

Wildfire Hazard Fuels Assessment

Ken-Caryl Ranch Open Space



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Wildfire Hazard Fuels Assessment Acceptance Statement

As the representative of Ken-Caryl Ranch Master Association, I have reviewed this assessment, which has been prepared at my request to guide Ken-Caryl Ranch’s wildfire mitigation activities, and Ken-Caryl Ranch will voluntarily apply the assessment recommendations on its property for the health, vigor and beauty of the landscape. I believe the management recommendations in this assessment are appropriate to meet Ken-Caryl Ranch’s goals and objectives, and will benefit the natural resources in Ken-Caryl Ranch, in addition to protecting surrounding property from wildfire.

_____	_____
Ken-Caryl Ranch Master Association Representative	Date
_____	_____
CSFS Forester	Date
_____	_____
CSFS Supervisory Forester	Date

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1 INTRODUCTION

This Wildfire Hazard Fuels Assessment has been prepared by professional foresters with the Colorado State Forest Service (CSFS), in cooperation with Ken-Caryl Ranch Master Association (KCR), in order to assess hazardous fuels in the Open Space areas. It includes assessments of the current fuels and expected fire behavior and recommended mitigation actions for fuels treatments, defensible space, and home hardening. This information was collected through field visits, aerial imagery mapping and analysis, fuels modeling, and fire behavior modeling. The resulting data were then compiled into a usable format for the community. The primary goals for this assessment include: guide wildfire hazard mitigation efforts in the Open Space areas and educate homeowners of their current wildfire hazard risks and the ways they can reduce these risks.

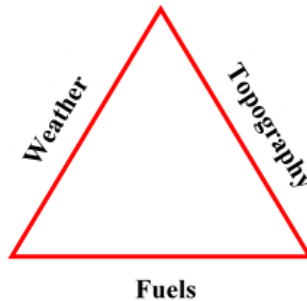
This fuels assessment will address the four priority areas in the Open Space areas previously identified by KCR; NMD1, NMD2, MDGB1, and MDGB2. This assessment is intended to be a working document that can and should be modified to accommodate unforeseen events that may alter the mitigation recommendations. Wildfires, wind-events, insect epidemics, disease outbreaks and other abiotic/biotic events will affect the management of this community and subsequently change the scope of this assessment. It is recommended that this Wildfire Hazard Fuels Assessment as well as any future assessments be reviewed and updated regularly by KCR, to determine progress on addressing wildfire hazards and new issues or opportunities that have become known since the last assessment update. Fuels reduction activities and other wildfire mitigation assessments in other planning documents should be considered when updating assessments. It should be noted that this is not a Forest Management Plan and does not include a forest inventory analysis, which is used to guide management prescriptions for current forest conditions.

Map 1: Priority Areas



2 FUELS

The property characteristics necessary to determine fire behavior and wildfire hazard risks are: fuels, weather, and topography. Together these three factors make up the “fire behavior triangle.”



Fuel type and composition determine how quickly a fire can spread and how intense or hot a fire may become. Moisture level, chemical makeup, and density are all contributing factors in determining fuel flammability.

Weather conditions such as wind, temperature, and humidity also contribute to fire behavior. Wind determines the supply of oxygen to a fire. It can change the direction of a fire and also push fire toward a new fuel source. The temperature of a fuel influences its susceptibility to ignition. Humidity affects the moisture level of a fuel, creating wet or dry fuels.

Topography features can help or hinder the spread of fire. Certain topographic formations can act as natural fire breaks or increase the rate of spread. Elevation and aspect (the compass direction that a slope faces) can determine how hot and dry a given area will be. Slope can determine how quickly a fire will move up or down hills.

Although all of these factors can be analyzed to predict fire behavior, weather and topography cannot be controlled. Fuels are the only factor that we can directly influence and will be the main focus of this assessment.

2.1 SURFACE FUELS

Surface fuels account only for surface fire potential; trees are not included. Fuel load, bulk density, fuel particle size, heat content, and moisture of extinction all factor into fire behavior and fuel models. The fuel bed is the primary carrier of wildland fire over an area, and each fuel model provides insight to the rate of spread over the landscape. Surface fuels typically are categorized into one of four primary fuel types based on the primary carrier of the surface fire: 1) grass, 2) shrub/brush, 3) timber litter, and 4) slash.



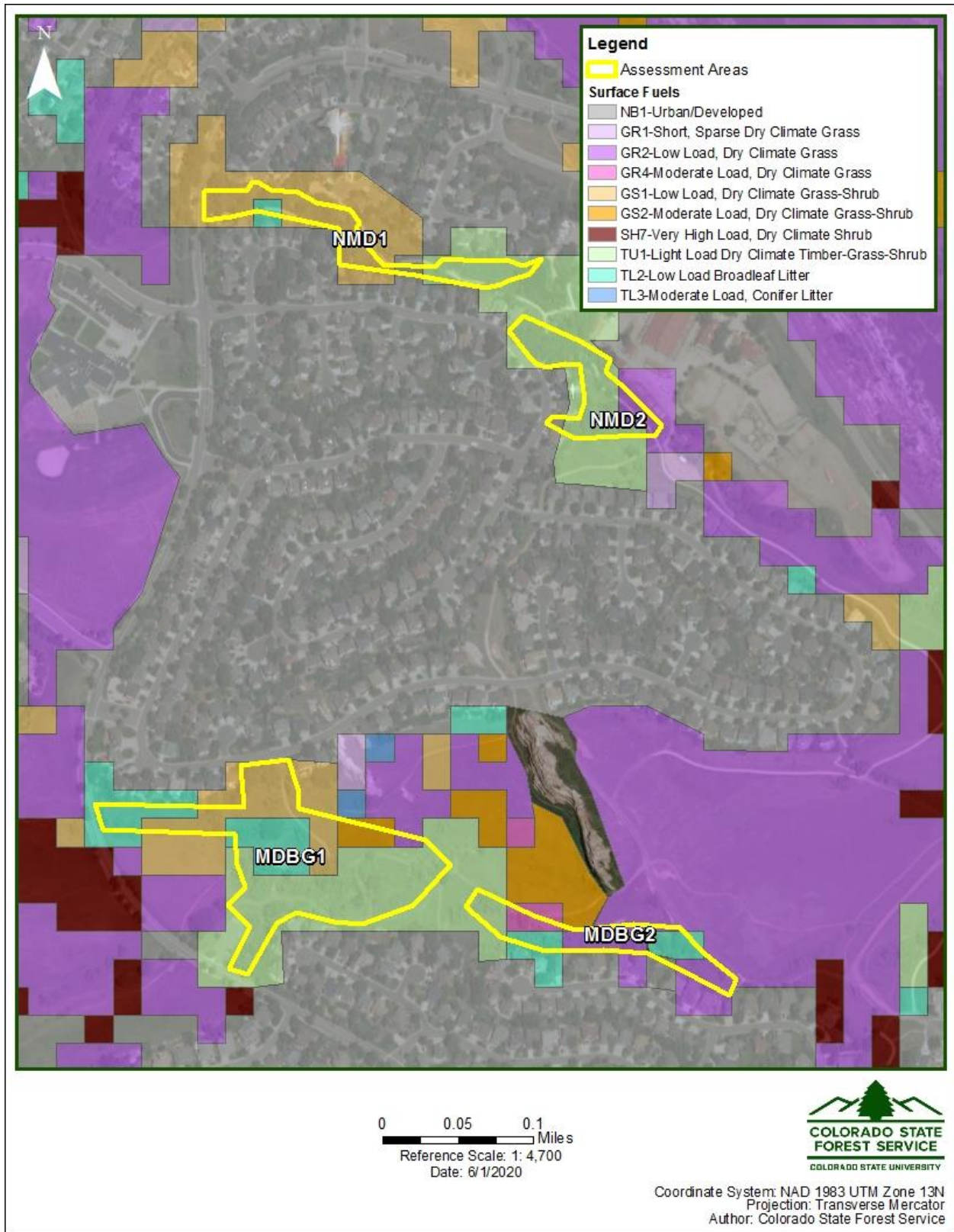
Photo 1: Grasses and shrubs make up a large portion of the fuels (CSFS, 2020)

The CO-WRAP generated fuel models for the four priority areas include models: GR1, GR2, GR4, GS1, GS2, TU1, TL2, TL3, and NB1. The fuel models as well as the stands in which they can be found are discussed below. Fuel models were ground-truthed for accuracy, where access allowed. See Section 3 for a more detailed explanation of flame length and rate of spread.

Table 1: Fuel models generated by CO-WRAP

Fuel Model	Spread Rate	Flame Length
GR1: Short, Sparse Dry Climate Grass	Moderate	Low (1-4 ft)
GR2: Low Load, Dry Climate Grass	High	Moderate (4-8 ft)
GR4: Moderate Load, Dry Climate Grass	Very High	High (8-12 ft)
GS1: Low Load, Dry Climate Grass-Shrub	Moderate	Low (1-4 ft)
GS2: Moderate Load, Dry Climate Grass-Shrub	High	Moderate (4-8 ft)
TU1: Light Load, Dry Climate Timber-Grass-Shrub	Low	Low (1-4 ft)
TL2: Low Load Broadleaf Litter	Very Low	Low (1-4 ft)
TL3: Moderate Load, Conifer Litter	Low	Low (1-4 ft)
NB1: Urban/Developed	N/A	N/A

Map 2: Surface fuels



2.2 VEGETATION

The four priority areas consist of riparian grassland/shrubland vegetation types. Riparian vegetation differs from the adjacent uplands in overstory species composition, greater dominance of shrubs and deciduous hardwoods, and higher stem densities, basal area, and herbaceous cover (Dwire, Meyer, Riegel, & Burton, 2016). These areas typically have very diverse characteristics and provide critical



Photo 2: Cottonwoods and aspen (CSFS, 2020)

habitat for numerous plant and wildlife species. Riparian vegetation also provides stream shading, sediment retention, stream bank maintenance and stability, and inputs of organic matter to streams (Dwire, Meyer, Riegel, & Burton, 2016). Riparian areas also tend to be very sensitive to disturbance, therefore any wildfire hazard mitigation activities around them should be mindful of this.

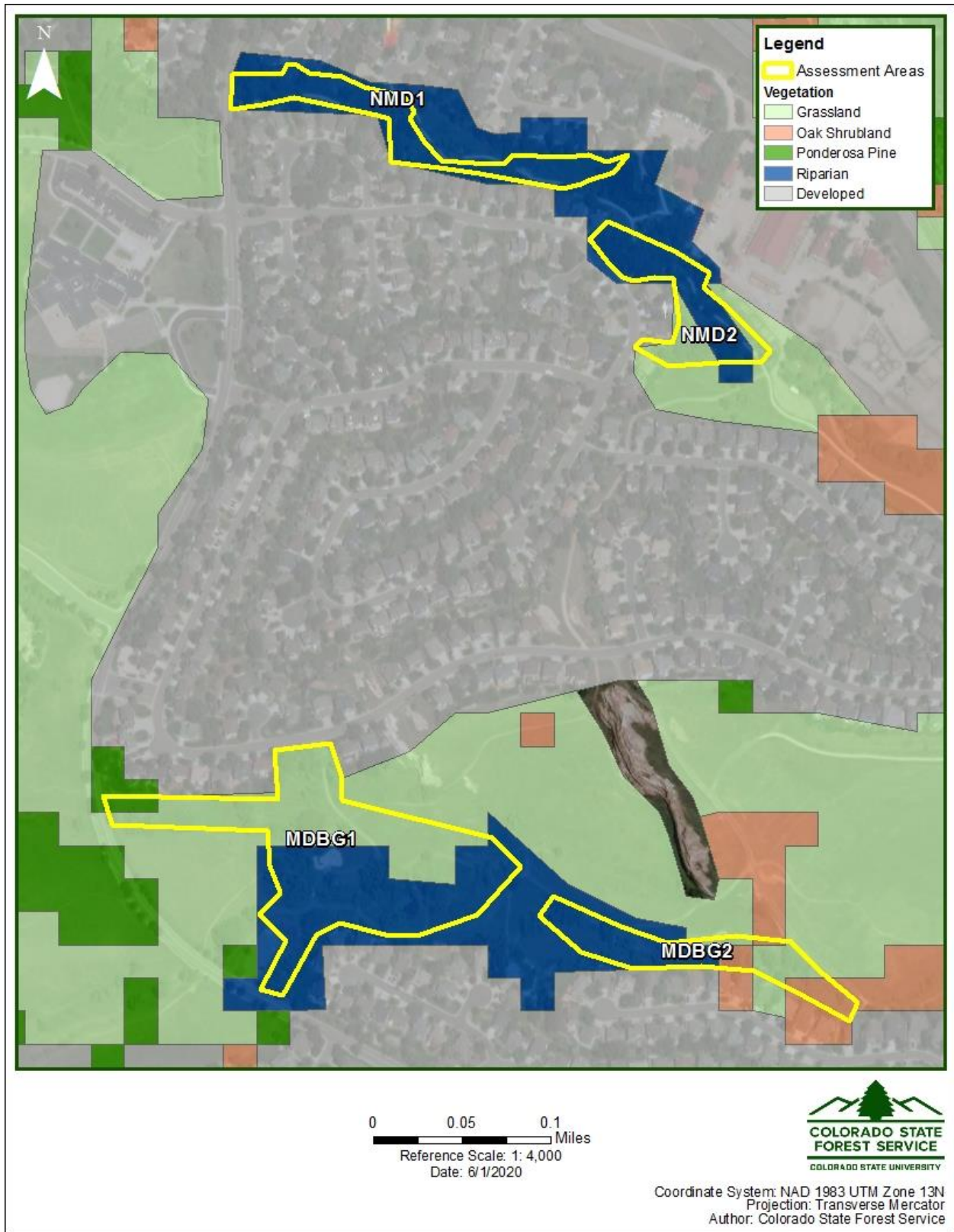
Vegetation noted during field visits of these areas includes: smooth brome (a non-native), crested wheatgrass, orchard grass, wild rye, Timothy grass, Kentucky bluegrass, Gambel oak, skunkbush, mountain mahogany, rabbitbrush, Cottonwood (plains and some narrowleaf) and willow (peach leaf, sandbar coyote, crack), and Western plum, Douglas-fir, blue spruce, and ponderosa pine. Most conifers in the area were on private property.

Cheatgrass, a Colorado List C noxious weed, was also noted during field visits. See sections Expected Fire Behavior 3.3 and 4.4 for more information regarding cheatgrass.



Photo 3: Riparian vegetation surrounding stream (CSFS, 2020)

Map 3: Vegetation



2.3 SURROUNDING FUELS

Home and defensible space assessments were not conducted for this document. These assessments are crucial in determining safety ratings and guiding future mitigation efforts on the private property. However, without conducting home and defensible space assessments, it was still evident during the data collection for this assessment that the community has overall poor defensible space and home hardening. The most common fire risks for the majority of the community are the large amount of fuels too close to structures as well as numerous properties with flammable building and landscaping materials. The amount of trees as well as their proximity to the home is incredibly important to a home's chances of ignitability and survivability if it were exposed to a fire.

Other fire risks noted in the community:

- Firewood stored within 30 feet of home
- Tall and un-mowed grass
- Trees growing over homes and touching homes/roofs
- Flammable fences and landscaping
- Fuels touching flammable fences and landscaping
- Pine needles on roof, gutters, decks, and vents
- Vents without proper screening
- Pine needles and duff under trees
- Ladder fuels
- Un-pruned and un-limbed trees
- Flammable bushes/shrubs close to homes and decks

See Section 4 for defensible space and home hardening recommendations.



Photo 4: Firewood stored against flammable fence (CSFS, 2020)



Photo 5: Dry fuels growing into flammable fence (CSFS, 2020)



Photo 6: Flammable fencing (CSFS, 2020)



Photo 7: Un-pruned conifer tree touching flammable fence (CSFS, 2020)

2.4 WATER SUPPLY

Although water is not a fuel source, it is still an important part of the landscape and in determining wildfire risk as well as suppression. The pond in MDBG1 and the pond between NMD1 and NMD2 are potential sources to draw water from in the event of a wildfire. The streams running within all four priority areas can act as natural fuelbreaks and can also serve as favorable areas for firefighters to lay hoses. No other current or proposed water sources are known at this time.



Photo 8: Pond in MDBG1 (CSFS, 2020)

3 WILDFIRE RISK

Wildfire risk is determined through analyzing fire behavior. Fire behavior characteristics are attributes of wildland fire that pertain to its spread, intensity, and growth. These characteristics are calculated through modeling interactions of fire with the following environmental influences:

- **Fuels:** composition and characteristics for both surface fuels and canopy fuels. Assessing canopy fire potential and surface fire potential allows identification of areas where significant increases in fire behavior affects the potential of a fire to transition from a surface fire to a canopy fire.
- **Weather:** Environmental weather parameters needed to compute fire behavior characteristics include 1-hour, 10-hour and 100-hour time-lag fuel moistures, herbaceous fuel moisture, woody fuel moisture, wind speed, and wind direction.
- **Topography:** Topography datasets required to compute fire behavior characteristics are elevation, slope and aspect.

Fire behavior models used in this plan:

Rate of Spread is the “relative activity of a fire in extending its horizontal dimensions. It is expressed as rate of forward spread of the fire front.” Typically it is expressed in chains per hour (ch/hr) or feet per minute (ft/min).

Flame Length is defined as the “flame length of a spreading surface fire within the flaming front. It is measured from midway in the active flaming combustion zone to the average tip of the flames.” It is an indicator of fire intensity and is often used to estimate how much heat the fire is generating. Flame length is typically measured in feet (ft).





Fireline Intensity or Fire Intensity Scale specifically identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist. It is measured by the heat energy released per unit time from a one-foot-wide (or one-meter-wide) section of the fuel bed extending from the front to the rear of the flaming zone

Crown Fire Activity or Fire Type represents fire activity in the forest or shrub canopy. Characterized as surface fire, passive crown fire (torching), or active crown fire.

There are two primary fire activities – surface fire and canopy fire. Canopy fire can be further subdivided into passive canopy fire and active canopy fire.

- **Surface Fire:** A fire that spreads through surface fuel without consuming any overlying canopy fuel. Surface fuels include grass, timber litter, shrub/brush, slash and other dead or live vegetation within about 6 feet of the ground.
- **Passive Canopy Fire:** A type of crown fire in which the crowns of individual trees or small groups of trees burn, but solid flaming in the canopy cannot be maintained except for short periods (Scott H., 2005).
- **Active Canopy Fire:** A crown fire in which the entire fuel complex (canopy) is involved in flame, but the crowning phase remains dependent on heat released from surface fuel for continued spread (Scott H., 2005).

Figure 1: Relationship of fire models and fire suppression (Andrews, Heinsch, & Schelvan, 2011)

Flame length		Fireline intensity		Interpretation
ft	m	Btu/ft/s	kJ/m/s	
< 4	< 1.2	< 100	<350	 <ul style="list-style-type: none"> • Fires can generally be attacked at the head or flanks by persons using hand tools. • Hand line should hold the fire.
4 – 8	1.2 – 2.4	100 – 500	350 – 1700	 <ul style="list-style-type: none"> • Fires are too intense for direct attack on the head by persons using hand tools. • Hand line cannot be relied on to hold the fire. • Equipment such as dozers, pumpers, and retardant aircraft can be effective.
8 – 11	2.4 – 3.4	500 – 1000	1700 – 3500	 <ul style="list-style-type: none"> • Fires may present serious control problems—torching out, crowning, and spotting. • Control efforts at the fire head will probably be ineffective
> 11	> 3.4	> 1000	> 3500	 <ul style="list-style-type: none"> • Crowning, spotting, and major fire runs are probable. • Control efforts at head of fire are ineffective.

3.1 IGNITION POTENTIAL

Sources of potential ignition within and surrounding KCR include: house fires, power lines, lightning strikes, cigarettes, sparks from vehicles/trailers along Ken Caryl Road, campfires, barbeques, and fireworks. Although Jefferson County Open Space does not allow open flames in their parks, the adjacent parks should not be ruled out as a potential source of ignition.

Man-made sources of ignition are a major concern in this area. Most homes in the community are close enough together to allow for home-to-home ignition.

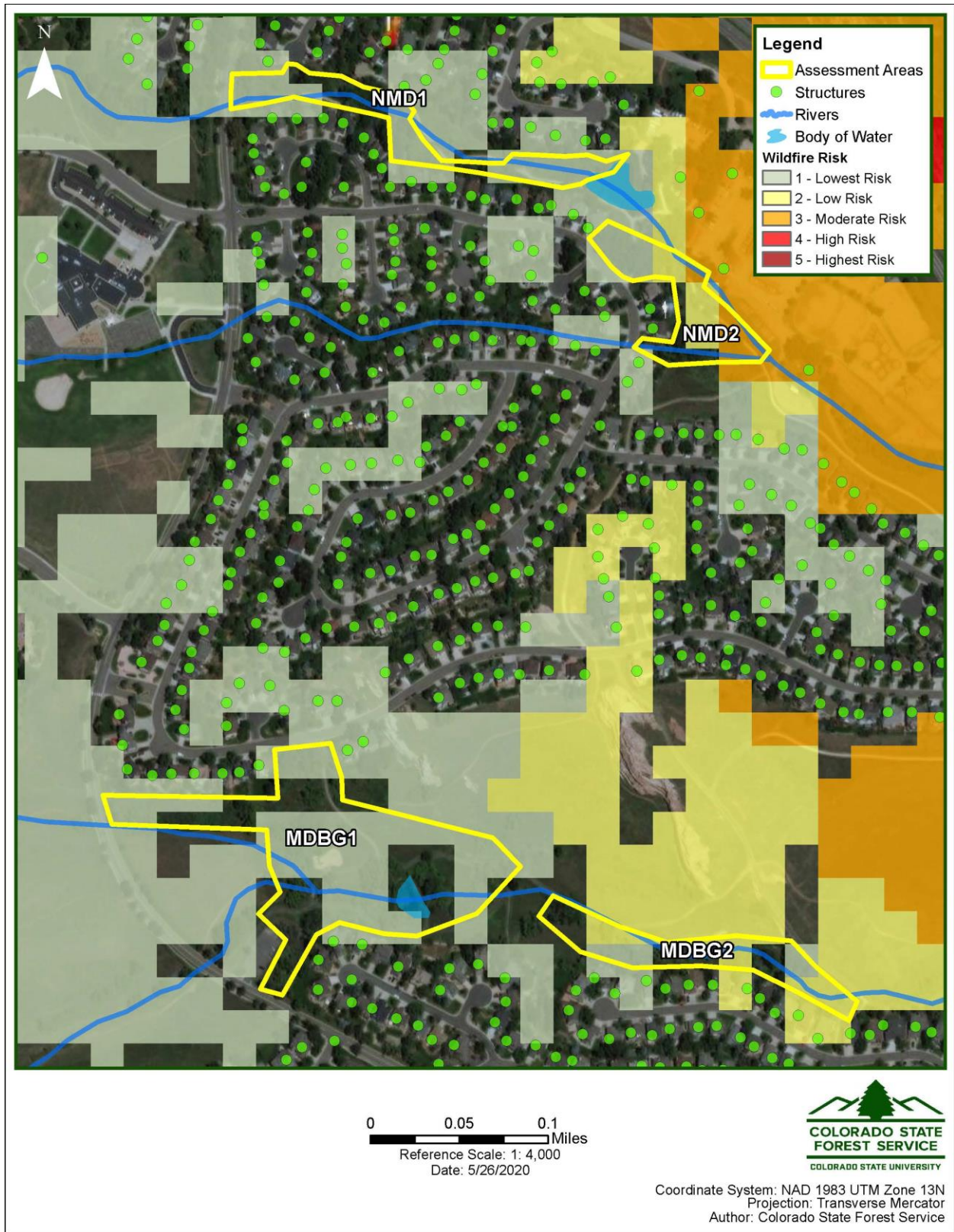
3.2 WILDFIRE RISK RATING

Wildfire Risk represents the possibility of loss or harm occurring from a wildfire. Wildfire Risk for the priority areas were modeled with the Colorado Wildfire Risk Assessment Portal (CO-WRAP). Risk is derived by combining the Wildfire Threat and the Fire Effects assessment outputs. It identifies areas with the greatest potential impacts from a wildfire – i.e. those areas most at risk - considering all values and assets combined together.

Wildfire Risk combines the likelihood of a fire occurring (threat), with those areas of most concern that are adversely impacted by fire (fire effects), to derive a single overall measure of wildfire risk. To aid in the use of Wildfire Risk for planning activities, the output values are categorized into five (5) classes. These are given general descriptions from Lowest to Highest Risk.

In the priority areas, the CO-WRAP identified a large majority of the land as lowest risk, while a small portion is moderate to low risk. This is due to the low tree density in the Open Space and the surrounding area. It is important to note that a low wildfire risk rating does not mean that these areas are not susceptible to wildfire. Defensible space and home hardening are still as necessary in areas of lowest risk as in areas of highest risk.

Map 4: Wildfire risk (CSFS, Colorado Wildfire Risk Assessment Portal, 2020)



3.3 EXPECTED FIRE BEHAVIOR

The four priority areas are primarily low hazard fuels such as hardwood trees and shrubs, or down and dead wood in light grass fuels. In riparian zones such as these, vegetation tends to burn less frequently and/or less severely than the adjacent uplands. This is due to the high fuel moisture content and greater dominance of moisture-dependent shrubs and deciduous trees.



Photo 9: Surface fire fuels (CSFS, 2020)

Given the vegetation type (riparian vegetation and a lack of conifer trees) and relatively level topography in the priority areas, the expected fire behavior is a surface grass fire with short flame lengths and a potentially rapid rate of spread. These areas have “very low” suppression difficulty ratings, which means suppressing a fire in them may be quicker and/or less costly given the terrain and vegetation conditions.

Figure 2: Riparian characteristics and fire behavior (Dwire, Meyer, Riegel, & Burton, 2016)

Fire behavior factor	Riparian characteristic	Potential influence on fire behavior	Citation
Fuel loads	High fuel loads due to high net primary productivity. Accumulation of fuels due to low fire return intervals.	High fuel loads can increase vulnerability to a fire in drought conditions, and influence fire severity, intensity and return intervals.	Agee 1993; Williamson 1999; Van de Water and North 2011
Fuel moisture content	High fuel moisture content due to proximity to water, shallow water tables, and dense shade.	Fuel loads may remain too moist for sustained fire spread late into the fire season.	Agee et al. 2002; Williamson 1999
Fuel continuity	Active channels, gravel bars, and wet meadows may function as natural fuel breaks.	Breaks in fuel continuity can prevent or slow the spread of fire.	Agee 1993; Everett et al. 2003
Vegetation composition	Greater dominance of moisture-dependent shrubs and deciduous trees.	Tree and shrub species adapted to light-moderate fire; lower resistance to severe wildfire.	Halofsky and Hibbs 2008; Williamson 1999
Low topographic position	Canyon/drainage bottoms; lowest points on the landscape.	High fuel moisture, high relative humidity, and few lightning strikes may decrease fire frequency and severity; more human-caused ignitions may increase fire frequency.	Olson and Agee 2005
Steep topographic position	Narrow, steep stream channels that may serve as “chutes” or “chimneys.”	If high fuel loads are present, could result in “wicking”—the rapid up-canyon spread of fire.	Agee 1998
Microclimate	Topography, presence of water, and dense shade can create cooler, moister conditions.	High relative humidity and cool temperatures may lessen fire intensity and rate of spread.	Williamson 1999; Brosofske et al. 1997

Fire behavior is dependent on location, wind, temperature, and fuel conditions at the time of ignition. Dried grasses can produce a flashy fire that burns quickly, but without generating much heat. Under favorable conditions, a grass fire with no winds can spread relatively slowly. However, a tall-grass fire with strong winds can spread very rapidly and grow beyond suppression efforts. Mowing these grasses may slow the expected rate of spread as well as decrease the flame length in the event of a fire in the Open Space, even in high winds.

As mentioned in the Section 2.2, cheatgrass was observed during field visits. Cheatgrass is incredibly invasive, but also very flammable. The early-season growth habits of cheatgrass provide a competitive advantage by allowing it to grow tall and abundant before native species emerge (CSU Extension, n.d.). During years of high precipitation, this grass can produce more than 10,000 plants per square yard (CSU Extension, n.d.). Cheatgrass dies by early

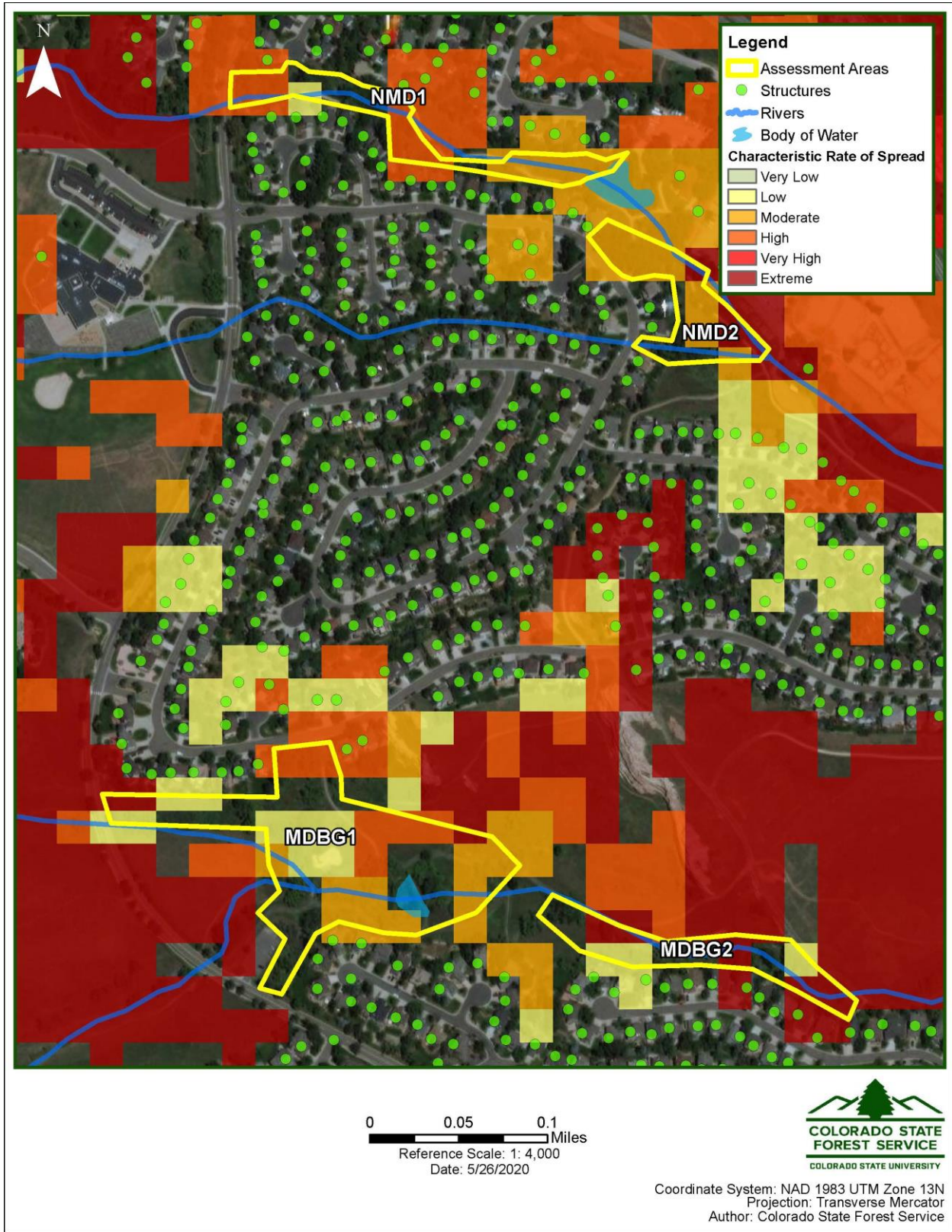


Photo 10: Cheatgrass (CSFS, 2020)

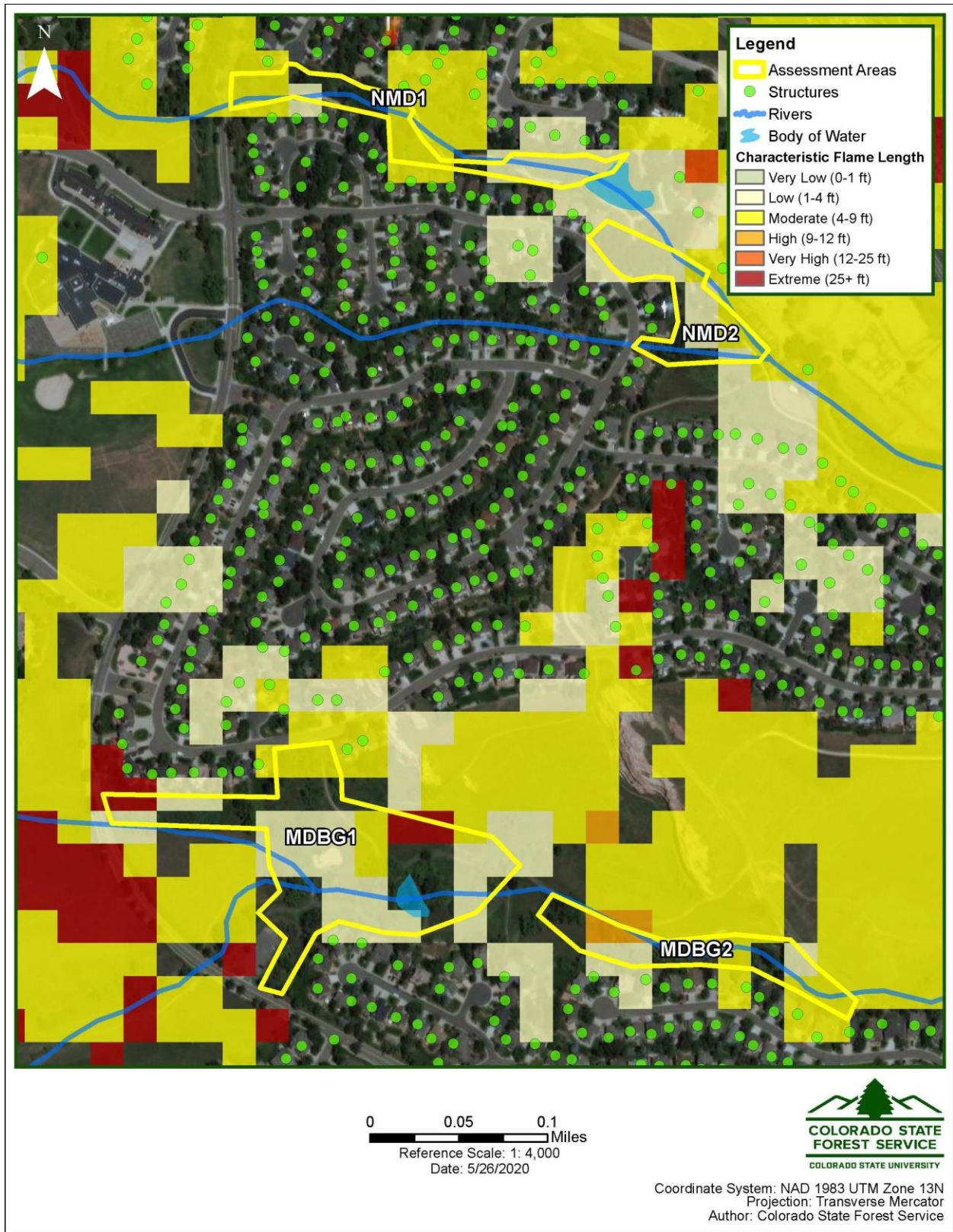
summer leaving behind thick, continuous dry fuels and creating extreme wildfire hazards across a landscape. Properly treating cheatgrass can reduce the fire hazard within the Open Space and the community. See Section 4.4 for cheatgrass treatment options.

Although the expected fire behavior for the Open Space is surface fires, that does not guarantee fire embers will not get into the crowns of conifer trees near the surrounding homes or ignite a home. Both of these situations may lead to home-to-home ignition in the community. Ember showers from a fire burning in the conifer forests to the west of KCR can also potentially travel for miles and land on a home. With proper defensible space, home hardening, and mowing grasses, the expected fire behavior and wildfire risks can be positively altered.

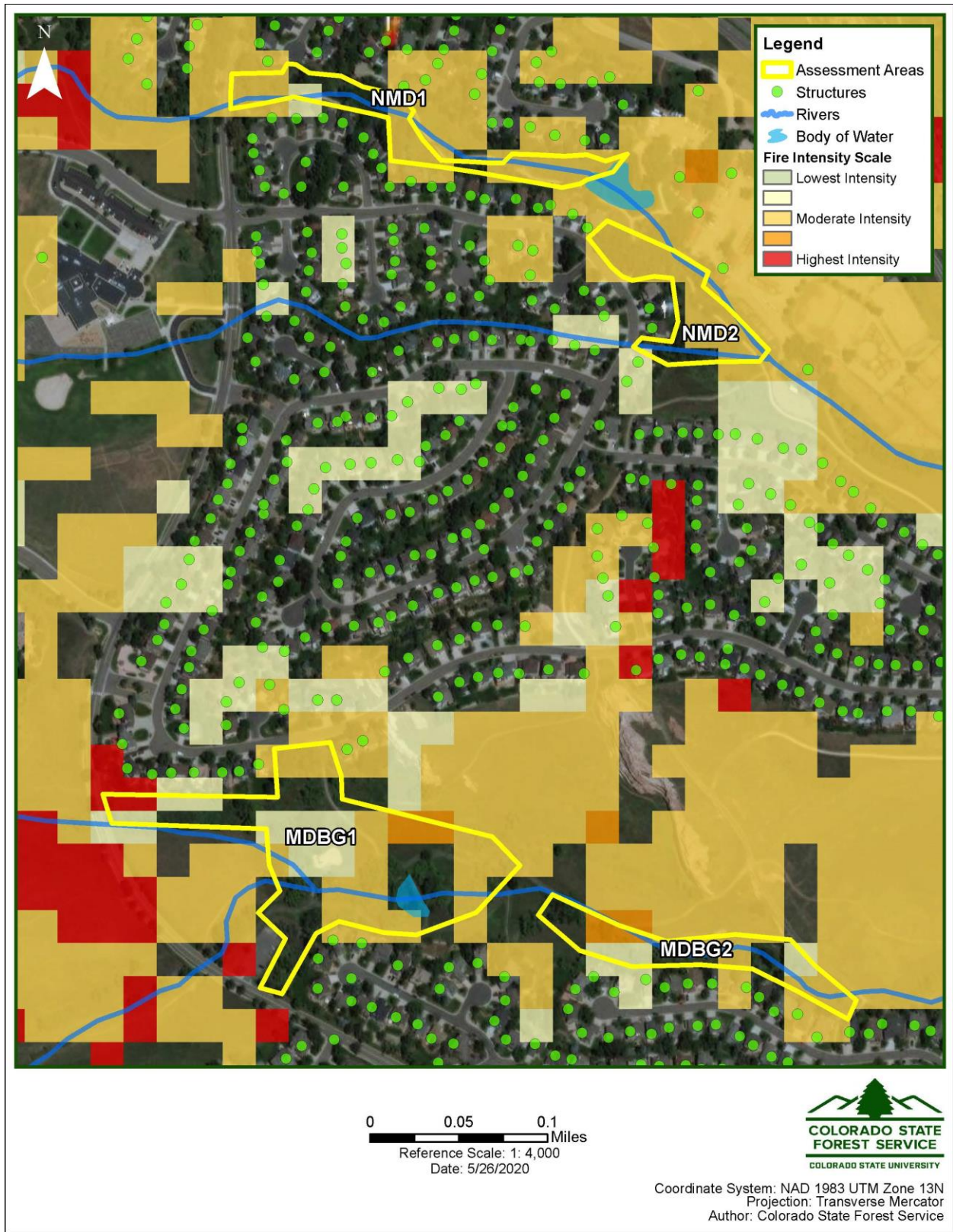
Map 5: Rate of spread (CSFS, Colorado Wildfire Risk Assessment Portal, 2020)



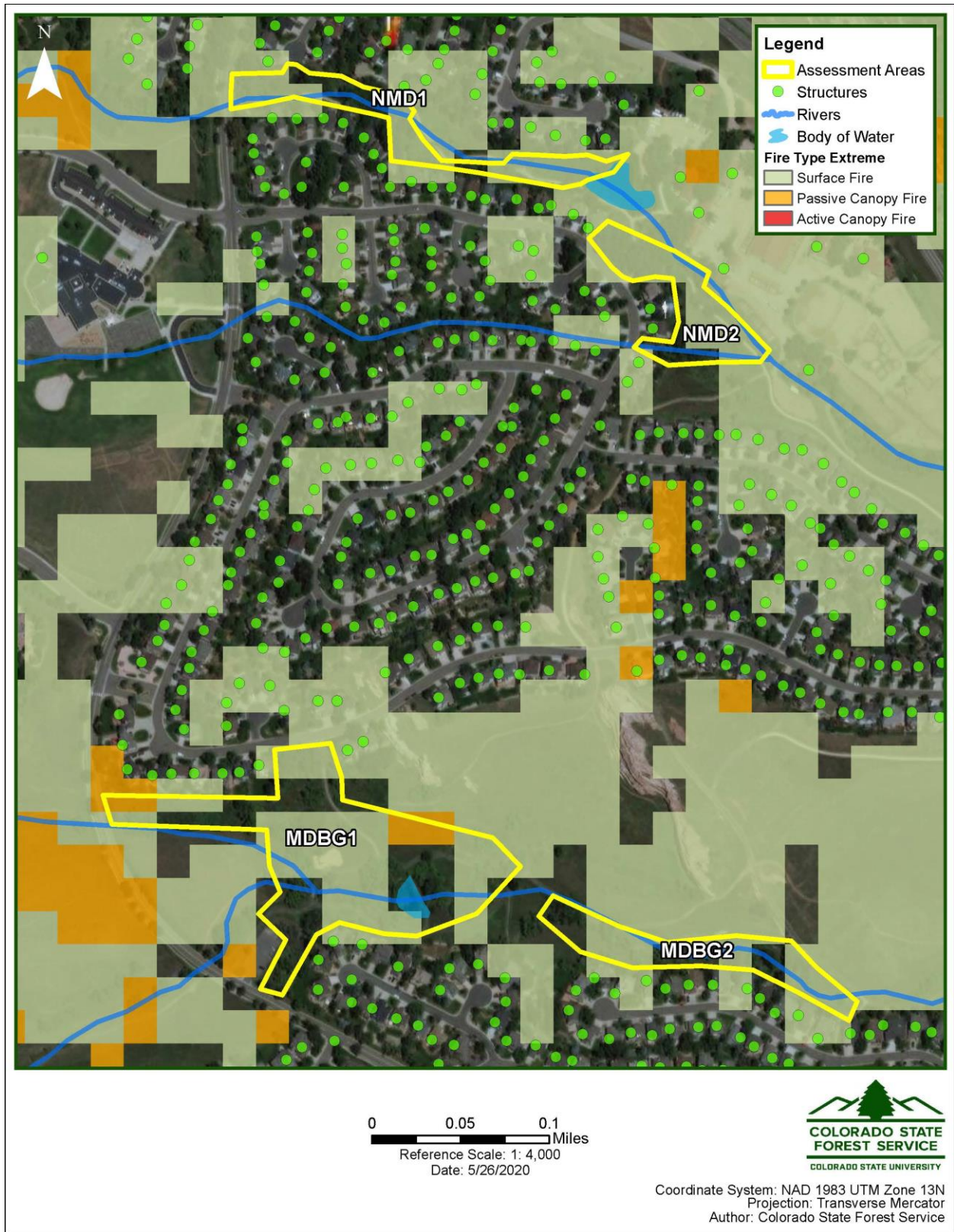
Map 6: Flame length (CSFS, Colorado Wildfire Risk Assessment Portal, 2020)



Map 7: Fire intensity scale (CSFS, Colorado Wildfire Risk Assessment Portal, 2020)



Map 8: Fire type (CSFS, Colorado Wildfire Risk Assessment Portal, 2020)



4 RECOMMENDED MITIGATION ACTIVITIES

The following recommended mitigation activities were derived through field visits, aerial imagery mapping and analysis, fuels modeling, and fire behavior modeling, with the goal of reducing wildfire hazard risks to the individual homeowner as well as the community as a whole. Fuels reduction recommendations are based on breaking up vertical and horizontal continuity of fuels across the landscape and are heavily dependent on location. Most fire activity in the Open Space areas can be addressed by mowing along trails and mowing and clearing within Open Space/private property interfaces. Home hardening and wildfire mitigation according to CSFS Defensible Space Guidelines on private property within interface areas is also recommended. Ideally, these mitigation activities should extend beyond the scope of the four priority areas to the entire community. Wildfires do not stop at property lines.

Open Space Mitigation Activities:

- Mow Open Space trails to create a 10-foot wide fuelbreak.
- Mow and clear small-diameter woody vegetation (up to 4 inches in diameter at base) 10 feet onto Open Space in interface areas.
- Replace flammable fences with non-flammable materials (see Photo 17 on Page 29 for example).

Surrounding Private Lands Mitigation Activities:

- Home hardening and defensible space that meets or exceeds CSFS standards in interface areas.

See Appendix A – Priority Maps for locations of the recommended mitigation activities.

4.1 FUELBREAK MOWING AND CLEARING

A fuelbreak is a strategically placed strip of land of varying width (depending on fuel and terrain), in which fuel density is reduced and large, continuous tracts of fuel are broken up, thus improving fire control opportunities. Fuelbreaks provide quick access for wildfire suppression and can aid firefighters greatly by slowing fire spread under normal burning conditions. This allows control activities to be conducted more safely due to low fuel volumes.



Photo 11: Mow fuelbreak along Open Space trail (CSFS, 2020)

In the four priority areas it is recommended to mow all Open Space trails during the fire season to create a 10-foot wide fuelbreak. This consists of mowing on both sides of the trail to a 10-foot width, which includes the trail width. Mow grasses to a low height of 6 inches, this is particularly important as grasses cure. Ken-Caryl Open Space is currently meeting this activity on the paved trails. It is also recommended to create a buffer between the Open Space and homes (interface). This can be achieved through mowing and clearing small-diameter woody vegetation (up to 4 inches in diameter at the base) 10 feet onto the Open Space from private property or fence lines within these interface areas. This is especially important when Open Space directly abuts structures or flammable fences. Also when mowing up to flammable fences, it is recommended to weed wack any vegetation growing under or around the fence. Trees (greater than 4 inches in diameter) in the Open Space can be left as long as it is easy to mow around them and there is 10 feet of spacing between individual trees or small isolated groups of trees. It is recommended to have a 10-foot



Photo 12: Interface where mowing, weed wacking, and shrub clearing are recommended (CSFS, 2020)

clearing of vegetation between private properties and the Open Space. Prune trees on the Open Space if limbs are touching homes, roofs, or conifer trees on the private property. However, deciduous trees have a lower wildfire risk around homes than conifer trees. Therefore, retaining deciduous trees and removing conifer trees when both are present within a defensible space may be favorable.

The 10 feet of mowing and/or clearing ought to be adequate to prevent rapid spread of wildfire from Open Space property onto private property, when adequate defensible space and home hardening has been created on the private land (CSFS, 2014). According to article #5 in Ken-Caryl Ranch Master Association & Metropolitan District Open Space & Parks Use Rules, private landowners in KCR are also permitted to mow a 10 foot strip in native grass along the edge of their property line on the adjacent Open Space property as well as remove woody vegetation less than 1 inch in diameter at the base within this area. For all Open Space rules and regulations see: <https://ken-carylranh.org/open-space/living-near-open-space/>.

Showy milkweed was noted during site visits. Milkweed plants are used by many pollinator species and are the only type of plant on which monarch butterflies lay their eggs. It is the decision of the private landowners and Open Space if they wish to preserve milkweed patches that reside within the 10 feet of mowing by mowing around them instead.

Replacing wooden fences with non-flammable material in these fuelbreak areas is also recommended.



Photo 13: Milkweed patch (CSFS, 2020)

4.2 DEFENSIBLE SPACE

Defensible space is the natural and landscaped area around a home or other structure that has been modified to reduce fire hazard. Defensible space gives your home a fighting chance against an approaching wildfire. It is recommended that all homes in KCR have defensible space that meets or exceeds CSFS Defensible Space Guidelines. These guidelines can be found online at: https://static.colostate.edu/client-files/csfs/pdfs/FIRE2012_1_DspaceQuickGuide.pdf. Home owners in the interface areas should focus on mowing grasses to at least a 6 inch height, especially during fire season and pruning trees on their properties.

See Appendix B – Wildfire Mitigation Guides for more information and photo examples taken at KCR.

4.3 FIREWISE CONSTRUCTION AND LANDSCAPING

A combination of site/landscape management techniques and appropriate construction materials are necessary to build more ignition-resistant structures in communities such as KCR. It is

recommended that home owners in the interface areas use non-flammable fencing material around their properties. If wooden fences are used, ensure there is a minimum of at least 5 feet of non-combustible material where it attaches to siding. Consider using rock, gravel, and stones to break up fuel continuity.

See Appendix B – Wildfire Mitigation Guides for more information and photo examples taken at KCR.

4.4 NOXIOUS WEED REMOVAL

Cheatgrass, a highly flammable noxious weed, was found on private land and Open Space during field visits and was also noted in the Ken-Caryl Ranch Open Space Fuels Management Plan (Walsh, 2007) and the Ken-Caryl Forest Management Plan (CSFS, 2014). Cheatgrass can be controlled mechanically, biologically, chemically, or by prescribed fire. Extreme cases may need a combination of some or all of these techniques. Like most noxious weeds, eradicating cheatgrass requires continuous retreating that may take years.

For specific cheatgrass treatment recommendations see: <https://static.colostate.edu/client-files/csfs/pdfs/06310.pdf>. For information on other invasive species in Colorado please visit: <https://csfs.colostate.edu/csfspublications/>.

5 APPENDICES

5.1 APPENDIX A – PRIORITY MAPS

The following maps are in order of highest to lowest priority. The priority ranking was determined solely by the degree of interface mowing and small-diameter woody vegetation removal in relation to the size of each of the Open Space areas. Defensible space and home hardening should be completed by all residents in Ken-Caryl, regardless of location within the community. It should also be noted that the “Clearing Focus Areas” are areas where a large amount of woody vegetation ought to be removed, but clearing of woody vegetation is not limited to these areas. See Section 4.1 Fuelbreak Mowing and Clearing for more details.

Priority Area: NMD1



NMD1	
General Info	<ul style="list-style-type: none"> • Acres: 2.1
Vegetation	<ul style="list-style-type: none"> • Vegetation Type: developed riparian grassland-shrubland • Surface Fuels: low load, dry climate grass-shrub and light load, dry climate timber-grass-shrub
Wildfire	<ul style="list-style-type: none"> • Risk: low • Expected Behavior: surface fire with 1-4 ft flame lengths; home-to-home ignition
Mitigation Priorities See Section 4.1 for more info	Open Space
	<ul style="list-style-type: none"> • Mow and clear small-diameter woody vegetation 10 ft onto Open Space within interface areas • Mow along Open Space trails to create a 10 ft wide fuelbreak
	Private Lands
	<ul style="list-style-type: none"> • Home hardening and defensible spaces within interface areas



Photo 14: Interface where mowing, weed wacking, and shrub clearing are recommended (CSFS, 2020)



Photo 15: Cottonwood (CSFS, 2019)

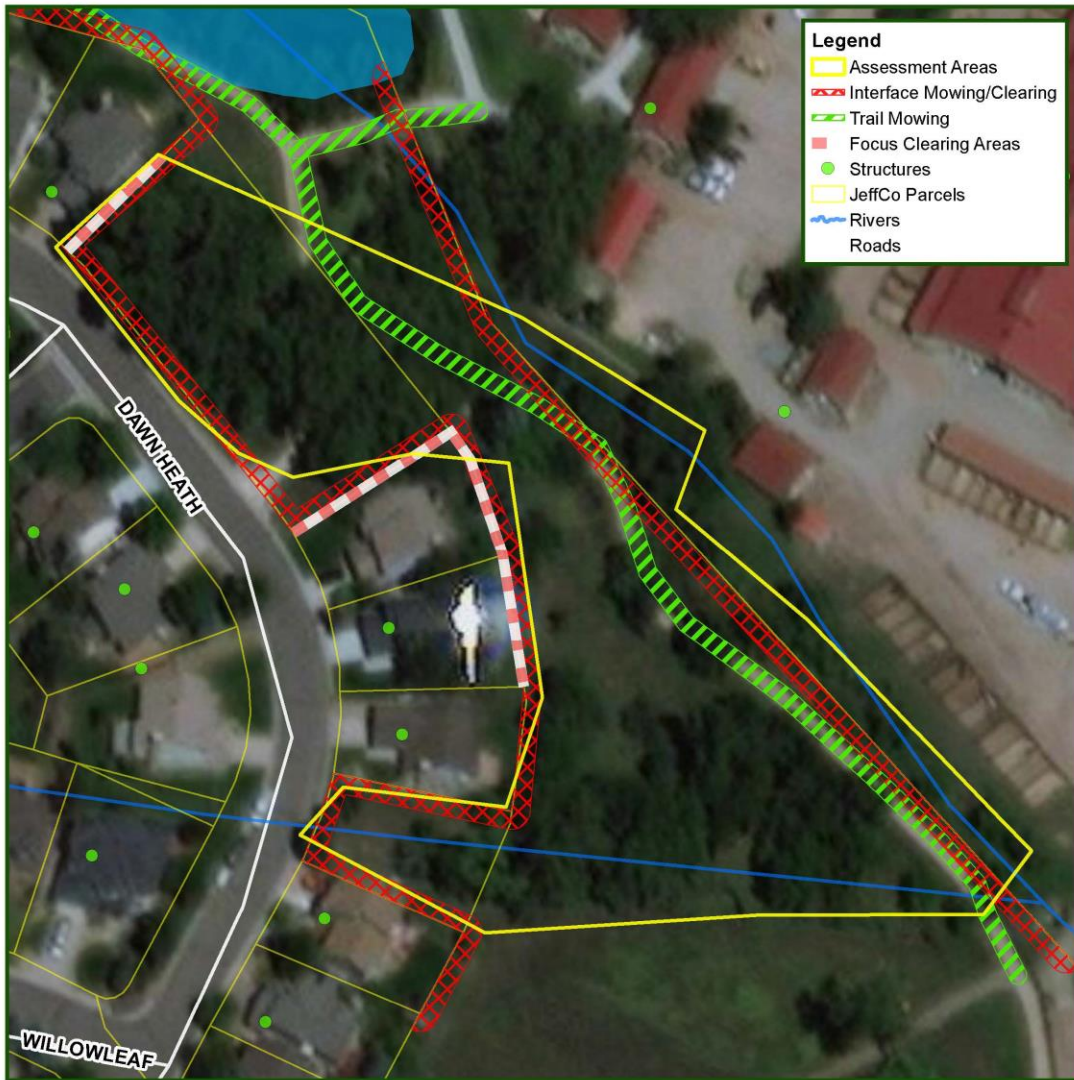


Photo 16: Year-round water source (CSFS, 2019)



Photo 17: Common vegetation seen along the trails (CSFS, 2020)

Priority Area: NMD2



NMD2	
General Info	<ul style="list-style-type: none"> • Acres: 2.0
Vegetation	<ul style="list-style-type: none"> • Vegetation Type: developed riparian grassland-shrubland • Surface Fuels: light load, dry climate timber-grass-shrub and low load, dry climate grass
Wildfire	<ul style="list-style-type: none"> • Risk: low • Expected Behavior: surface fire with 1-8 ft flame lengths; home-to-home ignition
Mitigation Priorities See Section 4.1 for more info	<p>Open Space</p> <ul style="list-style-type: none"> • Mow and clear small-diameter woody vegetation 10 ft onto Open Space within interface areas • Mow along Open Space trails to create a 10 ft wide fuelbreak • Replace flammable fences with non-flammable materials <p>Private Lands</p> <ul style="list-style-type: none"> • Home hardening and defensible spaces within interface areas



Photo 18: Mowed trail and flammable fence (CSFS, 2020)



Photo 19: Low wildfire hazard trees (CSFS, 2020)



Photo 20: Riparian drainage (CSFS, 2019)



Photo 21: Green grass will become wildfire hazard once it dries out (CSFS, 2020)

Priority Area: MDGB2



MDBG2	
General Info	<ul style="list-style-type: none"> • Acres: 2.2
Vegetation	<ul style="list-style-type: none"> • Vegetation Type: developed riparian grassland-shrubland • Surface Fuels: low load broadleaf litter and low load, dry climate grass
Wildfire	<ul style="list-style-type: none"> • Risk: low • Expected Behavior: surface fire with 1-8 ft flame lengths; home-to-home ignition
Mitigation Priorities <small>See Section 4.1 for more info</small>	<p>Open Space</p> <ul style="list-style-type: none"> • Mow and clear small-diameter woody vegetation 10 ft onto Open Space within interface areas • Mow along Open Space trails to create a 10 ft wide fuelbreak <p>Private Lands</p> <ul style="list-style-type: none"> • Home hardening and defensible spaces within interface areas



Photo 22: Winter reduces wildfire risk in the area and is a good time to start planning mitigation activities (CSFS, 2019)



Photo 23: Interface where mowing, weed wacking, and shrub clearing is recommended along wooden retaining wall (CSFS, 2020)



Photo 24: Rock retaining walls break up fuels, weed wacking can help reduce chance of creeping grass fires climbing up them (CSFS, 2020)



Photo 25: Cottonwood trees have a lower risk of producing crown fires than conifer trees (CSFS, 2019)

Priority Area: MDGB1



MDBG1	
General Info	<ul style="list-style-type: none"> • Acres: 7.4
Vegetation	<ul style="list-style-type: none"> • Vegetation Type: developed riparian grassland-shrubland • Surface Fuels: light load, dry climate timber-grass-shrub, low load, dry climate grass-shrub, and low load broadleaf litter
Wildfire	<ul style="list-style-type: none"> • Risk: low • Expected Behavior: surface fire with 1-4 ft flame lengths; home-to-home ignition
Mitigation Priorities See Section 4.1 for more info	<p>Open Space</p> <ul style="list-style-type: none"> • Mow and clear small-diameter woody vegetation 10 ft onto Open Space within interface areas • Mow along Open Space trails to create a 10 ft wide fuelbreak <p>Private Lands</p> <ul style="list-style-type: none"> • Home hardening and defensible spaces within interface areas



Photo 26: Interface where mowing, weed wacking, and shrub clearing are recommended along wooden retaining wall (CSFS, 2020)



Photo 27: Trails act as fuelbreaks in the Open Space (CSFS, 2020)



Photo 28: Interface where mowing and weed wacking are recommended along wooden fence (CSFS, 2020)



Photo 29: Interface where mowing, weed wacking, and tree pruning are recommended (CSFS, 2020)

5.2 APPENDIX B – WILDFIRE MITIGATION GUIDES

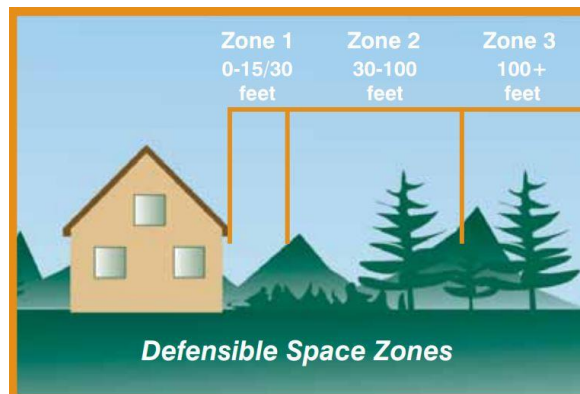
DEFENSIBLE SPACE

Defensible space is the natural and landscaped area around a home or other structure that has been modified to reduce fire hazard. Defensible space gives your home a fighting chance against an approaching wildfire. Creating defensible space also reduces the chance of a structure fire spreading to the surrounding forest and other homes. Two factors have emerged as the primary determinants of a home’s ability to survive a wildfire – the quality of the defensible space and a structure’s ignitability. Together, these two factors create a concept called the Home Ignition Zone (HIZ), which includes the structure and the space immediately surrounding the structure. To protect a home from wildfire, the primary goal is to reduce or eliminate fuels and ignition sources within the HIZ. This section will discuss defensible space recommendations.

Creating an effective defensible space involves a series of management zones in which different treatment techniques are used. Develop these zones around each building on your property, including detached garages, storage buildings, barns and other structures.

The actual design and development of your defensible space depends on several factors: size and shape of building(s), construction materials, slope of the ground, surrounding topography, and sizes and types of vegetation on your property. You may want to request additional guidance from your local fire department or a consulting forester as you plan a defensible space for your property. The following descriptions for defensible space zones were condensed from the original guidelines (CSFS, 2012). The complete version can be found online at: https://static.colostate.edu/client-files/csfs/pdfs/FIRE2012_1_DspaceQuickGuide.pdf.

Figure 3: Defensible space zones (CSFS, 2012)



Zone 1: The width of Zone 1 extends a minimum distance of 15-30 feet outward from a structure, depending on property size. Most flammable vegetation is removed in this zone, with the possible exception of a few low-growing shrubs or fire-resistant plants. Increasing the width of Zone 1 will increase the structure's survivability. This distance should be increased 5 feet or more in areas downhill from a structure. The distance should be measured from the outside edge of the home's eaves and any attached structures, such as decks.

- Install nonflammable ground cover (such as rocks, granite, or stone) and plant nothing within the first 5 feet of the house and deck.
- Prune and maintain any plants in Zone 1 to prevent excessive growth. Also, remove all dead branches, stems and leaves within and below the plant.
- Irrigate grass and other vegetation during the growing season. Also, keep wild grasses mowed to a height of 6 inches or less.
- Do not store firewood or other combustible materials anywhere in this zone. Keep firewood at least 30 feet away from structures and uphill if possible.
- Enclose or screen decks with 1/8-inch or smaller metal mesh screening (1/16-inch mesh is preferable). Do not use areas under decks for storage.
- Ideally, remove all trees from Zone 1 to reduce fire hazards. The more trees you remove, the safer your home will be. If you do keep any trees in this zone, consider them part of the structure and extend the distance of the entire defensible space accordingly.
- Remove any branches that overhang or touch the roof, and remove all fuels within 10 feet of the chimney.
- Remove all pine needles and other debris from the roof, deck and gutters, and within at least a 10 foot radius of all decks and structures.
- Remove slash, wood chips and other woody debris from Zone 1.



Photo 30: Properly limbed tree (CSFS, 2020)



Photo 31: It is recommended to remove juniper in Zone 1 (CSFS, 2020)

Zone 2: Zone 2 is an area of fuels reduction designed to diminish the intensity of a fire approaching your home. The width of Zone 2 depends on the slope of the ground where the structure is built. Typically, the defensible space in Zone 2 should extend at least 100 feet from all structures. If this distance stretches beyond your property lines, try to work with the adjoining property owners to complete an appropriate defensible space.

- Remove stressed, diseased, dead or dying trees and shrubs.
- Remove enough trees and large shrubs to create at least 10 feet between crowns. Crown separation is measured from the outermost branch of one tree to the nearest branch on the next tree. On steep slopes, increase the distance between tree crowns even more.
- Remove all ladder fuels from under remaining trees. Prune tree branches off the trunk to a height of 10 feet from the ground or 1/3 the height of the tree, whichever is less.
- Small groups of two or three trees may be left in some areas of Zone 2, but leave a minimum of 30 feet between the crowns of these clumps and surrounding trees.
- Keep shrubs at least 10 feet away from the edge of tree branches. This will prevent the shrubs from becoming ladder fuels.
- Periodically prune and maintain shrubs to prevent excessive growth, and remove dead stems from shrubs annually. Common ground junipers should be removed whenever possible because they are highly flammable and tend to hold a layer of duff beneath them.



Photo 32: Mowed grasses and rock-lining break up fuel continuity (CSFS, 2020)

- Mow or trim wild grasses to a maximum height of 6 inches. This is especially critical in the fall, when grasses dry out.
- Stack firewood uphill from or on the same elevation as any structures, and at least 30 feet away. Clear all flammable vegetation within 10 feet of woodpiles.
- Locate propane tanks and natural gas meters at least 30 feet from any structures, preferably on the same elevation as the house.



Photo 33: Mowed grasses leading up to fence (CSFS, 2020)

- Do not visibly screen propane tanks or natural gas meters with shrubs, vegetation or flammable fencing. Instead, install 5 feet of nonflammable ground cover around the tank or meter.

Zone 3: Zone 3 has no specified width. It should provide a gradual transition from Zone 2 to areas farther from the home that have other forest management objectives. This area focuses on forest health and may be suitable for strategically placed fuelbreaks. For most of the homes in KCR, Zone 3 extends into Open Space or neighboring properties, highlighting the importance of properties having proper defensible space and home hardening.

FIREWISE CONSTRUCTION AND LANDSCAPING

Fire Resistant Structures

Burning embers have caused the loss of many homes in the wildland-urban interface (WUI). Embers are produced when trees are consumed by wildfire, causing “spotting.” Spotting can drop embers or “firebrands” more than a mile ahead of the main fire, causing very rapid fire spread. In WUI fires, burning structures also can be sources of burning embers. Flammable horizontal surfaces, such as wooden decks or shake roofs, are especially at risk for ignition from burning embers. A combination of site/landscape management techniques and appropriate construction materials are necessary to build more ignition-resistant structures in the WUI. The goal is to create structures that can either resist fire on their own, or at least make it easier for firefighters to safely protect structures. As stated previously in Section 4.2, the two primary determinants of a home’s ability to survive a wildfire are the quality of the defensible space and a structure’s ignitability. Together, these two factors create a concept called the Home Ignition Zone (HIZ), which includes the structure and the space immediately surrounding the structure (CSFS, 2012). This section will discuss recommendations for reducing structure ignitability.



Figure 4: Home Ignition Zone (CSFS, 2012)

The following recommendations were condensed from the publication “Reducing Wildfire Risks in the Home Ignition Zone.” The complete version can be found at: <https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Preparing-homes-for-wildfire>.

- Decks and elevated porches: Place 1/8” metal mesh screening between low-profile decks from surface to ground, to block embers from collecting underneath. Never store flammable materials underneath elevated decks/porches. Remove dead vegetation and debris from under decks/porches and between deck board joints. New and replacement decks should be constructed using non-combustible composite deck surfaces.

- Fencing: Use non-flammable fencing material (metal or masonry) when attaching directly to the siding. Ensure there's a minimum of at least 5' of noncombustible material where it attaches to the siding. Do not add vines or other types of vegetation to fencing material. Wooden fences can carry flames directly to the house.
- Fireplace chimneys: Remove debris that may accumulate at roof-to-wall intersections. Embers from a fireplace can exit the chimney and could ignite a wildfire; to prevent this install a spark arrestor. When wildfires are approaching close the damper, fireplace screens, and glass doors.
- Gutters: Metal roof gutters do not ignite, only the debris material that accumulates in them – that's why keeping them clean is so important. Vinyl roof gutters can ignite when the debris material is ignited and flaming gutters can fall from the roof edge and land next to the house, which is why the immediate zone needs to be clear of flammable materials. New and replacement gutters should have leaf guards.
- Siding: Use ignition-resistant building materials on exterior walls. Examples include: Stucco, masonry products, plaster, cement board siding, and cement. Seal gaps and crevices. Examine the siding for locations where embers could accumulate or lodge and apply caulking at trim-to-siding locations where it is missing or has failed.
- Eaves and soffits: Reduce the size and number of embers that pass through vents in the eaves by covering them with a 1/8 inch metal mesh screening. Inspect soffit vents and maintain as needed.
- Garages: Weather seal the perimeter of garage doors to help keep embers out. Be sure the door is tight fitting so embers can't slide under the door or in from the sides. If possible, choose a metal or wood core door with metal exterior.
- Roofing materials: Types of Class A fire-rated roofing products offer the best protection. Examples include: Composite shingles, metal, cement tile, and clay. Inspect shingles/tiles and replace/repair those that are loose or missing to prevent ember penetration. If gaps exist between the roof covering and the roof deck at the eave or ridge, fill the space with a "bird stop" material. Keep roofs clean from leaf litter and pine needles. Remove all tree limbs that are within 10 feet of the chimney or those that overhang the roof.



Photo 34: Rock garden between grass and wooden retaining wall (CSFS, 2020)



Photo 35: Rock retaining wall (CSFS, 2020)



Photo 36: Rock garden breaking up fuel continuity (CSFS, 2020)

- Skylights: Remove debris next to and on skylights. Glass is a better option than plastic or fiberglass as it is not flammable.
- Vents: Consider purchasing closure devices for foundation and gable end vents and installing a louver-type dryer vent that stays closed unless the dryer is running. Clean debris from attic vents and install 1/8 inch metal mesh screening. For turbine vents, access the attic and inspect where the vent attaches to the roof and attach 1/8 inch screening to the roof sheathing. Dormer-face vents should be replaced with a low-profile vent. Ridge vents should be rated for high wind/rain exposure.



Photo 37: Rock lining between grass and conifer trees (CSFS, 2020)

- Windows: Multi-paned tempered glass can help reduce the risk of fracture or collapsing in a wildfire. Consider fireproof shutters to protect large windows and glass doors from radiant heat.

Fire Resistant Landscaping

Areas within the defensible space do not have to be devoid of plant life. However, the types of plants, their arrangement, and maintenance are very important to keep your home and surrounding landscape fire resistant. Please visit: <https://csfs.colostate.edu/csfspublications/> for a list of fire resistant species and more information on fire resistant landscaping.

Consider the following options while landscaping within your home’s defensible space:

- Landscape according to the recommended defensible-space zones. That is, the plants near your home should be more widely spaced and lower growing than those farther away.
- Do not plant in large masses. Instead, plant in small, irregular clusters or islands.
- Use rock, gravel and stepping stone pathways to break up the continuity of the vegetation and fuels. This can modify fire behavior and slow the spread of fire across your property.
- Incorporate a diversity of plant types and species in your landscape.
- Mulch can be organic or inorganic. Do not use pine bark, thick layers of pine needles or other mulches that readily carry fire.



Photo 38: Rock between homes and non-combustible fence along siding (CSFS, 2020)

6 GLOSSARY

All Age - In a stand of trees where there are considerable differences in ages of trees and in which three or more age classes are represented.

Artificial Regeneration - Where artificial means such as seeding or planting are used to establish a stand of trees.

Basal Area - A measure of density. It is the square footage of stump tops that would be exposed on an acre if all the trees were cut off at 4 ½ feet above the ground. Often expressed as BA/Acre.

Canopy Spacing - the target distance to create between the extent of branches from one tree to the extent of branches of the nearest neighboring tree

Chemical Control - using herbicides, fungicides, or insecticides to control or protect a property from noxious weeds, fungal diseases, or insect pest activity

Chipping/Mastication - using a chipper or masticating head to mulch slash material on site. Chips should be spread throughout a designated area and should not exceed four inches in depth. Chip piles should be utilized on the property or arranged for off-site hauling.

Cord - A unit of wood volume equal to a stack 4' x 4' x 8' solid. (128 cubic feet).

Crown Cover (or Canopy Cover) - the ground area covered by the crowns of trees or woody vegetation as delimited by the vertical projection of crown perimeters and commonly expressed as a percent of total ground area

Cutting Cycle - The time interval between treatments.

CWPIP (Community Wildfire Protection Implementation Plan) - document under the umbrella of a Community Wildfire Protection Plan. Written by residents, the document prioritizes the recommendations made in the Community Wildfire Protection Plan for a specific area, and presents measures to reduce wildfire threat in the defined community or communities.

CWPP (Community Wildfire Protection Plan) - document which evaluates community wildfire risk and recommends activities to reduce risks through hazardous fuels management and other mitigation actions. Must be approved by the Colorado State Forest Service.

DBH (Diameter at Breast Height) - The measurement of tree diameter at a point 4 1/2 feet above the uphill ground level. Usually expressed in inches.

Defensible Space - the area around a home or other structure where fuels and vegetation are treated, cleared, or reduced to slow the spread of wildfire

DMR (Dwarf Mistletoe Rating) - Refers to Hawksworth's 6-point rating level for measurement of differing levels of dwarf-mistletoe infection.

Entry - Actual entering of stands for treatment purposes.

Ephemeral Stream – a stream or portion of a stream that flows only in direct response to precipitation, receiving little or no water from springs and no long continued supply from snow or other sources, and whose channel is at all times above the water table

Even-Aged - A stand of trees in which the dominant trees originated at about the same time. Generally, only one age class is represented.

Forage - Food available to grazing livestock or wildlife in the form of grasses, shrubs, and forbs.

(Shaded) Fuel Break - an easily accessible strip of land of varying width (depending on fuel and terrain), in which fuel density is reduced, thus improving fire control opportunities

Fuel Load – the oven-dry weight of fuel per unit area

-note load is often described by size or timelag class, and as live or dead, herbaceous or woody

Fuel Treatment - Practices used to reduce wildfire hazard by changing the composition of forest fuels.

Fuelwood - Dead woody material that has not begun to decay and that can be utilized for heating purposes.

Ground-truth - Ground truth is a term used to refer to information provided by direct observation (field observations) as opposed to information provided by inference (remote sensing).

Group Selection - trees are removed and new age classes are established in small groups —the width of groups is commonly twice the height of the mature trees with smaller openings providing environments suitable for shade-tolerant regeneration and larger openings providing conditions suitable for more shade-intolerant regeneration

Group Selection with Reserves - some trees within the group are not cut to attain goals other than regeneration within the group

Harvest - Removal of mature (commercial) trees.

Ladder Fuels - combustible material that provides vertical continuity between vegetation strata and allows fire to climb into the crowns of trees or shrubs with relative ease – note ladder fuels help initiate and ensure the continuation of a crown fire

Live Crown Ratio – the ratio of crown length to total tree height

Lop and Scatter - using a chainsaw to cut material into small pieces that are scattered throughout a designated area and away from live trees. Scattered material should not exceed a depth of 18 inches. Material over four inches in diameter, and accessible to ground-based equipment, should be salvaged as forest product. The closer to the ground pieces lie, the more rapid the decomposition.

Management Units - Areas or units with similar tree characteristics and management objectives. Can be a portion of one stand or several stands combined.

Mature/Overmature - Trees that have reached their maximum growth potential and are falling victim to insects, diseases, and natural mortality.

Mechanical Control - using mechanical techniques such as mowing of weeds or protective barriers to keep pests at bay

Natural Regeneration - Tree seedlings that establish without added costs of seeding and/or planting. Seed source comes from existing or adjoining trees.

Patch - An area of trees of relatively uniform density, tree quality, and age structure that is too small to be treated as a stand.

Patch Cuts - the cutting of essentially all trees, producing a fully exposed microclimate for the development of a new age class

Piling and Burning - Slash or other forest woody fuels is bunched into piles and burned to eliminate fire hazard. Piling can either be done by machine or by hand. Burning should be done under safe conditions by permit from local air quality agency.

Pruning - the removal, close to the branch collar or flush with the stem, of live or dead side branches (ladder fuels) to decrease fire hazard or improve growth and form.

Removal - removing slash material completely from the site by way of hauling to a designated slash collection site.

Residual Basal Area – the remaining basal area after a treatment

Sanitation Cut - the removal of trees to improve stand health by stopping or reducing the actual or anticipated spread of insects and disease

Salvage Cut - the removal of dead trees or trees damaged or dying because of injurious agents other than competition, to recover economic value that would otherwise be lost

Silvicultural Practices - Tree management techniques and procedures utilized to reach a given desirable stand condition.

Single Tree Selection - individual trees of all size classes are removed more or less uniformly throughout the stand, to promote growth of remaining trees and to provide space for regeneration

Skidding - The process of moving felled (cut) trees to a central point for loading on a vehicle for transport to the manufacturing point. Can utilize crawler tractors, 4-wheel drive rubber-tired tractors, cable cranes, horses or mules.

Slash - materials left over from a forestry thinning project that have no or limited product value – tops of trees, branches, stumps, etc.

Snag Retention - maintaining standing, generally unmerchantable dead trees from which the leaves and most of the branches have fallen for wildlife habitat purposes

Stand - A subdivision of a treatment area that is several acres in size, usually 5 acres or larger. Applicable to an area of even-aged or all-aged trees that can be regenerated by a single reproduction method.

Suppression – in silviculture, the process whereby a tree or other vegetation loses vigor and may die when growing space is not sufficient to provide photosynthate or moisture to support adequate growth

Thinning - Removal of poorest formed, damaged, suppressed, and crowded trees in a stand to improve growth and form of remaining trees.

Thin From Below - the removal of trees from the lower crown classes to favor those in the upper crown classes

Thin From Above - the removal of trees from the dominant and co-dominant crown classes

Two-Storied Stand - A stand composed of two definite age classes of trees with a significant or noticeable difference in tree heights giving a "layered" effect.

Uneven-Aged - Same as all-aged.

Wildlife Brush Pile - using a variety of wood slash materials to create a six feet tall by six feet wide pile that is loosely stacked for the purpose of providing habitat for small mammals, birds, rodents, reptiles and/or amphibians

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