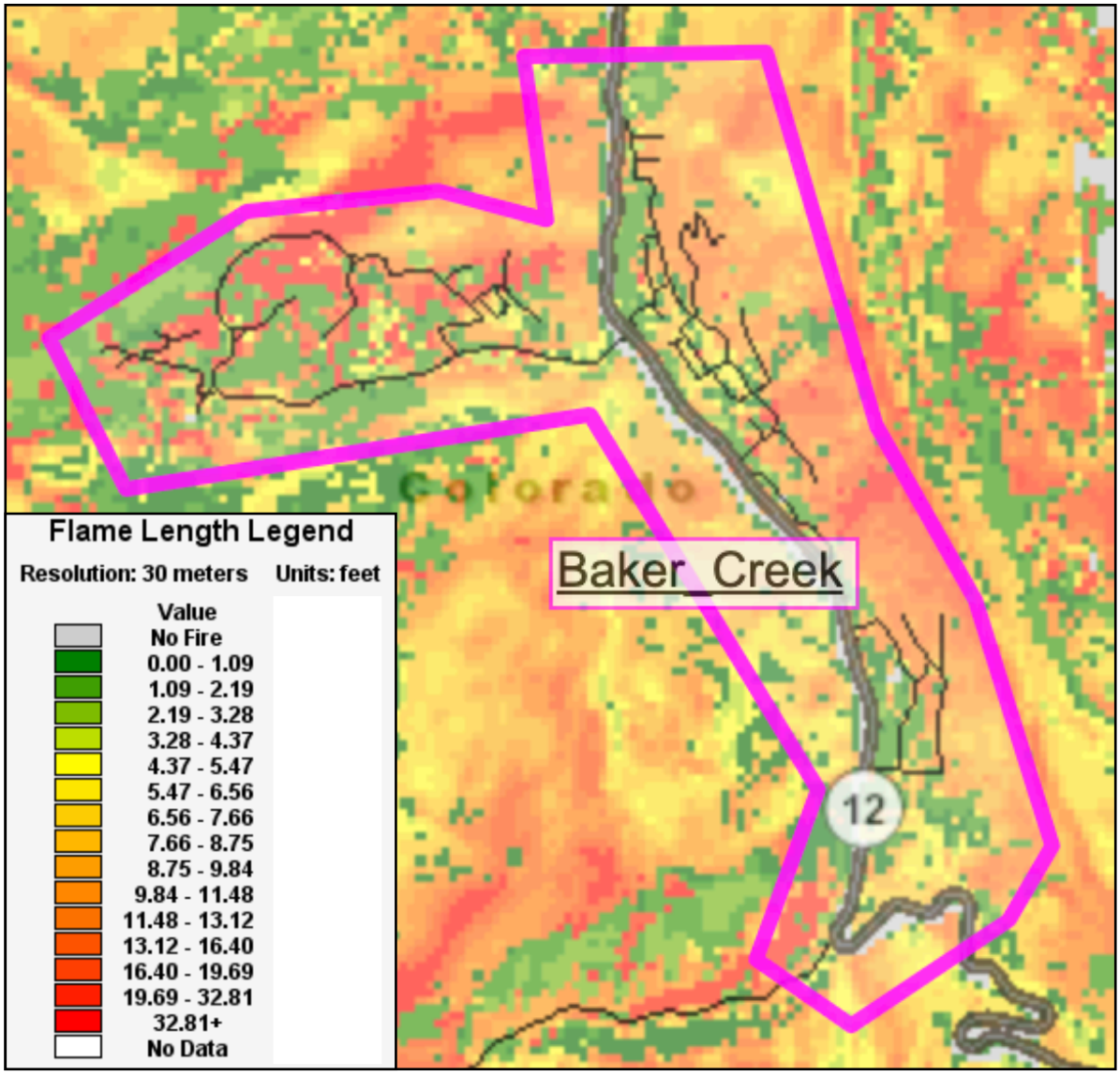
Each home needs to do as much as possible to mitigate their properties so that there are not wood piles next to structures, needles on roofs and gutters, and flammable grasses and shrubs are mowed and trimmed when close to foundations. Recommended guidelines that are laid out in the Home Ignitions Zone Checklists that the Colorado State Forest Service has prepared, will help home owners answer many of their questions. These can be found at: https://csfs.colostate.edu/wildfire-mitigation/home-ignition-zone-checklists/

Baker Creek/Spanish Peaks

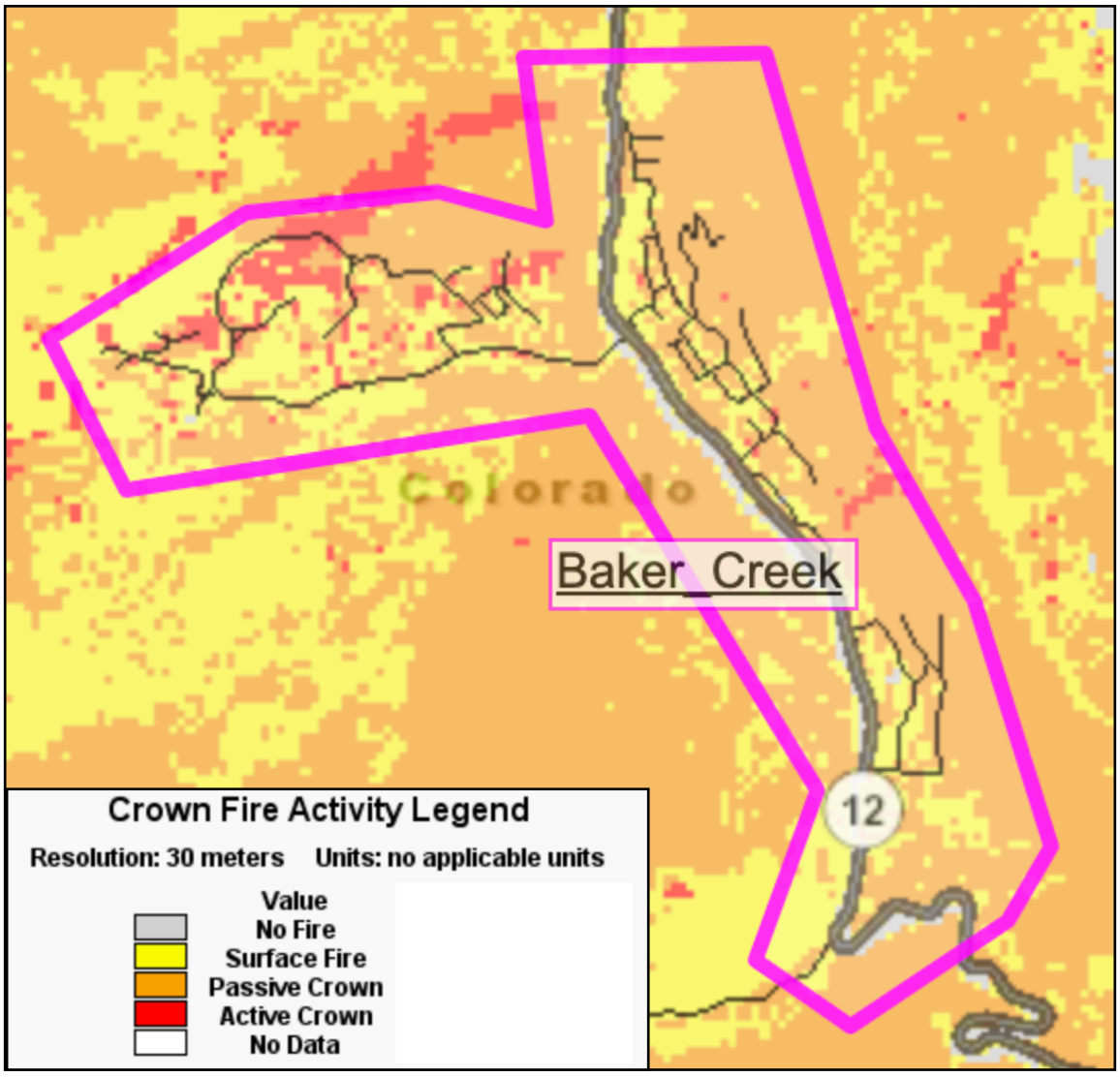
The fuel models represented within the Baker Creek/Spanish Peaks area are very similar to those in the Cuchara area, mostly timber understory and some timber litter. The primary carrier of fire in the timber understory fuel models is forest litter in combination with herbaceous or shrub fuels. The live herbaceous and shrub component affects the ability of fire to spread depending on the relative amount of dead fuels that may be present. Timber litter fuel models are primarily carried by the dead and down woody fuel such as logs and stumps in addition to the needle cast from the conifer trees. Live fuels, if present, has little effect on fire behavior (Scott and Burgan, 2005).

There are much smaller areas of the shrub fuel models and very little pure grass compared to other areas in the FPD. This is primarily due to the gain in elevation and or soil types present. One positive with this fuel model is that it can be altered fairly easily with thinning and doing some yearly maintenance to keep fire behavior to a lower degree, by trimming the shrub and small tree layers that continue to encroach.

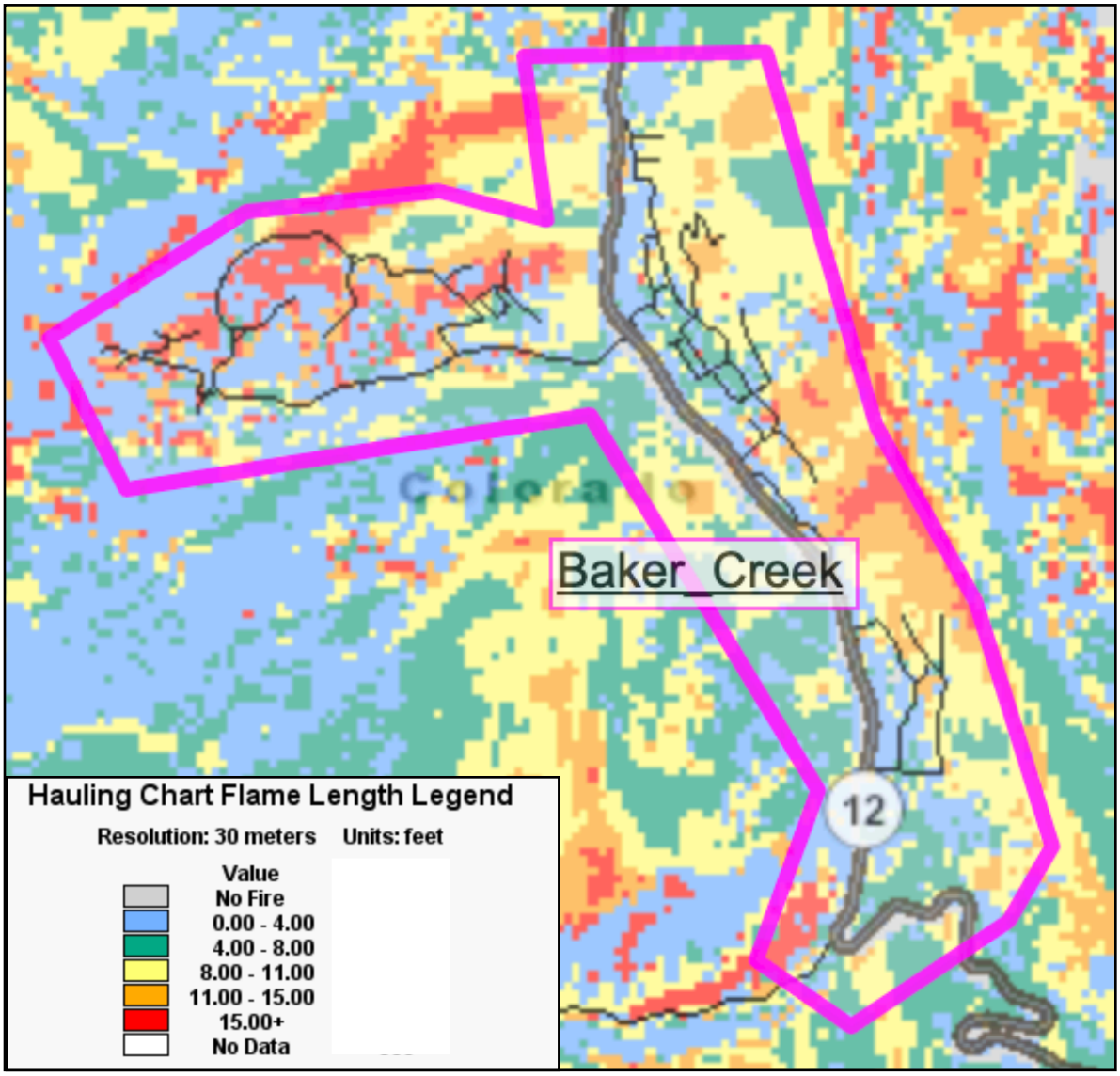




Flame Length output: Flame lengths within this analysis area are some of the most problematic in the Fire Protection District. As with most of the higher elevation subdivisions, Baker Creek/Spanish Peaks has a high percentage of passive crown fire as well as small areas close to homes that has some pockets of active crown fire. Working to decrease as much of the area as possible to a surface fire component would be very advantageous. This can be accomplished by raising the crown base height to 10 feet or 1/3 the height of the crown (whichever is less) and reducing the density of trees by thinning to a 10 foot spacing between crowns.



Crown Fire Activity output: The line of active crown fire and higher flame lengths in the northwest portion of the analysis area, within Panadero Loop road, seems to be attributed to a very high load of dead and down trees. The problematic part of this component of the fuel model is that it creates good receptors for spots, allows fire to remain on the landscape longer, and can do more damage to the soil creating erosion problems during monsoon events or snow melt. The eastern most portion of the analysis area, Spanish Peaks subdivision, where houses are tucked up in the trees are also very problematic due to the fact that there has been a high degree of mortality within this timber type over the past several years. The high percentage of white fir within this timber type has been hit very hard with Western Spruce budworm over the years. The combination of years of drought, and lack of a killing frost in the spring, has allowed budworm to stress trees to the point of killing the weaker trees. Once dead, white fir will only stand for a few years before they fall, thus increasing the surface fuel loads.



Hauling Chart output: This shows the areas that are the most problematic to fire fighters. The northwest and the eastern portions of the analysis area. The valley bottom and the area near the ski area has the lowest potential flame lengths.

Recommendations

The highest priority mitigation work within this subdivision would be to deal with the large amount of dead and down fuels down slope and along Panadero Avenue, from Highway 12 to the intersection with Panadero Loop road. Dead and down logs are very receptive to fire brands from an approaching fire and also burn for long periods of time, making the intensity of a fire much higher. Upslope from the road in this area some work has been done with a mechanical masticator, but on the steeper slopes work still needs to be accomplished

because the ground juniper and dead and down fuels could put the condominiums at the top of the ridge, at risk.

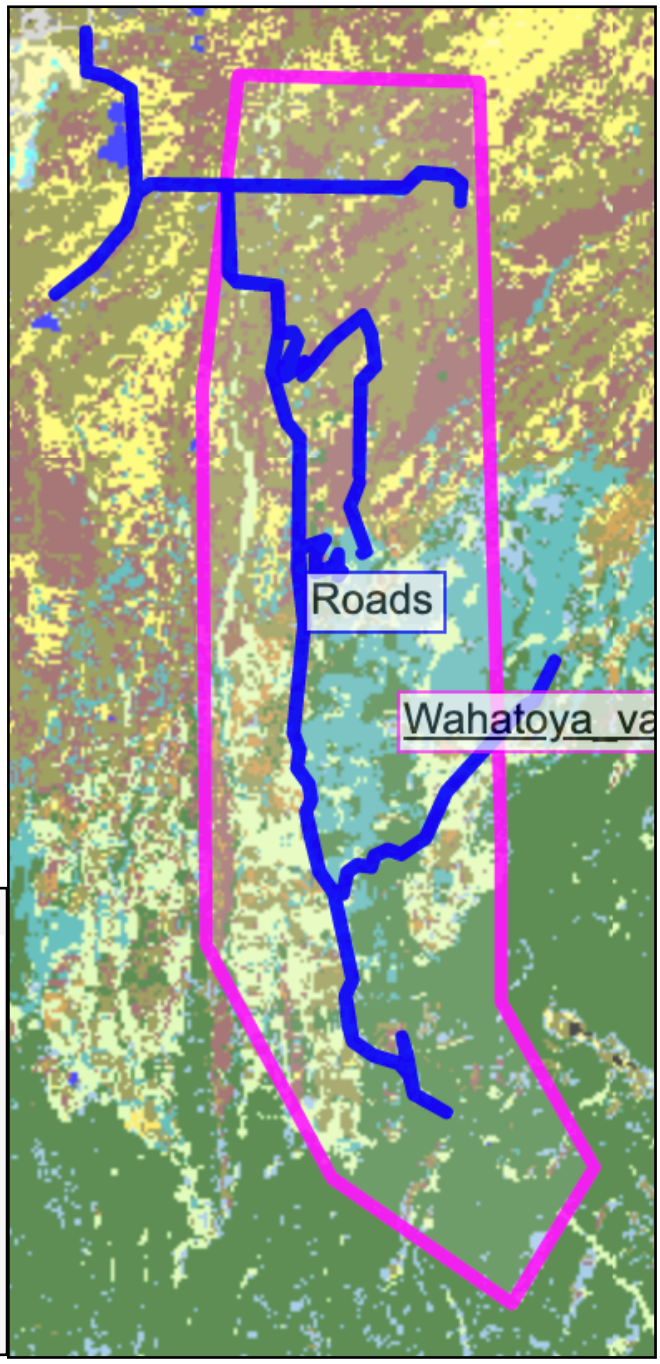
Within the Panadero Loop road there was significant amounts of dead and down aspen in past years, from some form of aspen mortality (tent caterpillar activity, blowdown, etc…), but it appears that the issue has been resolved by some rather extensive work. There are still a few piles of slash scattered around that should be removed or burned in the winter. A few homes still have some work to do on thinning the density of trees down to where there is sufficient crown spacing between the crowns. Most homes have done an adequate job of raising the crown base height to where trees should not be ladder fuel problems. The grass throughout most of the subdivision is very tall in wet years and when it cures and gets matted down by snow it will create a very receptive fuel bed for fire. Mowing around homes and down slopes leading up to homes is needed as part of general yearly maintenance.

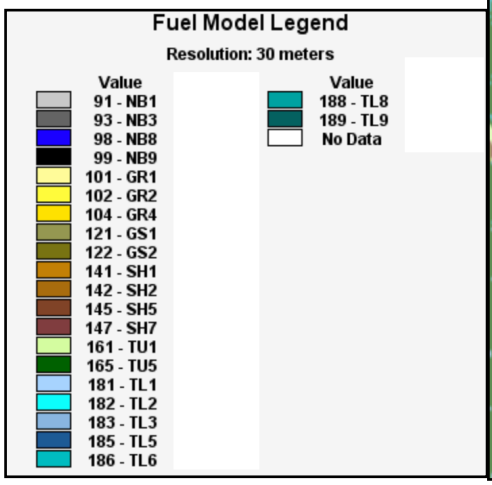
Each home needs to do as much as possible to mitigate their properties so that there are not wood piles next to structures, needles on roofs and gutters, flammable grasses and shrubs are mowed and trimmed when close to foundations. Recommended guidelines that are laid out in the Home Ignitions Zone Checklists that the Colorado State Forest Service has prepared, will help home owners answer many of their questions. These can be found at: https://csfs.colostate.edu/wildfire-mitigation/home-ignition-zone-checklists/ .

Wahatoya Valley

This area is a very long and narrow as well as very varied landscape. It is very much elevation and soil type driven by what fuel models are present and where. The northern portions are mostly shrub models with Gambel oak as the predominate species surrounded by lots of native grasses. The valley bottom is mostly hay fields that at times during the year are cut and baled so that would help to minimize some of the extreme fire behavior when grasses are cured. There is a middle portion that has more timber litter fuel models and those are piñon/juniper on west facing slopes and ponderosa pine up on the flats.

The southern portions get up into more of the timber understory fuel types, mixed conifer with a high component of white fir and Douglas fir.

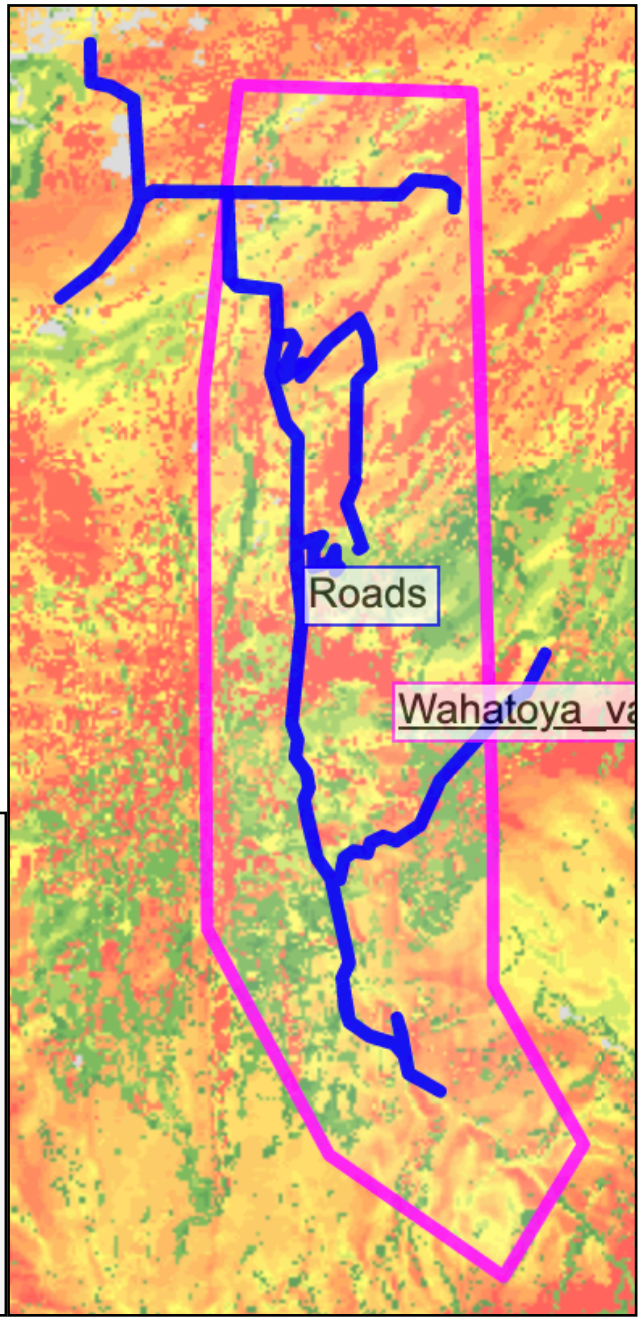


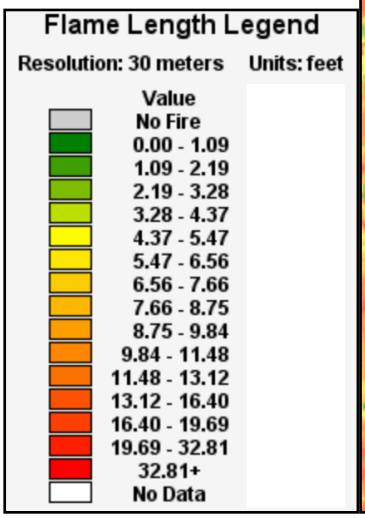


The highest concentrations of homes in this analysis area is at the end of the road in the green area at the toe of the polygon. The group of homes within the National Forest boundary has about 75+ homes in a stretch of the canyon that is less than 1 mile in length.

Flame Length output:

The brush and timber understory fuel types show the longest flame lengths on the north and south ends of the valley. The brush and grass components will have long flames due their light and flashy fuels. The central portion of the analysis area shows lots of green mixed with reds. The greens are shorter flame lengths within the ponderosa pine needle cast litter, with pockets of encroaching piñon and juniper and in places a well developed Gambel oak understory. This will create ladder fuels that can transition a surface fire with longer flames to more passive and active crown fire.

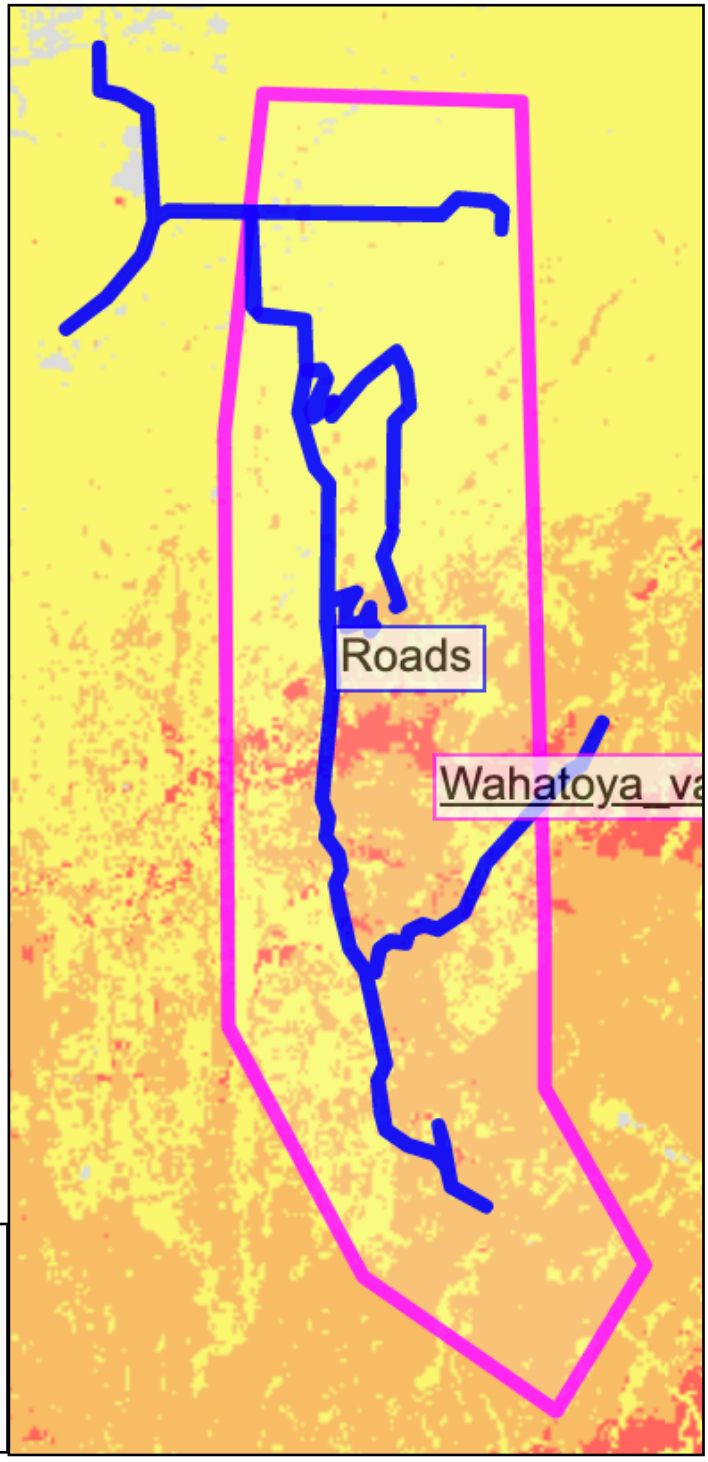


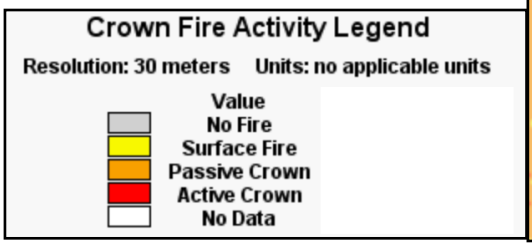


Crown Fire Activity output:

This portion of the FPD has less active and passive crown fire than other places in the district, however, knowing that the northern third of the area is predominantly oak brush, fires may stay more on the ground but can move with very rapid rates of spread. Property owners should be prepared that in high fire danger times of the year that fire can start and develop very rapidly, easily overtaking homes if not properly mitigated.

The southern portion shows a large expanse of passive crown fire and most of this area will behave much like the East Peak fire of 2013, burning with high intensities and spotting and torching being very common.

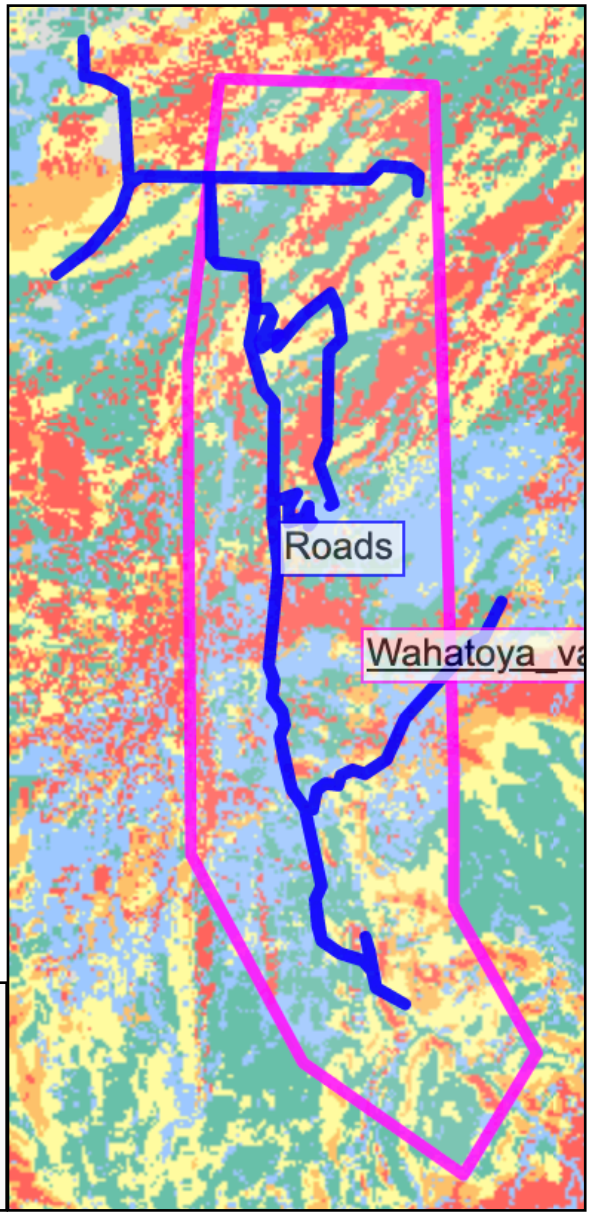


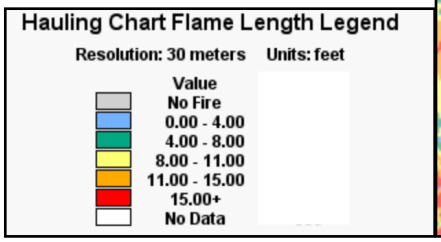


Hauling Chart output:

This output displays a real mixed bag of flame lengths mainly due to the mosaic of fuel models in the valley. The northern third that is predominantly grass and shrubs, produces flame lengths never less than 4 feet. This displays that the fuel models don't take into account that some of the meadows are cut and baled at times of the year. If the fields are not cut and allowed to cure, there could be times of the year when fire is a real problem. If each fall the hay is cut and left in a short grass state then flame lengths will be significantly less than what is shown here.

The middle third is a large section of less than 4 foot flames but also interspersed with 11 and 15+ foot flame lengths. The shows very well the ponderosa pine litter carrying most of the fire with large pockets where juniper has been allowed to encroach into the stands. Once the elevation goes up and the valley gets into mostly timber types in the south, the flames are pretty consistent in the 4 foot and above range. This will make most fires very difficult to control with small hand crews and/ or insufficient resources on hand.





Recommendations

Mitigation work in this area is imperative. The mosaic of fuel types in the Wahatoya valley makes it necessary to treat properties and their surrounding areas with individual attention.

Grass and Gambel oak fuel types can be mitigated but typically their treatments are not long lasting. Grass grows every year but can be mowed regularly or grazed, oak brush can be mowed once the larger stems have been mitigated but it too will grow back in a relatively short period (3 to 5 years). Timber understory and litter fuel types can have lasting effects when mitigated. Thinning trees from "below" meaning to cut the small diameter trees in the understory and remove ladder fuels is a very effective way to change a very active fuel model to a less active one, thereby helping to slow the spread of a wildfire.

The group of homes at the very southern end of the 360 road is a very problematic place within this analysis area. The roads are very narrow and steep and don't have room for fire resources and evacuating property owners to pass very easily. The canyon is very deep and narrow with homes very close together, in some cases only 30+ feet apart. Even with minimal fire behavior in and around this canyon, there would be potential for much increased fire activity due to the chimney effect of this steep, narrow canyon. Should one home catch fire, there is a very high possibility that structure fires will pass from structure to structure from the radiant heat, not withstanding the dense tree canopy. Most if not all incident management teams would not place fire crews in this area to actively protect structures, given the inaccessibility and number of structures and the close proximity to each other. It is possible that if there was time to do some prep work around homes, by setting pumps and sprinkler systems up, so that they could be left running. This could allow the fire to pass over the canyon with no fire resources standing by. It is not the best scenario but most likely the most realistic.

There is a good creek that seems to run most of the time. This could be a good source for pumps and water delivery to structures if needed. Damming the creek with logs, rocks and some plastic would allow for getting water for either sprinkler systems or refilling engines and portable water tanks.

Since the homes in this area are on very small tracts of land there is not much room for each home owner to do a thorough job of mitigating their land without working with their neighbors too. With this is mind, there have been many trees marked with blue paint around homes that appear to be hazard trees to the structures. This would be a good first step in mitigation work, if those were removed, then the remaining trees could be looked at and additional trees removed for improving the potential survivability of the structures.

Many of the homes in this area do not have metal roofs and most are sided with wood siding that has bark still attached. This was popular for summer cabins in the early 20th century but as we know now it makes a structure almost in-defensible in a wildfire. This style of building is very receptive to fire brands even if the fire is not in the canyon and up on the neighboring slopes. Due to the shear number of structures in this canyon, if a fire was approaching and an incident management team was assigned to the fire, it would still be very nearly impossible for a team to prep structures and get them to a point where they could survive fire in the canyon bottom. Wrapping the structures with fire shelter material would be out of the

question due to the time it would take and the number of resources it would require to accomplish the task. Unfortunately this area would have to be written off as a total loss if fire was able to get in the canyon bottom.

Each home needs to do as much as possible to mitigate their properties so that there are not wood piles next to structures, needles on roofs and gutters, flammable grasses and shrubs are mowed and trimmed when close to foundations. Recommended guidelines that are laid out in the Home Ignitions Zone Checklists that the Colorado State Forest Service has prepared, will help home owners answer many of their questions. These can be found at: https://csfs.colostate.edu/wildfire-mitigation/home-ignition-zone-checklists/

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Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model, Scott & Bergen, 2005, published by the USDA Forest Service, General Technical Report RMRS-GTR-153

Fuelbreak Guidelines for Forested Subdivisions & Communities, Frank C. Dennis, Colorado State Forest Service, https://static.colostate.edu/client-files/csfs/pdfs/fuelbreak_guidellines.pdf

Definitions

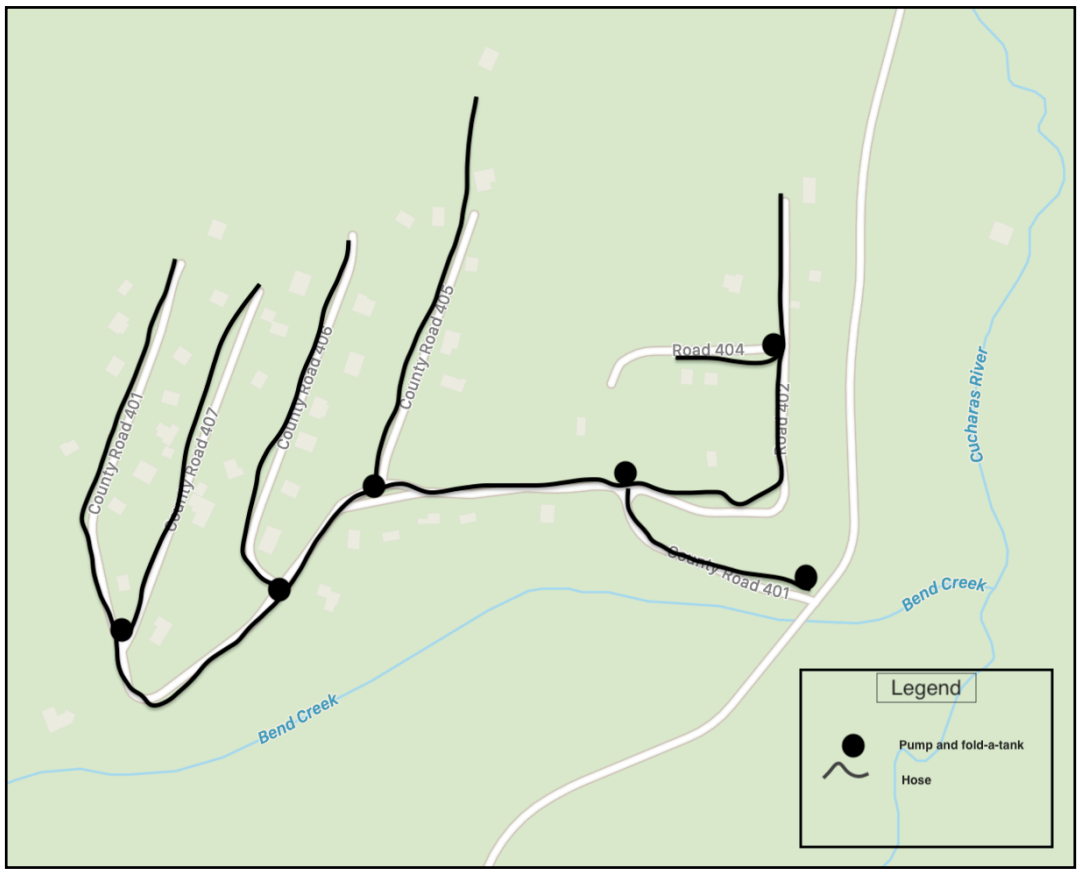
Chain(ch) is a standard unit of measure used by many different specialties including forestry and fire and is 66 feet in length. There are 80 chains in a mile.

Moisture of Extinction is also known as extinction moisture content. The fuel moisture content at which a fire will not spread, or spreads only sporadically and in a non-predictable manner.

Appendix A - Pinehaven water delivery system.

Example plan for water delivery:

When a large multi-day incident occurs in the vicinity of the subdivision, it may be necessary to devise a plan to deliver water within the subdivision without using the fire hydrants. This can be for several reasons. The water supply for the hydrants might not be working properly and can't deliver water, the water system is not capable of delivering the quantity of water needed for suppression of a wildland fire or water available from hydrants is needed for structure fires. Therefore, an independent delivery system would be needed. Most Type 1 and 2 incident management teams (IMT) come with a structure protection specialist as part of their operations section. The structure protection specialist would normally be tasked with creating a detailed plan of how their group or division would go



about protecting houses within a subdivision. This can be time consuming depending on the current stage of the fire and when an incident management team assumes control of the fire. Time may be of the essence to get the plan created and in place. Having a pre-developed plan that can be handed over to the IMT for quicker implementation or setting up a local fire

department for success by having many of the items already done when an IMT arrives, can make the difference between homes being saved or lost.

The following is a simple plan to pump water from one central location along Highway 12 in the area where the trash dumpsters are. This will supply water up into the subdivision to support fire personnel with structure protection. This plan is devised to minimize traffic on the roads within the subdivision by large water tenders and structure engines on narrow roads. Structure protection plans are as simple or as complicated as fire personnel wish them to be; there is no one right way to devise them. They need to support the fire fighters on the ground and get the water to where it is needed, when it is needed. With that being said, the following plan does not go into details about where lateral hoses may be installed or if sprinkler systems are deployed around structures or not. This is just a way to get water into the subdivision from the paved road. Also this plan will not specify where water tenders will get water, as that will have to be determined by local fire department or IMT personnel via land use agreements or similar.

The hose lay from Highway 12 to the flagpole intersection is 600 feet and about 50 feet in elevation. County road 402 from the flagpole to the right and down the hill to the end is 1300 feet and the small spur road to the left is 300 feet. County road 401 left from the flagpole to the split in the road is 700 feet where another pump and tank would be placed. Then county road 405 is approximately 1000 feet to the end. County road 406 from the intersection where a pump and tank is placed to the end is 1100 feet. County roads 407 and 401 are 1000 feet and 3600 feet, respectively. The sum is 10,200 feet by adding 20 percent to the order (to compensate for possible breakage during operations) would make about 12,300 feet total of 1 1/2" trunk line. Divide this total by 2 to come up with the total feet needed of 1" laterals, if you only put them every 200 feet, or 6,200 total linear feet of 1" hose would be needed. A minimum of 65 gated wyes for the laterals should be ordered, but add extra just in case, for a total of 70 1 1/2" gated wyes. To complete the hose lay one must order pumps, portable water tanks, 1 1/2" to 1" reducers and 1" nozzles. To ensure there is ample storage for water along Highway 12 there should be two tanks at each location. Mark 3 pumps are standard pumps ordered from a regional or national fire cache. This model of pump is more than adequate to pump water up hill the 200 to 300 foot elevation gain over the 5-7% slope of the roads.

Here is a list that could be used to order from the Region 2 fire cache via Pueblo Dispatch if the local fire department is incident commander and managing the fire. If an IMT is ordered, they will either place orders from the cache or they typically come with a supply unit that has most of these items in a cache van, however in the early stages of their first couple of shifts, this order might far exceed the cache vans capabilities to supply the order.

6 - Mark 3 pumps with accessory kit
10 - 1500 gallon folding water tanks
12,300 feet of 1 1/2" hose
6,200 feet of 1" hose
70 - 1 1/2" gated wyes
70 - 1 1/2" to 1" reducers
70 - 1" nozzles