Firebreak Management

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Firebreaks, which can occur naturally or can be created, are used during prescribed fires as a boundary that surrounds the entire prescribed fire unit, stopping the spread of fire by reducing fuel and ultimately, minimizing fire intensity. Although they may look simple, quality firebreaks serve several purposes:

1. Prevent fire from escaping into areas outside the prescribed fire unit.
2. Reduce heat exposure to crews working on the prescribed fire unit boundary.
3. Simplify effort needed to suppress a fire and secure a fireline.
4. Provide a safe travel corridor for fire crews around the prescribed fire unit.

Types of Firebreaks

Several types of firebreaks exist, and often more than one type of firebreak is used during a prescribed fire. Different types of firebreaks offer different levels of performance and permanence and have varying levels of installation costs. The firebreaks that perform the best are those in which fuel is completely absent. The longevity of a firebreak is the duration of time that a firebreak is functional. Some are permanent and last from one season to the next, while others are temporary and may only last for minutes (*Table 1*). Although some firebreaks might not completely stop the spread of fire, all firebreaks should reduce fire intensity so crews can extinguish a fire easily.

Mowed – Mowed firebreaks are one of the most commonly used firebreaks in Nebraska. Mowing reduces the height of grass fuels to between 1 and 4 inches. Although mowing might reduce the height of the vegetation, it does not remove vegetation from the firebreak. Using mowed firebreaks in areas with excessive litter should be accompanied by baling or raking to completely remove the vegetation.

Disked or tilled – Removing vegetation and exposing bare, mineral soil through disking or tilling is an excellent way to prevent the spread of fire. Disked or tilled firebreaks should be avoided in areas where soil erosion is likely, invasion by noxious weeds possible, or in native grass pastures. Freshly-disked firebreaks in areas that feature well established grass sod may require a few passes to eliminate large sod clumps that could make traveling on the firebreak difficult.

Green vegetation – Because of the high levels of moisture in new shoots, firebreaks composed of growing vegetation can serve as an excellent firebreak (*Figure 1*). However, new growth can conceal residual fuel at the ground level. In order for green vegetation to fully perform as a firebreak, a prescribed fire needs to be conducted later in the spring, after green-up. Alfalfa, clover or cool-season grasses can be planted and used as a permanent firebreak surrounding a unit that will be burned frequently, but these firebreaks require regular management such as haying or mowing to remain productive. Alfalfa and clover firebreaks can also serve as nesting and brooding areas for ring-necked pheasants and northern bobwhite quail.

Figure 1. *Vegetated firebreaks can be composed of alfalfa, clover or cool-season grasses.*

Table 1. *List of different types of firebreaks categorized based upon how well they perform in preventing fire escape, how long they last and the cost of installation (financial cost and/or time spent). Performance here is estimated based upon the firebreak alone, without additional alterations or intervention by fire crews.*

Type of Firebreak	Performance	Longevity	Installation Cost
Mowed	Medium	Medium	Medium
Disked or tilled	High	Medium	High
Green vegetation	Medium	Medium	Low
Unvegetated areas	High	Medium	Low
Maintained road	High	High	Low
Unimproved road	Low	High	High
Livestock trail	Low	Medium	Low
Grazed	Medium	Medium	Low
Surface water (lake/river)	High	High	Low
Feathered (mowed/disked)	High	Medium	High
Wetline	Medium	Low	Low
Harvested agricultural field	Low	Medium	Low
Blackline	High	Medium	High

Unvegetated areas – Several unvegetated areas can exist across a grassland in Nebraska. These areas can include rock or otherwise naturally exposed features, or areas of a grassland that receive exceptionally high levels of livestock pressure, such as those around watering facilities or mineral supplement locations (*Figure 2*). Although these areas can be used as a firebreak, they are often discontinuous locations that must be connected with other types of firebreaks.

Maintained road – Since vegetation is usually absent, paved or gravel roads provide a great firebreak. However, using roads as a firebreak can be dangerous for drivers and crew members if smoke drifts across the road. Posting warning signs or assigning a crew member or local law enforcement official to warn traffic of low visibility can mitigate this danger. Along some roadways, permission may be need from the county or state roads department in order to burn the right-of-way.

Figure 2. *Unvegetated firebreaks, such as areas surrounding livestock tanks are usually discontinuous, and must be connected with other firebreaks.*

Figure 3. *Unimproved roads, such as pasture roads offer great access for crews, but often contain vegetation that could carry a fire. A little mowing would turn this unimproved road into an excellent firebreak.*

Unimproved road – Two-track or field access roads make great locations for firebreaks, but are often associated with a build-up of excessive fuel (*Figure 3*). Additional work such as mowing might be necessary to make these firebreaks fully functional. Unmaintained seasonal roads also can accrue ruts and gullies from erosion, making travel with equipment difficult and hazardous. Grading these areas ensure safe travel.

Livestock trails – Although livestock trails feature the complete removal of fuel, they are usually narrow and offer limited protection from a fire escape

Figure 4. *Livestock trail firebreaks are narrow and can be easily crossed by fire.*

Figure 6. *Using available surface water as a firebreak is a great way to maximize the performance of a firebreak with minimal work beforehand.*

(*Figure 4*). Livestock trails perform best as firebreaks when they are used with another type of firebreak. For instance, a livestock trail that runs parallel to a mowed firebreak or heavily grazed firebreak where fuel is reduced over a larger area is ideal.

Grazed – Grazing areas adjacent to the prescribed burn unit the season prior can substantially remove fuel. In addition, these areas often encourage early green-up of cool-season vegetation. The moisture content within green-up vegetation serves as an additional barrier to fire spread (*Figure 5*).

Surface water – Although surface water features such as lakes, reservoirs, and rivers serve as excellent firebreaks (Figure 6) and generally require little preparation, they are rarely available. Smaller waterways such as creeks may be an unreliable firebreak if they are not flowing when the burn is planned. Small waterways also could have downed timber fuels that extend across the waterway into an area outside the intended burn unit.

Figure 5. *Heavily grazed areas green-up early in the spring, providing moisture for an excellent firebreak.*

Feathered – Combining different types of firebreaks can maximize performance and minimize cost. One of the most common combinations, a feathered firebreak, uses both a mowed and a disked or tilled firebreak (*Figure 7)*. A 5 foot disked or tilled firebreak strip bordered by two 5 foot mowed firebreak strips offers a 15 foot firebreak that combines the performance of a disked or tilled firebreak with the simple installation and low environmental impact of a mowed firebreak.

Wetline – Wetlines are frequently used during a prescribed fire to supplement existing firebreaks. A wetline involves spraying water along

Figure 7. *Feathered firebreaks combine several multiple types of firebreaks. Below, this firebreak combines mowed and tilled firebreaks.*

the boundary line of a prescribed burn unit and lighting the adjacent grass in the burn unit with a drip torch. The fire will burn away from the wetline, but the moisture from the wetline prevents the fire from crossing the firebreak. Since the moisture from a wetline can be absorbed into the soil, or evaporate on a warm or breezy day, wetlines are often only effective for a few minutes and should only be considered a temporary firebreak, and crew members performing these tasks should work together and in close proximity. A foam solution can be used to increase the lifespan of a wetline, however these products are often expensive. Regardless of whether a wetline is composed of water or foam, they should only be used in combination with an additional firebreak.

Harvested agricultural fields – Harvested crop fields are often thought to serve as great firebreaks. While this may be the case for some fields that contain only small amounts of scattered litter such as soybeans, other crops like corn with substantial litter can easily carry a fire (*Figure 8*). Litter can be especially abundant in fields where in no-till practices are used. Corn husks can be especially problematic because they can easily become airborne and deposit an ember or fire into areas outside the burn unit. When using a harvested corn field as a firebreak, you should consider disking or tilling the firebreak as well to further reduce fuel.

Blackline – A blackline is a firebreak that uses fire to eliminate the fuel on a burn unit boundary. When installing a blackline, a fire is lit, then extinguished when the desired width of the firebreak has been achieved. Since blacklines are installed in narrow areas, multiple crew members are needed and clear communication is essential. Only experienced crews should attempt to install a blackline. Blackline firebreaks require a lot of time to install, and therefore are typically completed on a day prior to the day of the larger burn unit. During prescribed fires that use a ring ignition pattern, a modified form of a blackline is used as the backing fire extending against the wind will eventually serve to stop the advancement of the head fire. Because of their complexity, requirement for an additional day of ideal weather conditions, and redundancy if a backing fire already will be used during the prescribed fire, blackline firebreaks are not often used in Nebraska.

Figure 8. *Harvested agricultural fields can contain substantial ground level litter which will need to be removed in order to function as a firebreak.*

Firebreak Location

The proper location of a firebreak is a critical element that determines firebreak performance. Since the goal of a firebreak is to stop the spread of fire, they should be established in areas where fire intensity is naturally lower. Individuals desiring to conduct prescribed fires on a regular basis should spend plenty of time considering firebreak locations so these same locations can be used during subsequent

fires. When determining the best place for a firebreak, the most important characteristics include areas with gentle slopes or flat topography, and areas that can support reliable travel by crews and equipment. *In addition, several features should be avoided when establishing firebreak locations*.

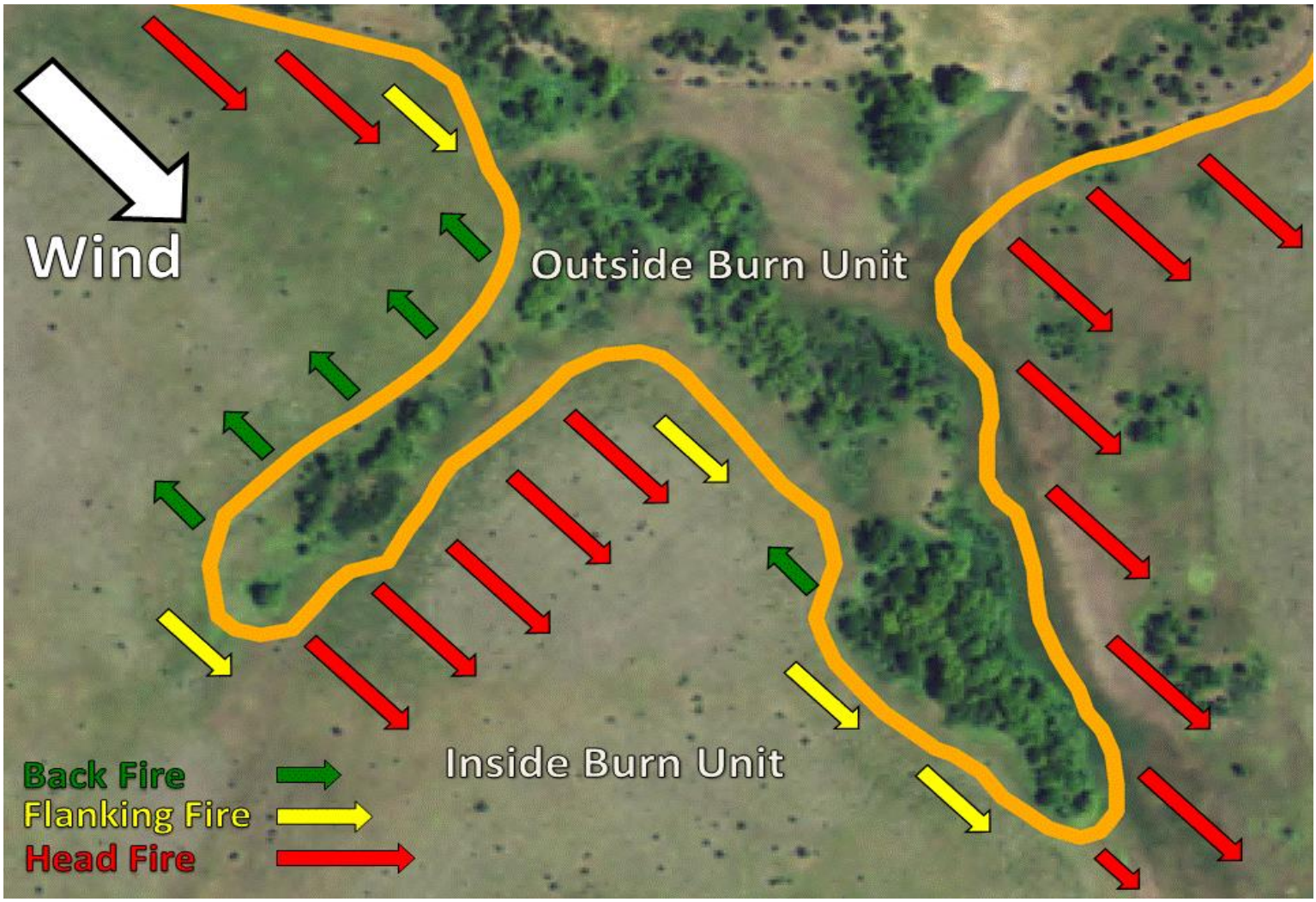
Large fuels or heavy fuel loads – While burning, large fuels like trees or cut tree piles and dense grass create high levels of heat, making working on a nearby firebreak difficult or impossible for crew members. If these areas cannot be patrolled due to heat, a fire can more easily cross a firebreak. In addition, large fuels can burn and smolder for a long time, often much longer than the duration of a prescribed fire. If the fuel is close to a firebreak, high winds in the days following a prescribed fire can send embers out of the burn unit. A general rule is for firebreaks to be established at least 300 feet away from large, unburned piles of cut trees that are within the burn unit.

Steep slopes – Fire moves rapidly uphill, and steeper slopes are often associated with greater flame lengths and increased fire intensity. Firebreaks that occur on steep slopes can create a dangerous flanking fire that can be hazardous to crew members and difficult to control if the backing fire is not well developed. Transporting equipment on steep slopes can be difficult or impossible. Some vehicles might have difficulty moving up steep slopes, especially considering the weight of water being hauled. In addition, the chances of upsetting an ATV are also increased on steep slopes. Even if a firebreak is located on a gentle slope, steep slopes adjacent to the firebreak could create problems as fire gains intensity traveling uphill. Also, wind speed increases as it passes through narrow, steep slopes like saddles or chimneys.

Narrow areas – Firebreaks established parallel to a fenceline can become dangerous to crew members, especially if the opposite side of the firebreak is adjacent to large fuels or heavy fuel loads. While fencelines are a logical place to establish firebreaks, a fence can prevent crew members from escaping the fire if they need to or from pursuing a fire that has crossed the firebreak. Keep these possibilities in mind, especially in areas with heavy fuels. Gates or fence "let-downs" can be readily used as alternate escape routes in these areas.

Complicated curves – Straight firebreaks are much simpler to manage than firebreaks with curves. Firebreaks with sharp curves become complicated because the angle of a direct wind constantly changes through the curve (Figure 9). For example, igniting along a curve can translate into lighting a backing fire, flanking fire, and headfire all within a very short distance, and can

Figure 9. *Sharp curves along a firebreak can result in frequently changing fire direction. In the example below, an ignitor following the brown fireline would frequently alternate between lighting a headfire, flanking fire, and backing fire in a short distance.*



become confusing for crewmembers. If the curve is extremely sharp and in a small area, the potential for lighting a headfire toward a backing fire that has not adequately developed is possible. Firebreaks should be established as straight as possible, with the number of complicated curves kept to a minimum. If the area intended for a prescribed fire includes a border that features numerous or complicated curves, consider expanding the prescribed unit boundary and establishing firebreaks in areas that can support a straighter border with fewer curves.

Other hazardous areas – Many other hazards that could threaten the safety of crew members might exist within or near a prescribed burn unit. Features such as electrical lines, natural gas lines, oil or gas wells, propane tanks, rubbish piles, wet or swampy areas, holes or other unexpected topographical features should be avoided when establishing the location for a firebreak.

Firebreak Dimensions

The appropriate width for a firebreak is determined by the ability of the firebreak to reduce fire intensity, minimize the possibility of a fire escaping, and provide safe travel for crews and equipment. A useful rule of thumb for determining the appropriate width of a firebreak is to multiply the average height of the adjacent fuel within the burn unit by 10 (*Table 2*). For example, a firebreak adjacent to 3 foot tall grass should be 30 feet wide (3 feet x 10 = 30 feet). A firebreak adjacent to 20 foot tall eastern red cedars should be 200 feet wide. The amount of area needed to adequately install such a firebreak would be immense. Removing these trees or establishing the firebreak further away from such fuels may be an option that would save time and expense. The width of a firebreak adjacent to hardwood trees will probably be substantially less since the functional fuel in a hardwood woodland is usually ground level leaf litter with a height of less than 6 inches. Although a 6 inch fuel height would require only a 5 foot wide firebreak (0.5 feet x 10 = 5 feet), some trucks being used on the fire might have a clearance width of 6 feet. The height of fuel might provide a general guideline for firebreak width, but other factors can also be considered. Extra width can be added when adjacent fuels within the prescribed burn unit are especially volatile, adjacent fuels outside the burn are heavy, or if extra protection is desired for structures, utility facilities, oil or gas wells or other features adjacent to the burn unit.

Table 2. *List of common fuel heights in Nebraska and corresponding width of the firebreak based upon: firebreak width = 10 x height of adjacent vegetation.*

Adjacent Fuel in the Burn Unit	Height of Fuel	Width of Firebreak
Grass	1 feet	10 feet
Grass	2 feet	20 feet
Grass	3 feet	30 feet
Eastern red cedar	10 feet	100 feet
Eastern red cedar	20 feet	200 feet
Hardwood leaf litter: lofty	6 inches	5 feet*
Hardwood leaf litter: compacted	2 inches	~2 feet*

**These values do not take into account the size of equipment that might be used on the fire. The minimum width of a firebreak should at least encompass the width of all equipment being used on the fireline.*

Installing Firebreaks

Mowed, disked, tilled, planted and planted firebreaks all need to be installed manually. Special considerations should be taken during the planning and installation process to ensure that firebreaks perform at a high level.

Mowed – Mowed firebreaks can be easily installed by an agricultural mower or shredder. The mower or shredder should be set at the lowest setting, ideally leaving around 2 inches of standing residual fuel. Most of the mowed or shredded material will remain on the firebreak and can be removed by baling or raking (*Figure 10*). If the material is raked, it should be raked towards the edge of the firebreak opposite of the prescribed burn unit. Mowing or shredding should occur well in advance of your prescribed fire. If planning on burning in the spring, mowing

Figure 10. *Mowing reduces the height of vegetation, but does not remove fuel from the firebreak. Baling or raking may be used to remove this fuel. .*

Figure 11. *One pass with a tiller might not be enough to expose a solid line of soil through the firebreak.*

the previous fall will allow for litter to decompose and become compacted from the weight of snow. Over time, wind can deposit additional fuel onto the firebreak. If substantial amounts of fuel have accumulated, raking again in the days prior to the prescribed burn might be necessary.

Disked or tilled – Disked or tilled firebreaks should be installed at a depth of 4 inches. Although tilling adequately separates clumps of soil and sod, disking can overturn clumps of sod that not only makes travel by vehicle or foot difficult, but also can smolder for several days and possibly ignite a fire outside the burn area. In addition, a single pass of disking or tilling can leave enough fuel across the firebreak to support a fire escape. Multiple passes over the same area may be needed to sufficiently break sod clumps and bury potential fuel (*Figure 11*).

Planted – Vegetated firebreaks need to be installed well in advance of the prescribed fire. Alfalfa, clover, and cool-season grasses often take 2 years or more to generate a robust stand. Plants within vegetated firebreaks eventually mature and need to be maintained through a periodic mowing to reduce height and litter accumulation. Baling or raking can be used to remove the mowed material from the firebreak.

Wetlines – Due to their temporary nature, wetlines are installed *during* a prescribed fire. Wetlines are placed directly adjacent to the fuel within the burn unit. An ignitor will follow the wetline and light the adjacent vegetation, allowing the fire to burn away from the wetline. Adjustable water nozzles allow for a straight stream or fog pattern. A moderate fog pattern that spreads to about 1 foot wide is ideal. Slightly waving the nozzle back and forth can further increase the width of the wetline to between 18 inches and 2 feet. Applying water directly in front of a truck tire will compact vegetation, reducing the surface area of fuel exposed to air, and ultimately extending the time needed for evaporation (*Figure 12*). The ignitor and the crew member installing the wetline should not be working more than 10 yards apart. Separating further could provide enough time for wetlines to evaporate. Foam retardant can be mixed with the water supply to extend the lifespan of a wetline firebreak. In some cases, wetlines using foam retardant will be functional for over 10 minutes. However, foam retardant can be expensive and cannot be readily purchased in most communities. Anyone interested in using foam retardant as a wetline should ensure their equipment is compatible with a foam retardant solution.

Figure 12. *Since they can quickly evaporate, wetlines should only be considered a temporary firebreak. Compacting the vegetation with a tire can increase the performance of a wetline.*

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