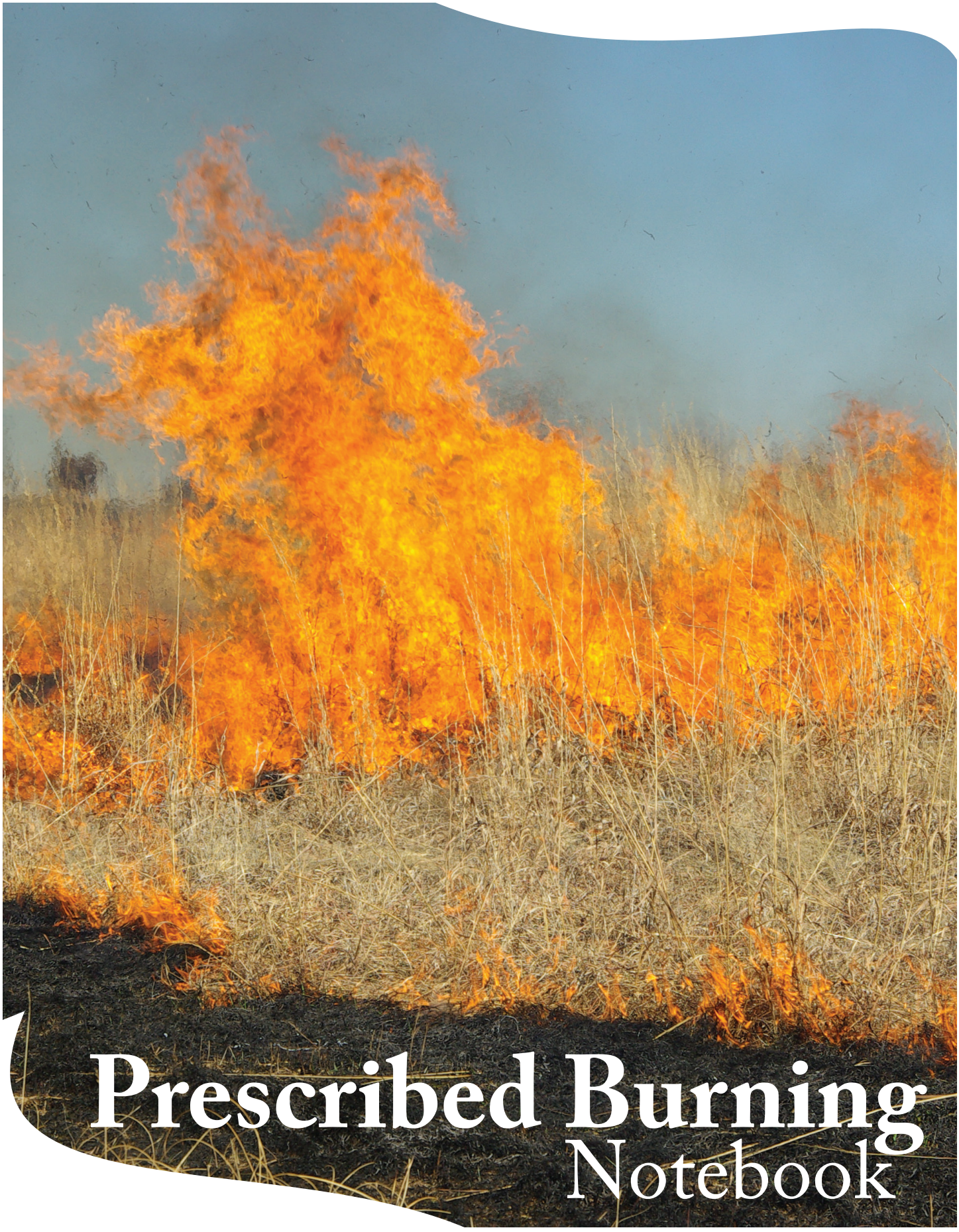

Prescribed Burning Notebook

Kansas State University

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Introduction

Intentionally set fires have been used to achieve specific objectives for thousands of years in the Great Plains. Range managers today continue to use fire to create native landscapes that are healthy, productive and beautiful. Prescribed burning requires knowledge, skill, resources, coordination, and a respect for others. This notebook contains basic information for planning a safe and effective burn and is intended to supplement material presented in Kansas Joint-Agency Burn Workshops. There are aspects of prescribed burning that can't be learned except through experience, but understanding how a burn is planned and executed is a necessary background.

Fire is a powerful tool for managing rangelands, and requires careful and judicious use. Prescribed burning regulations in Kansas are largely delegated to the county level. Most counties opt for at least the minimum notification rules set out in the Kansas State Regulations for Agricultural Open Burning, and many have additional regulations. Following regulations assists in creating and maintaining good relationships with local fire departments, emergency managers, and other local officials, and fosters a collegial atmosphere within the fire community.

Beyond regulations, consideration for neighbors near and far is equally important. Special populations who might most be affected by smoke should be accommodated through careful planning and notification. Smoke can be deadly on nearby roadways, and impact air quality hundreds of miles away. Escaped fires can harm both people on the fire and nearby structures. Fire education in Kansas emphasizes careful planning and execution of prescribed burns to minimize the risk of these unintended consequences.

Legal risks associated with prescribed burning can be minimized by having a well-thought out prescription for your burn, and staying within the prescription as you burn. Burn plans assist everyone concerned by describing the conditions necessary for accomplishing burn objectives, identifying crew, communication, and equipment needs, and highlighting areas that need special attention during the burn. The process of planning allows contemplation of all aspects of the proposed fire and increases the ability to identify and address risks in advance.

This notebook is one part of the effort to provide fire education in Kansas. My hope is that prescribed fire will continue to be used to manage the diverse, beautiful rangelands of Kansas, providing lush forage, exquisite wildflowers, healthy soils and watersheds, and thriving wildlife.

Carol Blocksome
Editor
December 16, 2015

FIRE! *The word is feared by most people. But fire is the major factor allowing grasslands to exist. Historically, grasslands developed with fire, drought, and grazing. Natural fires ignited by lightning as well as those started by Native Americans occurred throughout the year. Most often, these fires occurred in areas with heavy growth. Heavy grazing by bison, elk, and longhorn created short areas that were resistant to burning. As fires swept through an area, the grazing shifted to the new regrowth on burned areas. Heavily grazed areas regrew and supplied fuel for future fires. In addition, Native Americans used fire for attracting game, to "fire-proof" camp sites, and in religious ceremonies. Most woody plants were prevented from establishing by recurring fires. In eastern Kansas, the grasslands were an oak savannah, which is a grassland with scattered mottes of oak trees across the landscape. Trees and shrubs survived where fire couldn't reach such as along streams and in areas with shallow soils. Today, fire combined with management drought, and grazing, is the key to maintaining grasslands.*

In modern grassland management, the role of prescribed burning must be part of a long-term management plan. Management decisions determine how, when, and why fire will be used. Prescribed burning influences what vegetation will be present by when it is used, how it is combined with other practices, and what use is made of the land. Managing to include fire will result in different vegetation responses under different management strategies. When multiple benefits are desired (example: livestock production and wildlife habitat), management compromises will be needed.

Benefits of Prescribed Burning

Research and experience have shown that fire can be used as a major management practice for native and introduced grasslands, hay meadows, and establishing and managing new native grass stands. It can recycle nutrients tied up in old plant growth, stimulate tillering, control many woody and herbaceous plants, improve grazing distribution, reduce wildfire hazards, improve wildlife habitat, and increase livestock production in stocker operations. To gain these benefits, fire must be used under specified conditions and with proper timing. This is termed "prescribed burning."

Timing

Timing of the burn is a critical element for obtaining the desired response. The kinds, amounts and nutritional content of various plants in a rangeland area can be changed by fire. The presence and abundance of plant species, forage yields, and range condition are all affected by the time of burning.

To control or reduce undesired plants, they should be burned at the weakest point in their growth stage. In order to damage a particular plant, burning must occur when the plant is actively growing or has buds above the soil surface, which can be destroyed. For perennial plants, the plant's food reserves should be at or near their lowest point in their annual growth cycle, so regrowth would be difficult. Perennial plants that have bud zones below the level of the fire readily resprout, normally with an increase in stem numbers. Annuals, that have their growth point above the soil surface, will be damaged or destroyed by a fire that occurs during their growth period.

Management decisions determine how, when, and why fire will be used.

Prescribed burning must be integrated into grazing management to gain the full benefits. Combining stocking rate with prescribed burning will allow the desirable vegetation to be competitive and help reduce the encroachment of many undesirable plants.

Some examples of how fire affects plants may help in understanding why timing is important. Buckbrush (coral berry) or sand plum, woody perennials, must be burned in late spring for 2 to 3 consecutive years for effective control. During late spring, both are actively growing and fire destroys the top growth. Regrowth is slow since its food reserves are low. Successive burns prevent build-up of food reserves and eventually kill the plant. Smooth sumac, another woody perennial, has a life cycle similar to warm season grasses in that it does not reach the lowest point in its food reserves until late May or June. It also doesn't begin vegetative growth as early as native grasses. Burning in late spring will kill the top growth, but results in an increase in the number of stems that resprout from below-ground buds. The net result is an accelerated increase in the size of the smooth sumac invasion area. Eastern red

cedar is readily killed by burning, especially when it is less than 5 feet in height. It does not have buds that can resprout, so when this plant is defoliated, it dies. Larger cedar trees will not be killed by fire and must be cut at ground level to be controlled.

Much the same response can be obtained with forbs. Western ragweed and western ironweed are perennial forbs, which can be reduced with two or three consecutive annual burns.

Fire also can reduce the amount of undesirable grasses. Low-producing cool-season grasses, such as Kentucky bluegrass and annual bromes, are greatly reduced by a late-spring fire. They are actively growing at the time of the burn and have difficulty re-growing after the burn.

Burning to favor desired grass plants should be done when they are just starting to green up. The native grasses should have an average of $^1/_2$ to 2 inches of new growth when they are burned. This occurs in mid to late spring. At this stage the plants are able to grow quickly. Ideally, the soil profile should have adequate water at the time of burning, and the surface should be damp. Big bluestem and Indiangrass are increased when the range is burned in late spring. In the tallgrass prairie area, the amounts of sideoats grama, blue grama, and buffalograss increase only slightly. Little bluestem and switchgrass decrease or are maintained by a late spring burn.

Recommended burning dates for native warm-season grasses for livestock production are shown in Figure 1. It should be noted that these dates may be as much as 10 days earlier or later depending on growing conditions. Cool season grasses (smooth brome or tall fescue) are normally burned in late February or March with good soil moisture.

Long-term research at Konza Prairie Natural Research Area, Kansas State University, has shown that annual spring burning over many years does not reduce overall forage yields. Repeated annual burns does result in a gradual decline in the percentage of broadleaved forbs and cool-season grasses and an increase in the percentage cover of warm-season grasses. When annually burned pastures are grazed, this shift is not as pronounced and a greater mix of various grasses and forbs is maintained. In addition, with no burning over the long term, the cover of woody plants increases by about 1 percent per year initially, but then accelerates such that prairie grasses and forbs can be completely displaced by 100 percent tree and shrub cover in less than 40 years.

With no burning over the long term, prairie grasses and forbs can be completely displaced by 100 percent tree and shrub cover in less than 40 years.

Forage Yield

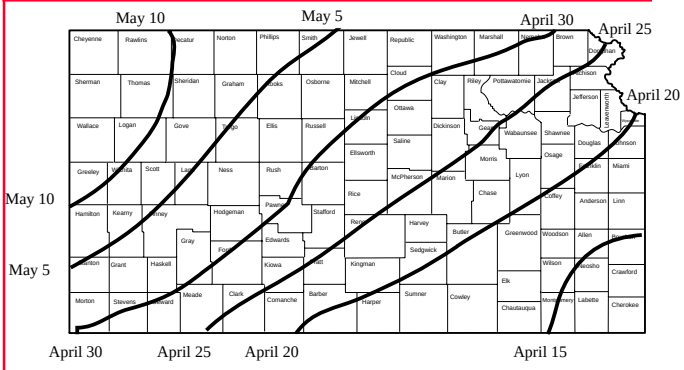


Figure 1. Approximate average vegetative green-up dates in Kansas

Forage yield is affected by the timing of the burn. Research done at Kansas State University has shown that the earlier the burning date, the lower the forage yield (Figure 2). There is no difference in forage yield between the late spring burn and unburned range.

The changes in forage yield due to the burning date are due to moisture and temperature changes. Soil moisture in early burned areas can evaporate at rates as high as one-half inch per week. Also, rainfall may not be taken into soil as readily as on the late burned or unburned areas. Soil temperature rises quickly following the burn as sunlight warms the darkened soil (old growth insulates the soil). This, along with greater sunlight reaching newly emerged shoots results in faster plant growth and greater grass tillering compared to non-burned areas. Properly timed, there is little change in soil moisture conditions, soil structure, and soil erosion due to runoff.

Grazing Distribution

Fire is an excellent management practice for improving grazing distribution. Areas that are not usually grazed or are under grazed can be burned while leaving the over-grazed areas unburned. The animals are attracted to the grasses in the burned areas since they are more accessible and palatable.

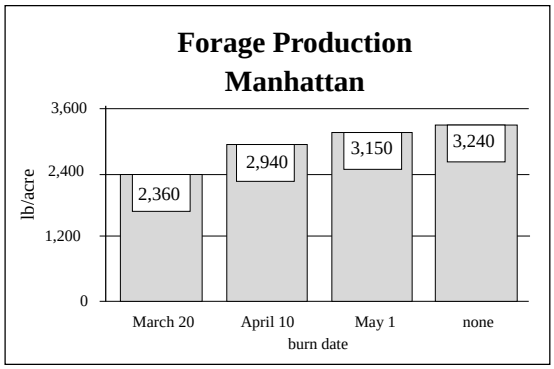


Figure 2. Average forage yield after 17 years of annual burning at the times indicated at Manhattan.

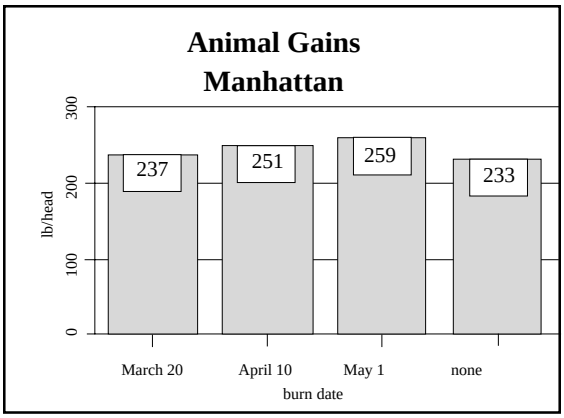


Figure 3. Average season-long stocker gains after 17 years of annual burning at the times indicated at Manhattan.

Over-grazed areas generally will not have enough fuel to carry a fire, will be used less, and can recover. By burning, the grazing pattern can be changed and even out of the grazing distribution. Prescribed burning also has great value in reducing grazing distribution problems caused by a wildfire over part of the pasture. (See *Management Following Wildfire*, L-514)

Livestock Production

Research has shown that yearling or stocker animals can gain 10 to 12 percent more on late spring burned than on either unburned or early burned pastures (Figure 3). This response is apparently due to higher quality forage being available in the first half of the grazing season. These benefits are realized only during the year of burning.

Cow-calf gains on burned pastures have not shown any significant differences from unburned. Burning is primarily done to control weeds, cool season grasses and brush, improve grazing distribution, and reduce litter buildup. The benefits of burning to the cow-calf operator are in maintaining a highly productive grassland over the long term. After 2 to 4 years without burning, excess litter and old growth can accumulate, and cool-season annuals, weeds and brush can increase, thus reducing forage production. A program of burning 2 or more consecutive years, and then waiting until needed again (approximately 2 to 4 years) is adequate to provide the above benefits.

Prescribed burning, together with herbicides and other management options, can be used to reduce these plants and maintain healthy grasslands.

Weed and Brush Management

Many grass, broadleaf, and woody species can invade and reduce forage production and availability. Prescribed burning, together with herbicides and other management options, can be used to reduce these plants and maintain healthy grasslands. However, some species are enhanced by the same burns that benefit the grasslands. Smooth sumac, a shrub, can be top-killed, but new sprouts will increase the number of stems. Other species, such as rough-leaf dogwood, can be controlled, but only through long-term annual burning. Shrubs, such as buckbrush and sand plum, can be controlled with two annual burns, and then waiting 2 to 4 years before repeating.

Broadleaf species, such as ironweed, can be controlled with two annual burns with a 2- to 4-year wait before burning again. Broadleaf species, such as western ragweed, respond to burning similarly, but also are utilized by grazing livestock particularly during the May to June period. Musk thistle, a noxious weed, is not controlled by burning, but is reduced by a healthy, competitive grass stand.

For weed and brush control recommendations, see *Chemical Weed Control for Field Crops, Pastures, Rangeland and Noncropland* issued each January by the Kansas Agricultural Experiment Station.

Native Hay Meadows

Prescribed burning should be used on native hay meadows to stimulate tillering of desirable species, control weeds and brush, and remove old mulch left by haying. Timing of the burn is the same as native grass pastures. A program of burning 2 or more consecutive years, then waiting 2 to 4 years until needed again may be used to provide the needed benefits.

Wildlife

The habitat for any wildlife species must provide **cover, food, water, and space**. Cover is needed for protection from weather and predators. Space is needed for food and water plus breeding and rearing young. A mixture of different vegetation types (grass, broadleaf, and woody) may be needed to meet the habitat requirements. Fire, together with other management practices, can be used to provide these basic components.

Native wildlife of the Kansas prairies evolved with the grassland. Fire was a critical factor in wildlife habitat development. Properly used, prescribed burning can be used to increase desirable warm season grasses and forbs for food supply, nesting, and brood rearing cover for ground dwelling birds. Early spring burns are preferred over those for livestock production for maximum wildlife benefits. In addition, removal of excess litter improves access to insects, while increasing mobility and brood survival of the birds. Prescribed burning also benefits some wildlife by controlling woody vegetation. Prairie chicken populations will decline if woody vegetation becomes too dominant. Prairie chicken booming grounds may be abandoned when vegetation from the previous year is so dense or tall that courtship activities are inhibited. Bobwhite quail show remarkable responses to fire management. Feeding, roosting and travel are enhanced for quail on newly burned ranges. Burns that are 1- and 2-years-old provide greater amounts of quail food than older burns. Burning pastures in a rotation within a grazing unit will result in more diverse vegetation so birds will have suitable areas for nesting, brood rearing and winter cover. Maintaining some unburned areas each year provides habitat for many fire sensitive plants and animals.

Prescribed burning should be used on native hay meadows to stimulate tillering of desirable species, control weeds and brush, and remove old mulch left by haying.

Big game habitat can be changed with burning by changing the quality of the food resources, changing the structure of the plant canopy, and changing the chemical and botanical composition of the plant communities. Selection of habitats and foods by wildlife depends on several factors including food biomass and nutritional quality. Responses to fire by big game populations depend on what habitat factor was limiting that population size, the rate of vegetation change, and the habitat requirements of that particular wildlife species. If prescribed burning enhances that limiting factor, it will improve local wildlife populations.

Native Grass Seedings

Experience from the Conservation Reserve Program has shown that prescribed burning can be used to hasten the development of newly seeded native grasses. As early as the spring after the seeding year, burning can stimulate tillering, control annual weeds, and remove accumulated mulch. Care should be exercised that soil moisture is adequate to assure regrowth after the burn.

Wildfire Hazard Reduction

Reducing the wildfire hazard with fire may seem unusual. In years of high precipitation or under light use, large amounts of old growth can accumulate. This litter provides ideal conditions for wildfires to occur during dry periods. Wildfires that occur under high winds and low humidity may burn over these areas with unusual results. As the headfire burns through, the heavy fuel load creates a hot fire that is difficult to control. If there are heavy amounts of litter on the soil surface, the litter burns slower and may create a large burning area behind the headfire. Wildfires under these conditions are extremely dangerous and difficult to control. Litter fires can be damaging to plant crowns as well.

Burning in late spring to remove the buildup of old growth and/or litter will reduce the possibility of large and extremely hot, damaging wildfires. Wildfires occurring in grasslands that are routinely burned are easier to control and less damaging to plants.

Effect on Soil Conditions

When a fire is properly timed, there is little change in the soil moisture conditions. The earlier the burn, the greater the loss of moisture. The burned soil surface readily absorbs heat so that evaporation rates are greatly increased.

Soil moisture should be considered in the timing consideration. Table 1 defines the preferred soil moisture conditions for a successful burn.

Rangeland burned too early will have high evaporation rates. When bare soil with little or no plant or mulch cover is exposed to the action of rain, the surface structure of the soil may be destroyed. This makes it more difficult for water to get below the soil's surface layer. The longer the time between the burning date and when desired perennial plants start to green up, the greater the problem. The result is reduced forage growth due to less soil moisture being available for plant growth.

Properly timed burns are done when the warm season perennials are starting to green up. This allows them to grow quickly so the bare soil surface will only be exposed for a short period of time. This reduces the erosion hazard, reduces evaporation, and allows water to penetrate the soil.

Air Quality

The smoke from a range fire causes little long-term detrimental effects to air quality. In fact, there is no known permanent environmental damage. However, short-term exposure to smoke can cause debilitating health effects to individuals with respiratory conditions such as asthma, emphysema, or cardiovascular diseases. Consideration must be given to the effect of smoke moving down wind. Also, safety must be considered for public roads and airports to avoid creating hazards down wind. The wind conditions should be stable with a speed of 5 to 15 mph to help disperse the smoke quickly. The amount and type of fuel present, the fuel moisture content, and the fire spreading rate will determine the amount of smoke produced.

Prescribed burning is an excellent management practice for grassland.

For more information on proper prescribed burning safety and techniques, see *Prescribed Burning Safety* (L-565) and *Prescribed Burning Planning and Conducting* (L-664) available from local County Extension Offices.

Summary

Prescribed burning is an excellent management practice for grassland. Properly used, it can be a cost effective method for increasing the productivity of rangeland as well as controlling many undesirable plants. It also can reduce the hazards of wildfires and benefit domestic livestock and wildlife. Safety of people on and around the burn as well as public roads and airports must be considered.

Table 1. *Preferred soil moisture and surface moisture conditions to ensure a proper burn on grass stands based on location or soil characteristics.*

Location or soil conditions	Soil moisture[1]	Surface moisture[2]
Eastern Kansas	enough to assure growth to cover the soil surface after burn	damp
Central Kansas	moisture to major rooting depth	damp
Western Kansas	moisture to full rooting depth	damp
sandy soils	moisture to full rooting depth	damp to moist
sub-irrigated soils	enough to assure growth to cover the soil surface	damp

[1] Rooting depth varies with soils. Normally, the rooting depth should be considered as either the soil depth to an impervious layer that restricts root growth or the soil depth to which heavy root growth penetrates.

[2] Damp = wet to touch but no free water. Moist = excess water when soil squeezed in hand.

Effect of Prescribed Burn Timing on Both Grasses and Undesirable Plants

Walt Fick, Kansas State University

Cool-season pastures, such as tall fescue and smooth bromegrass, are normally burned in late February or March, if soil moisture is good. If the grass is green and starting to grow, producers could start burning cool-season pastures by mid-February. Cool-season grasses should have about 1 to 2 inches of new growth before burning. At this stage, the plants are able to regrow quickly.

There is no agronomic reason to delay the prescribed burn until later in February or March if the grass is already growing. If the weather suddenly turns extremely cold shortly after a cool-season pasture is burned, that does not predispose the plants to more severe winterkill injury. However, cold temperatures may delay growth. Warmer soil temperatures following burning due to removal of protective insulation usually results in more rapid growth and earlier maturity. The key reasons for burning cool-season pasture are to remove heavy accumulations of mulch or old growth, annual grass control, and to control eastern redcedar.

Warm-season range grasses will not start growing until later in the spring, regardless of how warm the winter temperatures are. The time to burn native warm-season grasses depends upon your goals. Increased livestock gains and brush control are normally enhanced by burning in the mid- to late-spring when the native grasses have an average of ½ to 2 inches of new growth. This usually occurs by mid- to late-April in the Flint Hills region, and early-May in northwest Kansas. Ideal dates may be shifted as much as 10 days earlier or later, depending on temperatures. Ideally, the soil profile should have adequate water at the time of burning and the surface should be damp.

Other reasons for burning include improved livestock distribution, wildlife habitat enhancement, maintenance of CRP stands, and conservation of native plant communities. Timing for these purposes is more flexible and can be done earlier. CRP spring burning for most soils can be done between February 1 and April 15 or April 30, depending on your location in the state. Summer buns can be conducted between July 16 and August 31. Always contact your local FSA office for rule updates prior to planning a burn.

Timing of the prescribed burn will affect species composition on grazed rangeland. Big bluestem, indiangrass, and switchgrass basal cover increase when the range is burned in late spring compared to unburned sites. The basal cover of little bluestem is normally maintained by late-spring burning. In the tallgrass prairie area, late spring burning will generally maintain sideoats grama and buffalograss, but increase the basal cover of blue grama. Kentucky bluegrass seems to be decreased by burning at any time of the year.

On grazed tallgrass rangeland early burning reduces forage yield. There is no difference in forage yield between a late-spring burn and unburned range. Long-term research on the Aldous Burn Plots near Manhattan has shown that annual burning on tallgrass ungrazed prairie in late spring over many years does not reduce overall forage yields. Repeated annual burning does result in a gradual decline in the percentage of broadleaf forbs and cool-season grasses (in a warm-season grassland), and an increase in the percentage cover of warm-season grasses. When annually burned rangelands are grazed, this shift is not as pronounced and a greater mix of various grasses and forbs is maintained.

With no burning over the long term, the cover of woody plants increases by about one percent per year initially, but then accelerates such that prairie grasses and forbs can be completely displaced by 100 percent tree and shrub cover in less than 40 years.

The effect of burning on undesirable woody plants and forbs will vary, depending on the growth habit. In general, plants are more easily killed by burning when their growing points are aboveground, are unable to resprout from belowground, and their food reserves are at the lowest point.

Burning readily kills eastern red cedar, especially when it is less than 5 feet in height. It does not have buds that can resprout, so when this plant is defoliated, it dies. Larger cedar trees will generally not be killed by fire and must be cut at ground level to be controlled. Buckbrush (coral berry) or sand plum must be burned in late spring for 2 to 3 consecutive years for effective control. During late spring, these plants are actively growing and fire destroys the topgrowth. Regrowth is slow since its food reserves are low. Successive burns prevent buildup of food reserves and eventually kill the plant. Western ragweed and western ironweed are perennial forbs, which can also be reduced with 2 or 3 consecutive late-spring burns.

Smooth sumac has a life cycle similar to warm-season grasses in that it doesn't reach the lowest point in its food reserves until late May or June. Burning in late spring will kill the topgrowth, but results in an increase in the number of stems that resprout from belowground buds. The net result is that smooth sumac will actually spread more rapidly as a result of late-spring burning.

Burning for Stocker Operations in the Kansas Flint Hills

Clenton Owensby, Kansas State University

In order to realize the greatest net return from grazing stockers in the Kansas Flint Hills, the rangeland should be burned annually at the beginning of growth of the dominant warm-season perennial grasses, with big bluestem being the species to use in making the time of burning decision. By burning at that time the stockers will gain on average 32 pounds more than from unburned range. That increase in gain comes during the first half of the growing season. Therefore, there is no difference in the increased gain for stockers under season-long (SLS) and intensive early stocking (IES). Burning at dates earlier that that will not give the maximum increase in gain. For instance, burning 5-6 weeks earlier than the beginning of growth of big bluestem will result in no increase in gain compared to unburned range. The increased gain from burning at the proper time is only realized in the year that the burning occurs. There is no carryover effect into the following year on livestock gain. Areas burned at the beginning of growth of big bluestem will have sustained biomass production and have a botanical composition that fosters maintenance of the prairie with no invasion my woody plants.

One major impact of IES vs. SLS lies in the increased amount of the area burned on IES pastures compared to SLS. The lack of grazing in the latter half of the season provides a continuous fuel source for burning compared to SLS which has a patchy fuel source and a lower percentage of the area burned. The total amount of biomass at season's end is slightly higher on the IES pastures as well.

Burning for Cow/Calf Operations in the Kansas Flint Hills

For spring-calving herds, there is no apparent benefit for improved calf gains, primarily because they are usually not relying on forage as their primary food source during the period when forage quality is enhanced by burning. However, fall-calving operations will benefit from annual burning if weaning occurs after July 1. Therefore, the economic incentive for increased livestock performance does not typically exist for spring-calving operations, but does exist for fall-calving operations. Maintenance of a quality grassland requires that burning occur in cow/calf operations for a period of 3-4 consecutive years of burning to reduce any invasion of undesirable plants that has occurred since the last burning. Almost all woody species resprout following topkill by fire and it takes 3-4 consecutive years of burning to eliminate them. The burning must occur at the beginning of growth of big bluestem which coincides with the low point in the food reserves of the woody species. Burning at earlier dates actually increases the number of stems of sprouting species. Some species, most notably smooth sumac, are not killed by fire in the late spring because their food reserves are not at their low point. However, the fire keeps the plants in a juvenile state and reduces the impact on forage production associated with older closed canopy stands of woody species.

Burning Conservation Reserve Areas in the Kansas Flint Hills

Unless invaded by woody species or undesirable dicots, burning of CRP lands can occur at any time in the spring. Fire or other litter removal operations are necessary for maintenance of a CRP grassland. If litter is not removed, the stand does not thicken up and protect against erosion between the grass clumps. Fire should occur once every 2-3 years.

Control of Japanese Brome with Prescribed Fire

Keith Harmoney, Kansas State University

Grazing and spring burning, alone and in combination, can reduce Japanese brome densities. However, Japanese brome is likely to persist in the stand. In a 5-year study near Hays, Kansas, final Japanese brome densities after burning and grazing were similar to initial conditions, but were much lower than if not burned or grazed. Burning removes the litter layer, leaving the soil surface less ideal for Japanese brome germination and survival. There was no reduction in native vegetation yields after 5 years of annual spring burning on this lowland range site; however, the percent composition of western wheatgrass in the stand did decline with intense early spring grazing.

Previous studies have shown native vegetation yield decreases on nearby upland range sites when burned by a very early spring wildfire or after 3 consecutive years of annual spring burning.

Prescribed Burning Regulations, Notification and Permits

Many counties in Kansas require permits and notification prior to igniting a prescribed burn. Permit and notification regulations vary widely between counties and even fire districts, and only a few generalizations can be made.

State regulations for agricultural prescribed burning are detailed in the Kansas Air Quality Regulation (K.A.R.) 28-19-648. Unless otherwise specified by a county, the absolute minimum requirement is to notify the local fire control authority prior to ignition. If there is likelihood that smoke will affect visibility on a roadway or at an airport, local law enforcement and airport authorities, respectively, must be notified before burning.

Counties frequently have additional regulations covering prescribed burning which can be obtained from local emergency managers and fire departments. These local regulations can range from requiring a simple report of the number of acres burned to mandatory requirements for equipment, water and crew.

Some counties require that a formal burn plan with a map of the site to be burned be provided to the fire department prior to the burn date. This plan describes the parcel being burnt and identifies the location of the fire lines. The map shows the burn location and the layout of roads leading to the burn site. This will decrease response time in case of an escape, and also provides the dispatcher with contact information for the prescribed burn boss to facilitate communication.

Almost all counties in Kansas require notification immediately before starting a fire so that emergency personnel are not called out needlessly. Passing travelers and others will call in a fire when they see flames or smoke. If the dispatcher is unaware that a fire is a prescribed burn, emergency personnel will be dispatched under the assumption that it is a wildfire. Failure to notify the dispatcher of an impending prescribed burn shows a lack of courtesy to fire department volunteers, who leave their jobs and may lose pay in order to respond to a false alarm of wildfire.

If notification of the intent to burn is not called in immediately prior to beginning ignition and the fire escapes or is mistakenly identified as a wildfire and results in fire personnel being dispatched to the burn site, several negative consequences can ensue. When fire crews arrive, they may put out the fire and not allow re-ignition for the remainder of the day. This will delay the completion of the burn and require re-assembling crew and equipment at a later date to complete the burn. In some counties, the person conducting the burn will be charged fees associated with the fire crew response, including fire truck mileage and the lost wages of volunteer fire crew members. At the very least, failure to report a prescribed burn will unfavorably reflect upon the burn boss and on local prescribed burning activity.

Immediately following completion of a burn, it is also a courtesy and safety consideration to call the dispatcher and state that the burn is completed. This allows the fire department to track the number of fires still burning in the county. If a fire should reignite from

embers after the burn is completed and begin to spread, it can be more rapidly determined that it is a wildfire and needs suppression.

Prescribed burn permits issued by local jurisdictions can be permission to either conduct a prescribed burn during some specified period or to start ignition at a particular date and time. Counties may require neither, either, or both types of permits. Advance permits are generally obtained from the fire department dispatcher. These can be for a specified prescribed burn or for a period of time, such as a year.

Some counties require a verbal permit from the dispatcher just prior to fire ignition. If many people are burning at once, the potential need to respond to multiple fire escapes could overextend fire department resources. To avoid this situation, a fire department may not allow additional fires to be lit until some burns are completed.

Burns planned in counties designated in the Kansas Flint Hills Smoke Management Plan should include consideration of smoke model forecasts prior to burning. Local jurisdictions may choose not to permit burning on days when smoke is likely to cause air quality non-attainment in urban areas. Additionally, producers are asked to voluntarily refrain from burning on days when smoke could have large impacts on air quality. To view smoke model forecasts for a specific burn location, consult the smoke management website at www.ksfire.org.

Some counties require proof of prescribed burning training prior to issuing a permit to burn. Check with the dispatcher to determine what is needed so that training requirements can be completed ahead of the burn season.

Clarification of Regulations for Open Burning

This is to clarify the provisions of section 28-19-647 (e) of the Kanas Regulations for Open Burning.

These provisions apply only to open burning activities that require approval from the Kansas Department of Health and Environment, such as city/and or county tree and brush burning sites. They do not apply to agricultural burning activities, such as rangeland and CRP burning.

Although the section (e) regulations don't apply to agricultural burning, they are still highly recommended practices. They address safety, smoke and pollution issues that should be of equal concern to those burning agricultural land.

Miles Stotts, KDHE Bureau of Air
24 March 2011

AGRICULTURAL OPEN BURNING
28-19-648.

(a) Open burning of vegetation such as grass, woody species, crop residue, and other dry plant growth for the purpose of crop, range, pasture, wildlife or watershed management shall be exempt from the prohibition on the open burning of any materials imposed by K.A.R. 28-19-645, provided that the following conditions are met:

(1) the person conducting the burn shall notify the local fire control authority with jurisdiction over the area before the burning begins, unless the appropriate local governing body has established a policy that notification is not required;

(2) a person shall not conduct a burn that creates a traffic safety hazard. If conditions exist that may result in smoke blowing toward a public roadway, the person conducting the burn shall give adequate notification to the highway patrol, sheriff's office or other appropriate state or local traffic control authorities before burning;

(3) a person shall not conduct a burn that creates an airport safety hazard. If smoke may affect visibility at an airport, the person conducting the burn shall give adequate notification to the appropriate airport authorities before burning; and

(4) the person conducting the burn shall insure that the burning is supervised until the fire is extinguished.

(b) Nothing in this regulation shall restrict the authority of local jurisdictions to adopt more restrictive ordinances or resolutions governing agricultural open burning operations.
Authorized by K.S.A. 1994 Supp. 65-3005; implementing K.S.A. 1994 Supp. 65-3005, K.S.A. 65-3010; effective March 1, 1996.)

KANSAS STATE REGULATIONS FOR OPEN BURNING
Kansas Dept. of Health and Environment

28-19-645. Open burning prohibited.
A person shall not cause or permit the open burning of any wastes, structures, vegetation, or any other materials on any premises except as authorized by K.A.R. 28-19-647 and K.A.R. 28-19-648. (Authorized by K.S.A. 1994 Supp. 65-3005; implementing K.S.A. 1994 Supp. 65-3005, K.S.A. 65-3010; effective March 1, 1996.)

April Burning Restrictions
28-19-645a. Restrictions on open burning operations that supersede the provisions of K.A.R. 28-19-645 for certain counties during the month of April.

(a) A person shall not cause or permit open burning operations of any waste, including vegetation and wood waste, structures, or any other materials on any premises during the month of April in Butler, Chase, Chautauqua, Cowley, Elk, Geary, Greenwood, Johnson, Lyon, Marion, Morris, Pottawatomie, Riley, Sedgwick, Wabaunsee, and Wyandotte counties, except as authorized by subsections (b) through (d).

(b) The following activities shall be exempt from the prohibition in subsection (a):

(1) Open burning operations for the purpose of range or pasture management and conservation reserve program (CRP) burning activities meeting the requirements in K.A.R. 28-19-648 (a)(1) through (a)(4); and

(2) open burning operations listed in K.A.R. 28-19-647 (a)(1) and (a)(2).

(c) A person may obtain approval by the secretary to conduct an open burning operation that is not otherwise exempt if the conditions and requirements of the following are met:
(1) K.A.R. 28-19-647 (b)(1) through (b)(3); and
(2) K.A.R. 28-19-647 (d) and (e).

(d) Open burning operations that shall require approval by the secretary and are deemed necessary and in the public interest shall include the open burning operations listed in K.A.R. 28-19-647 (c)(1) through (c)(3).

(e) In Johnson, Wyandotte, and Sedgwick counties, the open burning operations listed in K.A.R. 28-19-647 (c)(4) and (c)(5) shall require approval by the local authority.

(f) Nothing in this regulation shall restrict the authority of local jurisdictions to adopt more restrictive ordinances or resolutions governing agricultural open burning operations. (Authorized by K.S.A. 2010 Supp.65-3005; implementing K.S.A. 2010 Supp. 65-3005 and K.S.A. 65-3010; effective, T-28-3-1-11, Mar. 1, 2011.)

28-19-646. Responsibility for open burning.
It shall be prima facie evidence that the person who owns or controls property on which open burning occurs has caused or permitted the open burning. (Authorized by K.S.A. 1994 Supp. 65-3005; implementing K.S.A. 1994 Supp. 65-3005, K.S.A. 65-3010; effective March 1, 1996.)

28-19-647. Exceptions to prohibition on open burning.
(a) The following open burning operations shall be exempt from the prohibition on the open burning of any materials imposed by K.A.R. 28-19-645:

(1) open burning carried out on a residential premise containing five or less dwelling units and incidental to the normal habitation of the dwelling units, unless prohibited by any local authority with jurisdiction over the premises;

(2) open burning for cooking or ceremonial purposes, on public or private lands regularly used for recreational purposes;

(3) open burning for the purpose of crop, range, pasture, wildlife or watershed management in accordance with K.A.R. 28-19-648; or

(4) open burning approved by the department pursuant to paragraph (b).

(b) A person may obtain an approval from the department to conduct an open burning operation that is not

otherwise exempt from the prohibition imposed by K.A.R. 28-19-645 if it is demonstrated that the open burning is:

(1) necessary, which in the case of burning for the purpose of disposal of any materials, shall mean that there is no other practical means of disposal;

(2) in the public interest; and

(3) is not prohibited by any local government or local fire authority.

(c) Open burning operations for which an approval is required but which are deemed to be necessary and in the public interest include the following:

(1) the use of safety flares for disposal of flammable gases;

(2) fires related to the training of government or industrial personnel in fire fighting procedures;

(3) fires set for the removal of dangerous or hazardous liquid materials;

(4) open burning of trees and brush from non-agricultural land clearing operations; and

(5) open burning of clean wood waste from construction projects carried out at the construction site.

(d) Each person seeking an approval to conduct an open burning operation pursuant to this regulation shall submit a written request to the department containing the following information:

(1) the location of the proposed open burning and the name, address and telephone number of the person responsible for the open burning;

(2) a description of the open burning including:
   a. the estimated amount and nature of material to be burned;
   b. the proposed frequency, duration and schedule of the burning;
   c. the size of the area to which the burning will be confined;
   d. the method of igniting the material;
   e. the location of any public roadways within 1,000 feet of the proposed burn;
   f. the number of occupied dwellings within 1,000 feet of the proposed burn; and
   g. evidence that the open burning has been approved by appropriate fire control authority having jurisdiction over the area; and

(3) the reason why the proposed open burning is necessary and in the public interest if the activity is not listed in subsection (c) of this regulation.

(e) Each open burning operation for which the department issues an approval pursuant to paragraph (b) shall be subject to the following conditions, except as provided in paragraph (f):

(1) The person conducting the burning shall stockpile the material to be burned, dry it to the extent possible before it is burned, and assure that it is free of matter that will inhibit good combustion.

(2) A person shall not burn heavy smoke-producing materials including heavy oils, tires, and tarpaper.

(3) A person shall not initiate burning during the nighttime, which for the purposes of this regulation is defined as the period from two hours before sunset until one hour after sunrise. A person shall not add material to a fire after two hours before sunset.

(4) A person shall not burn during inclement or foggy conditions or on very cloudy days, which are defined as days with more than 0.7 cloud cover and with a ceiling of less than 2,000 feet.

(5) A person shall not burn during periods when surface wind speed is less than 5 mph or more than 15 mph.

(6) A person shall not burn within 1,000 feet of any occupied dwelling, unless the occupant of that dwelling has been notified before the burn.

(7) A person shall not conduct a burn that creates a traffic or other safety hazard. If burning is to take place within 1,000 feet of a roadway, the person conducting the burn shall notify the highway patrol, sheriff's office, or other appropriate state or local traffic authority before the burning begins. If burning is to take place within one mile of an airport, the person conducting the burn shall notify the airport authority before the burning begins.

(8) The person conducting the burn shall insure that the burning is supervised until the fire is extinguished.

(9) The department may revoke any approval upon 30 days notice.

(10) A person shall conduct an open burning operation under such additional conditions as the department may deem necessary to prevent emissions which:
   a. may be injurious to human health, animal or plant life, or property; or
   b. may unreasonably interfere with the enjoyment of life or property.

(f) The department may issue an approval for an open burning operation that does not meet the conditions set forth in subsection (e) upon a clear demonstration that the proposed burning:

(1) is necessary and in the public interest;

(2) can be conducted in a manner that will not result in emissions which:
   - may be injurious to human health, animal or plant life, or property; or
   - may unreasonably interfere with the enjoyment of life or property; and

(3) will be conducted in accordance with such conditions as the department deems necessary.

(Authorized by K.S.A. 1994 Supp. 65-3005; implementing K.S.A. 1994 Supp. 65-3005, K.S.A. 65-3010; effective March 1, 1996.)

April Burning Restrictions – Frequently Asked Questions

1. Is crop residue burning allowed in April?
No, crop residue burning is restricted for the 16 counties specified in the April Burning Restrictions of K.A.R. 28-19-645a (13 in Flint Hills + Johnson, Sedgwick & Wyandotte). Burning of the tall grass prairie is not considered crop residue burning.

2. Is burning yard waste allowed at an individual residence during April?
Yes, unless restricted by a local ordinance.

3. Are residential trash burn barrels allowed?
Yes, unless restricted by a local ordinance.

4. Are fire fighter training burns allowed?
Yes, with approval from KDHE. However, it is appropriate to request fire training be scheduled outside of the month of April in the affected counties.

5. Are camp fires and bonfires allowed in April?
Yes, open burning for cooking or ceremonial purposes, on public or private lands regularly used for recreational purposes.

6. Is open burning for land clearing and construction projects allowed in April?
Not in the 13 Flint Hills Counties. In Johnson, Wyandotte and Sedgwick counties, the local authority can approve burning of trees and brush from nonagricultural land clearing and clean wood waste at the construction site; all other open burning in these counties must be approved by KDHE. In the rest of the state, KDHE must approve this burning unless local ordinance is more stringent. It is our intent to discourage nonagricultural burning during the month of April.

7. Are air curtain destructors / incinerators allowed to operate in April?
Yes. ACDs are permitted by KDHE as a special type of incinerator.

8. Is the local permitted open burn site allowed to burn in April?
No, unless KDHE issues a special circumstances or emergency approval specifically for April. Otherwise, all local permitted open burn sites are discouraged from open burning during the month of April, even if a permit had been previously issued. The success of the Flint Hills Smoke Management Plan is contingent on all parties cooperating to reduce smoke impacts

9. What is an example of open burning that might be "deemed to be necessary and in the public interest"?
Fires set to remove dangerous or hazardous liquid materials, debris from an ice storm or a tornado (where landfilling is not feasible) or storage capacity after ice storms or tornados is not sufficient to wait until May or later.

10. If there are severe storms, can the collected debris be burned?
Yes, with approval from the local authority in Johnson, Sedgwick or Wyandotte counties, or with KDHE approval elsewhere.

April Burning Restrictions – Frequently Asked Questions

11. What agencies and offices are involved in regulating open burning?
a. Local fire, emergency response and law enforcement, depending on local ordinance.
b. The six KDHE District Offices
c. The Compliance Section of the Bureau of Air at KDHE in Topeka. Page 2 of 2

12. Where is the first place a person should call with questions concerning open burning?
The local fire department or law enforcement authority. Next, our KDHE District Office.

13. Which agency has the final authority on regulating open burning?
In most cases, the local fire department if they are more stringent. If local requirements are less stringent than KDHE, the state agency has authority.

14. Can a local fire chief override the April Burning Restrictions of K.A.R. 28-19-645a if requested by a local resident or business?
Yes, if local ordinance is *more stringent.* No when the purpose of the override is to allow something prohibited under state regulation.

15. How will the April Burn Restrictions be enforced?
KDHE intends to utilize compliance assistance and public education to get the word out. If there are extenuating circumstances in a particular situation, KDHE may utilize their enforcement authority to address an egregious problem.
If you have additional questions, please contact Russ Brichacek (785-296-1544) or Miles Stotts (785-296-1615).

Weather Conditions for Prescribed Burning

Few factors are as important as weather when conducting a prescribed burn. Weather affects the speed and direction of the fire, the intensity with which fuels burn, the predictability of fire movement, and smoke dispersion. Correct weather conditions are critical to conducting a safe burn with minimal chances of fire escape and crew injury.

Ideal Prescribed Burning Weather Conditions

Wind speed	5-12 mph.
Wind direction	steady, away from sensitive areas.
Mixing height	1800 ft. or higher.
Transport wind speed	8-20 mph throughout the mixing height.
Relative humidity	40-70%; no less than 30% ; 30-55% for optimal smoke management.
Temperature	55˚-80˚ F, ± 5˚; lower temperatures are associated with less ozone formation.
Cloud cover	clear to 70% cover; 30-50% cloud cover in both the smoke generating areas and the urban areas of concern are optimal for smoke management.

Effects of Weather on Fire

It is extremely important to have the best, most up-to- date weather information available when planning a prescribed burn. Weather factors can make a fire ineffective, difficult to control, or behave in unpredictable ways. Understanding how weather factors influence fire behavior can increase your ability to predict fire direction, behavior, and rate of travel, which will reduce the risk of wildfire and increase burn crew safety.

There are relatively few days during the late dormant season prescribed burning period when ideal weather conditions are present (Table 1). Depending on management goals, prescribed burning later in the summer may provide a longer window of opportunity for burning.

Average Number of Acceptable Burning Days [Weather]

	Tallgrass	Midgrass	Shortgrass
January	12[1]	15	14
February	14	14	10
March	14	13	8
April 1-20	11	9	6[2]

Note: Limiting factor was high winds except for [1] low temperature and [2] low humidity.

Source: Roberts, K., D. Engle, and J. Weir. 1999. Weather Constraints to Scheduling Prescribed Burns. Rangelands 21(6):6-7. Data from Oklahoma.

Humidity. Humidity generally moves in a cycle through the day. Highest humidity is generally in the morning, and declines as the sun warms the atmosphere. By evening, humidity begins to rise again. This typical cycle can be influenced by fronts, precipitation, or other weather events. Selecting a day when humidity is forecast to follow the typical cyclical pattern will allow better prediction of fire behavior.

Humidity can change very rapidly. Check the humidity on site before beginning ignition, and re-check periodically during the burn. Fire behavior is greatly affected by humidity.

Fuels vary in their response to humidity. Coarse fuels, such as cow patties, wood, and hay bales change their internal humidity comparatively slowly. Fine fuels, such as grass and crop residue, change very rapidly with changing air humidity. Fine fuels will be most affected by the daily humidity patterns and related changes in fire behavior.

Low humidity is associated with more rapidly igniting fuels and faster fire spread. Lower humidity is frequently accompanied by higher temperatures; the combination magnifies changes in fire behavior.

Extremely low humidity (below 20%) can cause erratic fire behavior. **Do not burn under these conditions.** A fire feature, a fire whirl, can form in low humidity situations. Fire whirls can be described as small tornados of fire. The rapidly whirling air can move any direction, carrying the fire across firebreaks to unexpected places. The upward draft scatters embers in all directions, which can start spot fires outside the firebreak. This is a dangerous situation, with potential for the burn crew to be caught in front of a fire moving from an unexpected direction.

Fire whirls can form at other times and in other situations (especially near locations where the fire is forced into a corner or narrow passage), but low humidity by itself can be enough to create favorable conditions for fire whirl formation.

High humidity fuel conditions occur after rain, heavy dews or when grass has started growing in the spring. Summer burns, unlike dormant season burns, frequently have high-humidity fuels regardless of air humidity because actively growing grass contains a much higher percentage of water than dormant vegetation. Thus, despite other conditions such as high temperatures which would typically make fires more erratic, summer fires tend to be safer because the green vegetation burns much more slowly.

Temperature. Low temperatures affect fire behavior by slowing ignition, resulting in a slower moving fire. Low temperatures delay evaporation of dew in the morning, resulting in fuels remaining wetter longer. Burning at low temperatures (around or below freezing) can cause problems with water lines and nozzles freezing.

High temperatures will result in the rapid drying of fuel in the morning as the dew evaporates. As temperatures climb during the day, fire behavior becomes more intense. Equipment can overheat and break down. Avoid burning when temperatures are above 100 degrees. This rarely occurs during dormant season burns, but can become a factor when prescribed burns are conducted during the summer.

Humans work well in temperatures that are good for prescribed burning. At high temperatures (above 80 degrees), the burn crew can become overheated and dehydrated as the fire increases the ambient temperature. More rest and water breaks will be needed.

Wind. Wind determines the overall direction of a fire. Fires burn fairly slowly at very low wind speeds (below 5 mph), but often move erratically as wind direction is likely to shift multiple times, reducing the ability to predict fire direction. Brief windless periods can cause the fire to be moved more by the fuel characteristics (type, amount, and continuity) than the wind direction. This can lead to a dangerous situation where the fire direction changes unexpectedly.

The most prevalent wind direction in western Kansas is from the southwest, and a southwest wind is common elsewhere in the state. Most years it will be easiest to find days to burn if you need a southwest wind rather than one from a different direction. South and northwest are the next most prevalent wind directions. Wind direction will almost always change slightly during a burn. Subtle changes in wind direction can be easily detected by tying a few inches of flagging tape to vehicle aerials and noting the direction the tape is floating.

Wind supplies oxygen to a fire, causing it to burn more rapidly as wind speed increases. High winds increase the forward speed of the fire as flames bend over the fuel in front of them, drying and heating the fuel so that it ignites more easily. Heat intensity increases as wind speed increases. Because undesirable brush and woody species are damaged more by hot fires, burns conducted to control these species need to be burned at the upper end of the prescribed wind range. Burning at wind speeds that are too high can cause a prescribed burn to escape and become a wildfire.

Wind transports smoke and embers. The chance of spot fires increases as wind speeds increase, with wind-blown embers igniting fuels ahead of the main fire line or across the fire break. Formation of spot fires is enhanced by gusty winds and low humidity. Gusty winds, with sudden bursts of increased wind speed, increase the chances that embers will be carried in unexpected directions and distances and also increase the chance of fire whirl formation. It is not recommended that prescribed burning be conducted during periods of gusty winds.

Wind can move smoke across a roads and highways, resulting in low drive visibility for drivers. Smoke from Kansas prescribed fires have resulted in fatal car crashes. Carefully consider the direction smoke will be traveling during the burn, taking into account any predicted wind shifts. If smoke potentially or actually affects traffic, notify the regional Kansas Department of Transportation and local law enforcement officials to assist with traffic control or request a permit to post warning signs along the road. Localized smoke problems are greatest when wind speeds and mixing heights are low, or air becomes still following a fire. Smoke can also rise and be carried by transport winds many miles away from the site of the fire, causing air quality problems downwind. Check mixing height and transport wind direction prior to burning to minimize impact of your fire on urban air quality.

Other weather factors. Cloud cover affects fire intensity and smoke dispersal. Cloud cover in excess of 70% can keep smoke from rising and cause visibility problems. Clouds block solar radiation, keeping fuel temperatures cooler and slowing ignition. Clouds can also signify that precipitation is imminent, or that a weather change is developing.

Precipitation immediately prior to a burn can cause damp soils, high humidity, and wet fuels, resulting in fuels ignite slowly or not at all. Damp conditions can result in patchy, smoky burns that may self-extinguish. Vehicle movement is hampered by mud and standing water, and getting stuck puts the vehicle at risk of fire damage. Precipitation immediately following a fire can be beneficial in extinguishing smoldering fuels; however, Kansas thunderstorms are frequently accompanied by strong winds, which may reignite fire from embers.

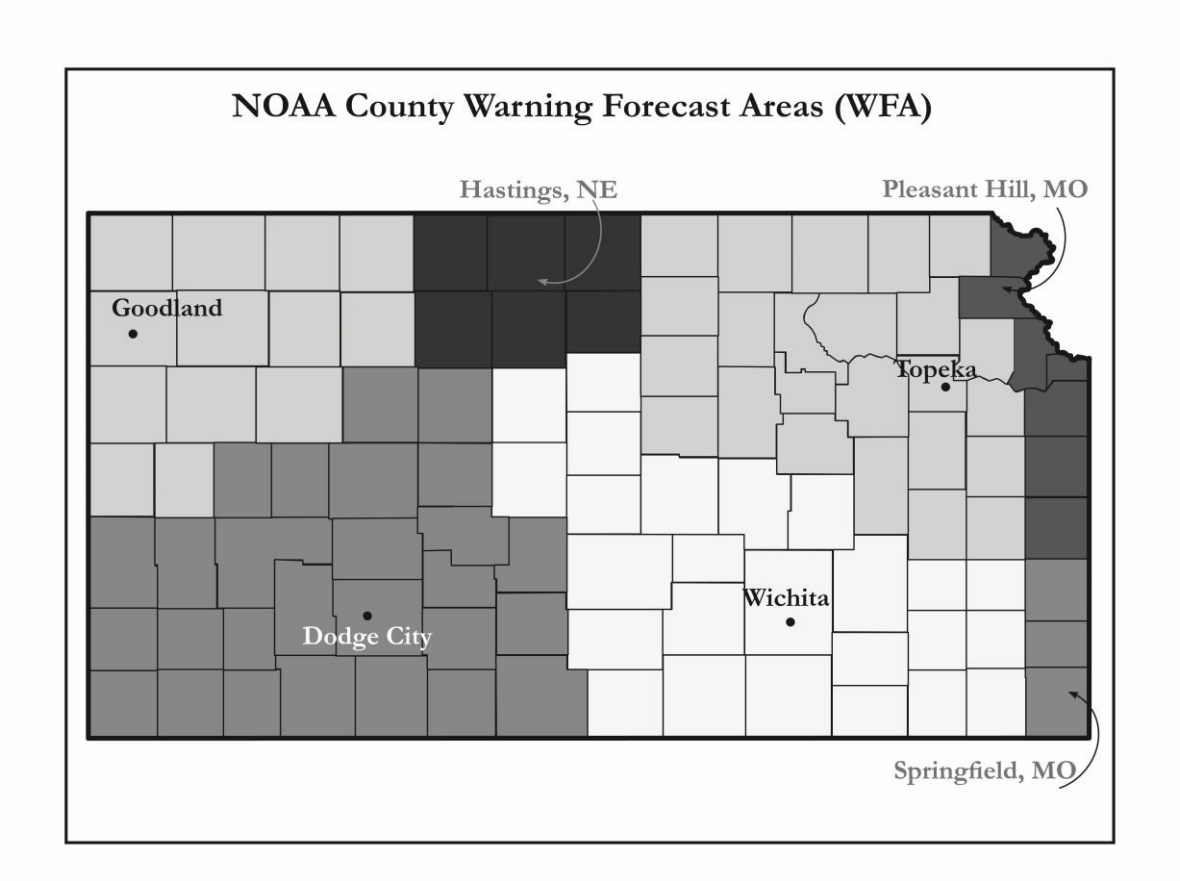
Burn bans can be issued by the governor of Kansas or by county commissioners, and are triggered by conditions that increase the change of wildfires. Drought, high temperatures, low humidity, high winds, and heavy fuel loads all increase the chance of wildfires. Burn bans can be absolute (no burning permitted at all) or conditional (agricultural burning is still permitted when evidence is provided to the fire department that a particular prescribed burn has a low chance of escaping). Exceptions to county burn bans are granted on a case-by-case basis and are not available in all counties.

Remember that rugged topography can play a part in local wind direction and speed when burning, and local topography effects won't be included in weather forecasts.

Weather plays an important role in prescribed burning. Use the best weather information available when planning a burn. Check the weather immediately prior to the burn, and adjust burn execution in response to changing weather conditions. Changes in the weather can turn safe burning conditions to hazardous conditions very rapidly. If the burn extends more than a couple of hours, have someone off-site check the weather periodically for forecast updates and notify the burn boss of any unexpected or developing conditions.

National Weather Service- Fire Weather Products

The National Weather Service (NWS) has numerous forecast products that are extremely useful for planning a prescribed burn. Forecasts are broadcast across the state from over 30 NOAA All-Hazards radio stations. A map of the locations of the various stations, the area for which the broadcast is intended, and the frequency of the station are provided on the Kansas Area NOAA All-Hazards Weather Radio Stations map. A special receiver is needed to receive these forecasts. For a discussion of receivers and NOAA broadcasts, read the information provided on the internet at: http://www.nws.noaa.gov/nwr/



The National Weather Service also provides an extensive array of weather products on the internet. http://www.weather.gov/ Follow the backslash with the city from which your forecast originates (see map above).

For example, if you lived in Phillipsburg, you would type in:
http://www.weather.gov/hastings

When the page appears, click on the map that is displayed at the location where you will be conducting your burn. This will take you to a page with a simplified 7-day forecast.

To the right of the 7-day forecast, you will see map with the heading "Click map for forecast." Click on the map at your burn location to obtain a more specific forecast for your burn location.

Below the forecast map, there are radar and satellite map and the hourly weather graph. At the bottom of the page, on the left hand side, there is a link to the forecast discussion. Other tools are available.

Hourly Weather Graph
One of the consistently most useful products for prescribed burning is the hourly weather graph. This product shows an hour-by-hour display of predicted weather conditions for the next 48 hours in a graphical format, or any user selected 48 hours within the 7 day forecast. The user may select additional weather elements from the checkboxes at the top of the graph. Fire weather elements are available within the first three forecast days.

The graph can be printed and taken to the field to be used as a reference for expected changes in the weather during the burn. Be aware that wind shifts may not be at the exact hour for which they are forecast. However, the general pattern of wind shifts and speeds should be close to those forecasted.

Information in this graph can also be accessed as a table in the **Graphical Weather Forecast**.

Forecast Discussion
The Forecast Discussion provides a more technical discussion of weather conditions and the forecast for the week, with areas of concern and/or the primary weather hazards for the coming week highlighted. Abrupt changes in weather predicted for the days following the burn (abrupt changes in wind direction, rising wind speeds, very low humidity, fronts, and thunderstorms) will require extra vigilance to ensure that smoldering fuels do not reignite and start wildfires.

Current Weather Observations
This tool provides the most current information available about the weather, including wind speed, gusts, temperature, dewpoint and cloud cover.

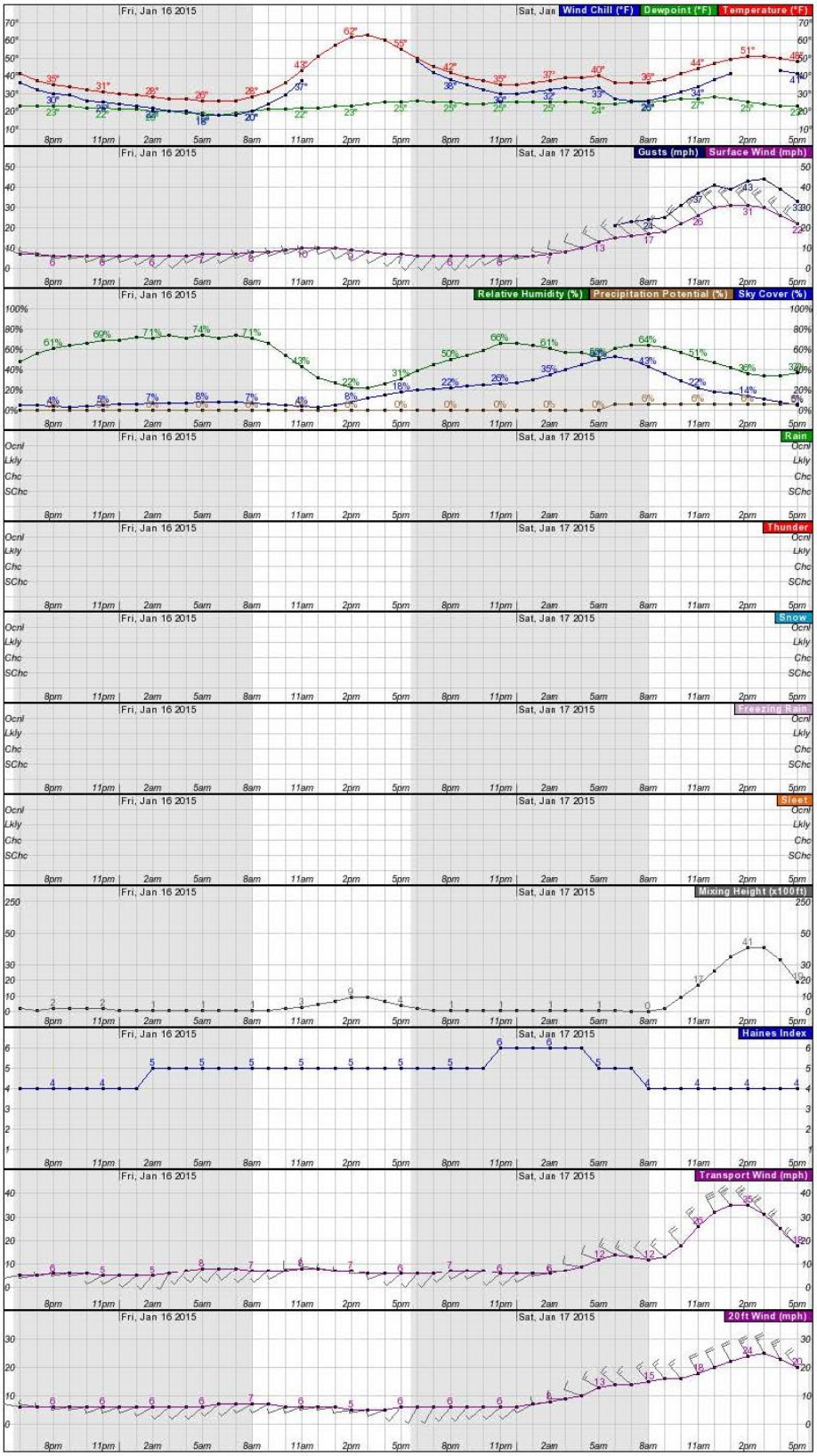
Weather Activity Planner
Select the desired weather conditions and forecast period to generate a plot showing when those weather conditions will occur.

Fire Weather Planning Forecast
Read a forecast and discussion of expected weather for the next 36 hours with special attention to fire weather concerns.

Red Flag Warnings/ Fire Weather Watch
An alert is issued when fuels and weather conditions are likely to produce extreme fire behavior, which is related to the risk of wildfire.

Grassland or Rangeland Fire Danger Index
The status of area rangeland grasses (not urban or groomed land), and the probability that a fire would get out of control if a firebrand was introduced into the current vegetative conditions are integrated into the fire danger index.

Hourly Weather Graph



Fire Weather Tools

Name	Inputs	Range of Values	Description	Application	Access
Keetch-Byram Drought Index (KBDI)	Maximum temperature, 24 h precipitation, long-term annual mean rainfall	0 (wet) - 800 (maximum drought)	Higher values associated with high fire threat. Critical values vary by season.	Prescribed burning application. Maximum value of 600 for burning.	flame.fl-dof.com/fire_weather/KBDI/index.html www.fs.fed.us/land/wfas/kbdi.png
Fire Potential Index (FPI)	Mapped fuel models, relative greenness (Normalized Difference Vegetation Index), temperature, humidity, precipitation, cloudiness	0 (low) - 100 (high)	Weights influence of live and dead vegetation to fire potential. High correlation between fire occurrence and high FPI.	Plan for minimizing threat from wildfires and prescribed burning.	firedanger.cr.usgs.gov/viewer/staticmaps/index.php
Low Visibility Risk Index (LVORI)	Relative humidity, smoke dispersion index	1 (low chance of low visibility) - 10 (high chance of low visibility)	LVORI is an index showing the relative danger of smoke contributing to a low visibility hazard. Caution needs to be taken when the forecast LVORI is above 7. This is especially necessary if conditions are conducive for fog, as smoke mixed with fog can create an extremely dangerous situation.	Used in planning prescribed burns and nighttime burning.	
Spot Weather Forecast	On site weather observations and measurements	Hourly temperature, relative humidity, wind speed and direction.	Special weather forecast issued to fit the time, topography and weather for a specific fire.	Use for prescribed local dispatchers.	Request through National Weather Service website. Available only by request through agency staff, including local fire chiefs, law enforcement, and emergency managers.
Buildup Index	Air temperature, humidity, 24 h precipitation, herbaceous stage	0 - 15 (low) 16 - 40 (moderate) 41 - 80 (high) 81 - 200 (very high) 201 - 250 (extreme)	Reflects the dryness or wetness of fuels that can have a pronounced effect on fire behavior.	Fire prevention and fire suppression.	

Spread Index	Fuel moisture, wind speed, precipitation, condition of lesser vegetation	0 - 4 (low) 5 - 9 (moderate) 10 - 19 (high) 20 - 39 (very high) 40 - 100 (extreme)	Measure of the effect of weather on the relative rate of forward movement of surface fires.	Fire behavior.	
Fire Weather Index (FWI)	Winds, temperature, humidity, precipitation	0 - 7 (low) 8 - 16 (medium) 17- 31 (high) 32 + (extreme)	Used to highlight regions where small-scale, short time variations from the normal or expected fire danger occur.	Assess fire danger and behavior.	
Dispersion Index (ADI)	Stability, mixing height, transport winds	> 81 Extremely Unstable 61 - 80 Highly Unstable 41 - 60 Moderately Unstable 0 - 40 Stable	Dispersion is the process by which the atmosphere mixes and transports particles such as smoke away from their source. Typical burning values are in the range 40-60. Hazardous conditions may exist for ADI > 100. *Should not be used alone in making burning decisions*.	Assess the impact of prescribed burning activity and wildfires on atmospheric smoke concentrations and air quality. Maximum 75, minimum 30 for daytime prescribed burning. Nighttime minimum 6.	
Haines Index (LASI)	Atmospheric sounding data	2 - 3 very low growth potential 4 low potential 5 moderate potential 6 high potential for large fire growth	Judges the growth potential of a fire by measuring the dryness and stability of the air over a fire. Correlated with large fire growth on initiating and existing fires where surface winds do not dominate fire behavior.	Indicates where wildfires or prescribed fires may get out of control. Should be considered along with a surface fire danger index for maximum effectiveness.	flame.fl-dof.com/fire_weather/observat

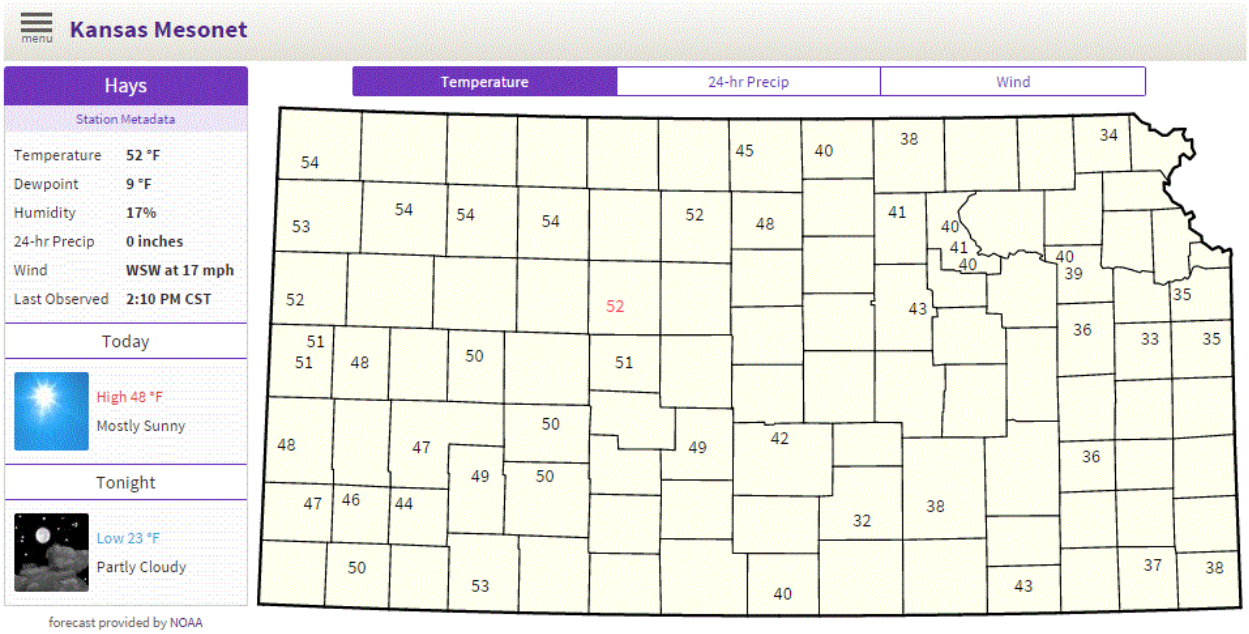
Kansas Mesonet

Kansas State University Weather Data Library operates a real-time weather observation network across the state consisting of 48 stations. This network is designed to display accurate, reliable, and easily accessible local weather observations across Kansas utilizing permanent stations. Observing weather phenomenon such as cold frontal passages, drylines, and rain events, the network samples at a high spatial and temporal resolution to enhance decision making for prescribed fires.

On the website (**mesonet.k-state.edu)** current observations are updated on a 5-minute basis. Clicking on a value at a location of interest on the map, additional data will be displayed either on the left hand side (for a computer/laptop) or above the map (on a mobile device). Displayed data consists of: temperature, relative humidity, dewpoint, wind speed, wind direction, and 24 hour precipitation (ending at the most recent 5-min observation).

Tabs above the map allow the user to toggle displayed map values to either temperature, wind speed, or 24 hour precipitation. For computer/laptop users, a National Weather Service forecast at the selected location is also displayed at the webpage's bottom left for most stations. Lastly, historical data (daily/hourly) is available via the menu in the top left hand corner.

These local conditions can aid in determining current burning conditions and when you can expect wind changes/other weather that can impact a fire in short term by examining other nearby stations.



mesonet.k-state.edu

Contact kansas-wdl@k-state.edu for additional data or additional information.

Prescribed Burning Liability in Kansas

Note: This document does not constitute legal advice. The following information is provided to assist landowners with insurance decisions.

"Will my current insurance cover me if my prescribed burn escapes?" This is a question that concerns every prescribed burn crew member. The answer is rarely simple. Insurance is only important if someone or something is damaged. Never assume an insurance policy provides prescribed burning coverage. It's the policy holder's responsibility to ask the questions needed to make good insurance decisions.

Kansas courts do not impose a rule of strict liability for prescribed burns. To quote the Kansas Court of Appeals in Koger v. Ferrin, 926 P.2d 680 (Kan. Ct. App. 1996), "In Kansas, farmers and ranchers have a right to set controlled fires on their property for agricultural purposes and will not be liable for damages resulting if the fire is set and managed with ordinary care and prudence, depending on the conditions present. There is no compelling argument for imposing strict liability on a property owner for failing to prevent the spread of a fire that did not originate with that owner or operator."

The best protection from liability is to follow safe prescribed burning practices and avoid escapes that damage others' property. Requesting and following a Natural Resources Conservation Service (NRCS) burn plan may decrease potential liability as it shows an effort to follow safe prescribed burning procedures. However, there is no guarantee that this will eliminate liability.

Most agricultural producers have a general farm and ranch policy. These policies may or may not cover prescribed burning. If there is any doubt, ask the question and get an answer ***in writing***. An email is considered writing for this purpose, but be sure to print it out and save it with the policy. Always mention the intention to conduct prescribed burns when applying for a new policy. Failure to disclose intent to burn may be considered lying on the application.

If a fire escapes, everyone who can possibly be sued may be included in the lawsuit. Insurance transfers the legal risk from the farmer or rancher to the insurance company. Clarify an insurance company's liability in such situations by asking for examples of covered and non-covered lawsuits. Determine who is responsible for paying the lawyer. If it's possible to settle out of court, it will generally be much less expensive.

Make sure that the limits of the policy are understood. Most general farm and ranch policies only cover activities carried out on the insured's own land. Coverage may or may not extend to crew members assisting with a prescribed burn on land they don't own. Coverage is most likely if: 1) the fire is conducted on land owned by the policy holder; 2) burning is considered consistent with normal farming and ranching practices, and 3) no laws or regulations are broken while conducting the burn. An example of a law or local regulation being broken would be the illegal ignition of a fire during a burn ban.

Burning with others as a volunteer, such as assisting a neighbor or when conducting a joint burn with other landowners, falls into a liability gray area. Specifically ask the insurance agent about this type of situation. Burn association members, those who burn as part of their job, and burn contractors will likely need to purchase a Commercial General Liability Policy with a specific endorsement for prescribed burning. A single policy may cover all members of a burn association. Typical coverage provided by this type of insurance is $1,000,000 to $3,000,000.

Many farm and ranch policies exclude coverage for activities which pollute. Be sure that smoke from a prescribed burn does not fall into this category.

Care in planning and executing a burn are your best defense against lawsuits. Have insurance, but do your best to avoid having to use it.

Prescribed Burning Liability Tips

1. The prosecution does not have to prove that you did something wrong; they only have to suggest the possibility.

2. Have a burn plan, but don't make it too complex. The more detailed the plan, the more likely the prosecution can find that you violated some provision of the plan through a flaw in execution.

3. Show diligence in finding information about conditions at the time of the burn. Run a fire behavior model such as BEHAVE, print it out, and keep it with the burn plan. Print out the fire weather forecast at the time the decision was made to burn.

4. Keep documentation with the burn plan and keep it until beyond the statute of limitations. However, old burn plans can help you evaluate if you've been achieving your management objectives.

5. Maintain good relationships with those in your neighborhood. Make sure you have all permits in place before you burn. Let the fire department know what you're doing and that you're prepared for what you're going to undertake. Notify neighbors about the burn well in advance, and make a special effort to contact anyone with respiratory ailments so they can take precautionary measures.

Questions to ask your Farm and Ranch Insurer

1. Is there a specific endorsement in my plan that covers prescribed burning?

2. What is covered if a prescribed burn escapes?
    a. Damage to my property
    b. Damage to my neighbors' property
    c. Damage from smoke
    d. Harm to burn crew members
    e. Harm to non-crew members

3. If smoke from a fire which I am conducting or assisting causes an accident, will my insurance policy cover it?

4. If a fire burns down a shed that contains chemicals or other pollutant and as a result there is a pollution cleanup needed, does my insurance cover me?

5. Who pays attorney fees if there is a lawsuit resulting from a prescribed burning escape?

6. If I am volunteering to help a neighbor burn and the fire escapes, does my policy cover me if I am sued?

7. If a neighbor is assisting me with my prescribed burn and the fire escapes, does my policy cover him if he is sued?

8. If I participate in a prescribed burn jointly conducted by adjoining landowners and covering land with differing ownership, does my insurance cover me if the fire escapes?

9. Does my policy require me to have prescribed burning training?

10. Does my taking a prescribed burning class change the insurance definition of my "business pursuits"?

11. If I work at a paid job that involves prescribed burning, but I am helping a neighbor as an unpaid volunteer and the fire escapes, am I treated as a volunteer or as a professional?

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Equipment

General Recommendations

All equipment should be well maintained and in good working condition. Immediately prior to use, all equipment should be tested to verify that it is working correctly and any needed adjustments made. Crew members should be familiar with the operation of all equipment they may need to use.

The best equipment is useless if it burns up. Escape routes and safe spots should be identified prior to ignition. Fire should be extinguished as quickly as possible if conditions become unsafe to continue burning.

Temperatures around freezing can cause nozzles and small diameter lines to freeze up. Wind chill during transportation can drop temperatures enough to freeze up equipment even at temperatures slightly above freezing. High temperatures may lead to equipment overheating.

Get the best equipment you can afford. Your life may depend on it.

WATER

There should be a minimum of 200 gallons of water capable of being pumped on site. Larger burns require more water, as do burns with lengthy perimeters or volatile fuels near firebreaks. County regulations may require a minimum amount of water.

Every effort should be made to conserve water. The location of the nearest water sources, both on and off site, should be identified and communicated to every person on the crew. The rate at which water from a supplemental water supply can be loaded into a sprayer should be considered. A garden hose will take a long time to fill a 200 gallon spray tank. A trash pump can be used to suck water from a stream or pond.

Wetting Agent (Surfactant)

Wetting agents extend the water supply by making water applications more effective. Wetting agents work as surfactants, reducing the tension on the outside of the water droplet and allowing it to spread out. Commercial wetting agents are available, but using inexpensive dishwashing soap will work well. Add roughly 1 ounce soap per 100 gal. of water in the spray tank. Add the soap after the water is in the tank to minimize suds. The water should feel slick to the touch. Too much soap may result in unwanted suds. Wash the tank thoroughly with clean water when cleaning up after the fire.

A quart of Class A firefighting foam added to 300 gallons of water will also act as a surfactant. Some foaming in the tank will occur.

Auxiliary Unit

Additional water brought on site can be used to refill sprayer tanks and provide a margin of safety. Nurse tanks used for herbicide spraying are frequently used as auxiliary water sources. These can be 500 gallons or larger. Other water storage tanks on trailers or loaded into farm trucks can be used. A 200-400 gpm trash pump with 2 inch diameter hose can be used to deliver water to sprayers, or the sprayer pump can be configured to suck water from the nurse tank into the sprayer.

Carry couplings that will allow the auxiliary water supply to be connected to local rural fire

department equipment and rural water district standpipes to allow for the rapid transfer of water to fire department trucks in case of an escaped fire or when fighting wildfires.

PUMPING SYSTEM COMPONENTS

All pumping system components should be compatible, durable, and capable of being rapidly adjusted. Carry replacements parts for the various components of the pumping system. Additional pumping systems on site reduce the risk of escaped fire if one pumping system should quit working. Generally, a minimum of two pumping units/fire line is recommended.

Agricultural spray units may be capable of being modified to use as fire equipment.

Wand and Nozzle Assembly

The wand delivers the water to the desired target. Sometimes a broad pattern is desired, as when suppressing a backfire. At other times, a more narrow concentrated flow is needed to extinguish fire on a burning object such as a fence post. When selecting a wand and nozzle assembly, choose one that delivers a minimum of 6 gallons/minute at 125 psi. The wand should have a trigger mechanism that allows for an adjustable output patter from fan to solid stream. A fine fog pattern will use the least water, but is easily dispersed by wind. A fan pattern is used most frequently. A stream pattern is used only where necessary as it uses the most water.

Pumping Units

Pumping units range from simple backpack sprayer units through pickup and ATV/UTV units and extend through large field sprayers modified for burning and rural fire district trucks. Each is appropriate in certain situations.

Backpack Sprayer

Backpack sprayers are small capacity (3-5 gallon) units that strap onto the shoulders. The backpack sprayer consists of a tank that is connected to a small hand pump/wand/nozzle assembly. The pump is incorporated into the wand and is activated by moving a sliding sleeve back and forth to pump and spray water. Backpack sprayers are most frequently used along the backfire and flankfire sides of the burn and for small spot fires. They can be carried into areas of rugged terrain where vehicles can't travel. Burn crew members should trade off carrying the backpack sprayer if the burn extends more than a couple of hours, as they are heavy and somewhat cumbersome. Backpack sprayers are generally refilled from a larger spray unit. PVC tanks have a hydraulic fitting that allows them to be filled with a hose attached to a larger spray unit if the plumbing is compatible.

There are several tank options. Stainless steel is heavy, rigid, and durable. Poly tanks are lighter and rigid. UV resistant PVC coated tanks are the lightest. Their flexibility makes them the most comfortable to wear but they hold slightly less water than the rigid tanks, can snag on barb wire and potentially develop holes.

Harnesses can be purchased to hold packback sprayers. These distribute the weight more evenly than the simple shoulder straps that come with the sprayer, and are recommended for ease of use and comfort.

All Terrain Vehicle (ATV) and Utility Type Vehicle (UTV)

All-terrain vehicles and utility-type vehicles fitted with spray tanks and wand assemblies are an extremely versatile vehicle for prescribed burning. They carry burn crew members rapidly around the burn site, transport and deliver water for extinguishing fires, assist with communication efforts, and can traverse fairly steep terrain without becoming stuck. A piece of flagging tape tied to the aerial will indicate the local wind direction, which can be influenced by the fire. It also makes the vehicle more visible in smoky conditions.

Use a heavy-duty type ATV for prescribed burning. A 4-wheel drive ATV with and approximately 500cc engine can carry a 15-25 gallon water tank. Use an electric pump capable of delivering 3-5 gpm at the nozzle end. UTVs can carry 30-100 gallon tanks, depending on the size of the vehicle.

Pickup Truck/Trailer

A pickup truck fitted with a spray are less nimble than ATVs but can carry more water and offer cab protection for the driver. Pickups are more nimble than tractor-mounted sprayers.

Tank

Tanks for pickup sprayers should be sized appropriately for the bed size and weight capacity of the truck/trailer. The tank should be mounted in a sturdy steel frame and securely fasted to the bed with hooks and tie-downs. Tanks should be positioned near the center of gravity between the axles, generally directly behind the cab. Low-profile tanks with interior baffles are preferred for the lower center of gravity, greater visibility around the tank, and less water movement within the tank when traveling.

While larger tanks and more water seem like a good idea, the extra water weight can slow down vehicle movement. Tanks should capable of releasing large quantities of water rapidly in case the vehicle gets stuck. The fill cap should be easily accessible for rapid refilling from a nurse tank.

Suggested sizes for slide-in pickup tanks are:

½ ton pickup	100 gal. tank
¾ ton pickup	200 gal. tank
1 ton pickup	300 gal. tank

Tanks can also be mounted on trailers and pulled with pickups. However, these are less maneuverable and can be difficult to back up in a hurry or where space is limited.

Pump Engine

A reliable, well-maintained pump converts stored water into fire suppressant. Recommended engine size for most sprayers is between 5 and 8 hp. Overhead valve construction is preferred due to its lower noise level, longer life, minimal maintenance needs, and continued good performance over several hours of running time.

The engine and the pump should be purchased together to ensure compatibility, minimize the number of couplers and adapters needed, and to reduce the vibration in overall assembly. The sprayer engine should operate independently of the vehicle engine so that water can be pumped

even if the vehicle engine stalls or quits running. This can be important to saving the vehicle and crew if fire should surround a stuck vehicle.

Pump

Pumps should be sized with the engine, with a range of 5-10 gpm. As hose length increases, pressure losses also increase (see TABLE 1), so consider how long a hose you want to use and adjust the pump size to ensure you have adequate pressure at the nozzle. Use screens to remove particles that would plug nozzles. Roller or piston pumps are recommended. High pressure is more desirable than high output.

Hoses

Selecting the right hose is a trade-off. Long hoses offer greater flexibility in fighting fires, but are heavier to drag around and more likely to be run over or caught in a fire line and melted. Shorter hoses are lighter but don't offer the range of a longer hose. Larger diameter hoses are heavier but deliver more water; smaller diameter hoses deliver less water and have greater pressure losses (see TABLE 1).

Hoses should deliver between 5 and 10 gpm and be capable of delivering a nozzle pressure of 150 psi. Calculate the pressure loss for a given length of hose (pump to nozzle) to determine the pump pressure necessary to deliver this flow.

Hose lengths and diameters vary slightly depending on how they will be used. A hose that will be used by the driver in the cab should be about 20 feet long and ½ inch in diameter. The hose can be draped over the side mirror support or other supports in the pickup stake pocket. The most common causes of hose failure are dragging on the ground and the resulting abrasion damage to hoses, or snagging hoses on fences, vehicles, or brush so that they develop holes.

Hoses used by fire crew on the ground can be either ½ or ¾ in diameter, and range from 50-100 ft. in length. Use a longer hose where terrain is rugged or brush and trees interfere with fire vehicle movement. When using a ¾ inch hose, splicing on a ½ diameter hose for the last 20 ft. will reduce weight and increase maneuverability while minimizing pressure losses.

TABLE 1: Pressure drop in hoses for various lengths. Based on Hazen-Williams equation for a flow of 6 gpm.

	Friction Factor C=150		Friction Factor C=130	
	Inside Diameter (inches)		Inside Diameter (inches)	
Length (ft)	0.75	0.5	0.75	0.5
	PSI pressure drop		PSI pressure drop	
25	12	8.6	1.6	11.2
50	2.4	17.1	3.1	22.3
75	3.6	25.7	4.7	33.5
100	4.8	34.3	6.2	44.7
150	7.1	51.4	9.3	67.0
200	9.5	68.5	12/4	89.3

Reel

Reels can be very useful when using and storing heavy hoses. Electric reels are the most convenient but require a power source and are more complicated to maintain. Manual reels are probably adequate for most producers doing prescribed burning.

Place the reel directly behind the driver to minimize effort in re-rolling the hose. Hooks and racks for the hose used by the driver are also helpful in controlling the hose.

Ignition Sources and Torches

Always have more than one ignition source on hand in case one fails to work. There are three general types of ignition sources. Grill or cigarette lighters are commonly used to light drip torches or propane burners. Check fuel reserves before taking to the burn site. Spark lighters are available in a variety of designs and are typically used for camping or welding applications. Matches are inexpensive and easy to use, but need to be kept very dry. Matches can be difficult to keep lit in windy situations.

Drip torch/smudge pot

The drip torch is the basic piece of equipment used to light prescribed burns. It is light weight compared to propane burners, very durable, highly dependable, easily lit and extinguished, and simple to refuel. Drip torches have a simple design with low maintenance requirements. A drip torch should easily last for more than 20 years if it is stored properly.

Drip torches use a fuel mix of ¼ gasoline to ¾ diesel fuel. The mixture can be approximate. Sometimes used oil is substituted for the diesel, but impurities in the oil can plug the tube. The gasoline provides rapid fire delivery, and the diesel provides heat to keep the fire lit until the fuel begins to burn itself.

Fuel delivery rate is adjusted with an air supply valve screw, which can be turned slightly to increase or decrease the drip rate. Tips are flat or round. Both work well in igniting fuel, but round tips use more fuel.

Fusee

Fusees are a short, stick-like flare device used extensively in forestry fire applications. Fusees offer the advantage of being self-contained, paring a small fuel supply with an ignition source. A fusee provides a quick, light-weight, temporary source of ignition that is easily carried. Fusees can be fitted into a piece of PVC pipe as a holder.

Fusees will continue to burn until extinguished or the internal fuel supply is exhausted (about 10 minutes). Fusees are extinguished by pushing the burning tip into the soil. They cannot be relit once they are extinguished.

Fire Stick

Fire sticks are home-made ignition devices constructed from an 8'-10' piece of 1¾" -2" steel pipe. One end is threaded to receive a cap and the other end is threaded to receive a plug. The cap end is used to fill the device with gasoline. The plug end has a notch filed across the threads to allow a small amount of fuel to drip out. Fire sticks are extinguished by raising the drip end straight up into the air.

Fire sticks are frequently dragged behind an ATV with a chain or wire, which allows rapid ignition of long fire lines and eliminates the fatigue of carrying a long pipe filled with fuel. Fire sticks are

inexpensive and built from readily available materials. Care should be taken not to spill fuel on clothes or other equipment when filling the stick. Fire sticks should be used with caution. Before attempting to use a fire stick, gain experience by assisting others familiar with this piece of equipment.

Other ignition devices

Propane burners are sometimes used for prescribed burning, but their best application is for burning brush piles and similar concentrated fuels. Compared to drip torches, they are heavy, expensive to use per foot ignited, and hold relatively a small amount of fuel. It would take several tanks to light a typical prescribed burn. Flame throwers have many of the same disadvantages as propane burners.

Other ignition devices that are not recommended are burning tires dragged with a chain and burlap bags held on a pitchfork. Both can be difficult to quickly and easily extinguish, and burning tires release noxious fumes.

HAND-HELD FIRE SUPPRESSION DEVICES

Hand tools include those for extinguishing or moving fire as well as more general purpose tools for fixing equipment and dealing with fences and other hazards.

Leaf Blowers powered by a small gas engines are useful for extinguishing smoldering fires or fires burning in short (less than1 ft. tall) vegetation and litter. A leaf blower can also be used where ravines or rock outcrops make moving sprayer vehicles problematic and where backpack sprayers cannot carry an adequate supply of water or are inconvenient to use. Using a leaf blower decreases the amount of water that is needed for a prescribed burn.

Recommended engine size is 2.5 KW, with an air volume of 500+ cfm at the end of the delivery tube. Air velocity should be about 170 mph as it leaves the leaf blower.

Fire Brooms are specially designed with fire-resistant bristles and is useful for sweeping embers back into the burned area. Fire brooms can be used to sweep the edges of backfires to extinguish small flames. Fire brooms are light weight and easy to use.

Fire swatters consist of an approximately 1 ft. x 2 ft. rubber flap attached to a hoe handle. They can be purchased or homemade. The fire swatter is used by laying over the part of the fire or ember to be extinguished and holding it in place briefly to smother the fire. Incorrectly used, a fire swatter can fan flames and spread fire. Fire swatters are heavier and more awkward to use than a fire broom.

Fire rakes have large sickle-shaped teeth that are useful for dragging larger fuels such as tree limbs. They are relatively heavy.

Fence pliers or side cutters should be carried by every burn crew member to allow them to cut through fence and wire tangles and escape an advancing fire. Other items that may be useful to the burn crew include a bucket, hammer, and sharp tile spade.

VEHICLE SUPPLY

Basic vehicle supplies should be on-site and easily located during the burn. Spare tires should be available for all vehicles, along with jacks strong enough to lift the heaviest piece of equipment including any water weight. Tow ropes or straps and chains should also be available and of adequate strength. Additional hand tools may be needed for minor vehicle and equipment repairs. Oil levels and tire pressure in all vehicles should be checked prior to the burn, and extra oil and spare tires should be carried in vehicles.

Fuel and Oil

Adequate fuel for fire vehicles should be brought to the burn site. Fuel containers and tanks should be easily accessed and capable of being moved rapidly to refuel vehicles.

Additional fuel supplies will be needed for drip torches and sprayer pumps. Don't premix drip torch fuel, as it will necessitate an additional container and increase the chance of using the mixture erroneously in a vehicle.

COMMUNICATION EQUIPMENT

Communication equipment is essential to conducting a safe burn.

Hand-held radios and walkie-talkies allow communication beyond sight lines. Communication equipment should be tested prior to the burn at the actual burn site to determine transmission is adequate in all parts of the site. Small, inexpensive walkie-talkies may be adequate for small burns over level terrain. As burn size increases and terrain becomes increasing rugged, more expensive radios may be needed. In Kansas, the statewide Prescribed Burn Association radio frequency is 151.625.
A remote speaker microphone can also be useful.

Examples of radios with greater range include:
Motorola cp200, VHF, 4 channel, 5 watt
Vertex VX-351, 16 channel

Cell phones should not be relied upon as the primary communications method. Coverage is often spotty in rural areas. Cell phones can be distracting if they are used for making and receiving phone calls and text messages while attention should be focused on the fire. However, cell phones can be used to summon help in case of an escaped fire or medical emergency or to check with someone off-site about changing weather conditions. Emergency numbers should be programmed into cell phones before the burn.

Phone books and a **list of emergency contacts** should be present in each vehicle.

Watches provide a method of synchronizing activities when specific times are set for burn crew members to be at certain locations at a certain time, or to initiate activities in sequence.

WEATHER EQUIPMENT

Portable weather stations can be either mechanical or electronic (Kestrel). Be sure that the model you select can detect wind speed, relative humidity, and temperature.

Flagging ribbon tied to the aerials of all vehicles will allow detection of even small wind changes. Since fire can generate its own winds, observing shifts in wind direction will allow the burn crew to predict fire direction and improve crew safety.

FIRE RETARDANTS

Fire retardants can be used in situations where protection of a structure, utility pole, or other valuable item warrants the cost. There are two main types of retardants.

Ammonium polyphosphate liquid fertilizer (10-34-0) is generally available from farm fertilizer suppliers. It is sometimes sprayed on firebreaks to increase their effectiveness. Ammonium polyphosphate is very corrosive and highly water soluble. Even a light rain will reduce its effectiveness.

Class A Foams are expensive but convenient to use. They can be purchased from fire supply companies. They may need a special nozzle for application.

SUMMARY

After a prescribed burn, clean and make necessary repairs before storing. Fire equipment can generally be used for many years if it is maintained. Select equipment and tools that you are comfortable with using and repairing. Confidence in your equipment will allow you to concentrate on the fire plan and the safety of the burn crew.

Equipment Suppliers

The following companies sell equipment useful for prescribed burning. Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned.

Forestry Suppliers, Inc.
http://www.forestry-suppliers.com/

Ben Meadows Company
http://www.benmeadows.com/

Agri-Mart
http://agrimart.net/hypro-21-adjustable-pattern-spray-gun/

National Fire Fighter Corporation
http://www.nationalfirefighter.com/index.php?cPath=20_162

Gempler's
http://www.gemplers.com/product/167707/Drip-Torch

The Supply Cache
http://www.supplycache.com

Fuel Loading, Fuel Moisture Are Important Components of Prescribed Fire

by Russell Stevens, The Samuel Roberts Noble Foundation

Many landowners will be implementing prescribed burns this winter and spring. Prescribed burning is a land management tool that should only be used when needed and after considerable planning, taking into account numerous factors including fireguards, equipment, labor, special concerns, smoke management and fuel characteristics (loading and moisture).

Two views of a backfire in the Flint Hills of Kansas

A common goal with prescribed burning is brush control in pastures. Too often there is not enough consideration given to developing an adequate fuel load and determining fuel moisture for a successful prescribed burn. Without a proper understanding of fuel loading and fuel moisture, a manager risks wasting valuable time and money when attempting to control brush with a prescribed burn.

Grasses are considered one-hour fuels and are the primary carrier of fire for most prescribed burns in our area. Fuel loading of grasses is the dry weight of grass in a burn unit, usually expressed in pounds per acre. Like estimating forage production, some experienced managers are able to visually estimate this value with fair accuracy. More accurate estimates can be obtained by clipping, oven-drying and weighing. A minimum of 1,500 pounds per acre of one-hour fuel is usually needed to carry a fire. However, for controlling brush in pastures, heavier one-hour fuel loads are usually needed, depending on brush species and size. For example, 1,500 pounds of one-hour fuels will probably kill seedling Eastern red cedar, but not most taller than 2 feet. Fire intensity increases with heavier fuel loads. Fuel loading also affects other fire behavior such as ignition, rate of spread and torching (fire racing upward from the ground to treetop).

There are two kinds of fuel moisture: live and dead. Live fuel moisture is more of an issue when burning live fuel during the growing season or live fuel such as Eastern red cedar during the dormant season. Since most prescribed burns in our area are during the dormant season, it is important to know dead fuel moisture for fire control and success. Live fuel moisture can also be important during a dormant season burn. For instance, knowing live fuel moisture of Eastern red cedar will help determine its susceptibility to fire.

Fuels are classified into four categories by which they respond to changes in moisture. This response time is referred to as time lag. The four categories are:

- 1-hour fuels: up to 1/4 inch in diameter.
- 10-hour fuels: 1/4 inch to 1 inch in diameter.
- 100-hour fuels: 1 inch to 3 inches in diameter.
- 1000-hour fuels: 3 inches to 8 inches in diameter.

Examples of one-hour fuels are grass, leaves, mulch and litter. Fuel moisture in these fuels can change within one hour according to factors such as temperature, rain, humidity and shade. Conversely, larger diameter fuels such as deadfalls, brush piles, etc., take up to 1,000 hours to respond to changes in environmental factors.

Fuel moisture can be determined by clipping and immediately weighing the sample before oven drying it to a constant weight. Then the following formula can be used to determine percent fuel moisture: [(Wet Weight – Dry Weight)/Dry Weight] x 100. Knowing the moisture in fuels to be burned will help managers understand the susceptibility of fuels for ignition, fire rate of spread, fire intensity and risk of spot fires, torching and crown fires, all of which are factors that need to be managed to control the fire as well as to achieve desired goals such as brush control.

Managers who understand and properly apply their knowledge of fuel loading and fuel moisture will have greater success in achieving their goals for using prescribed fire.

http://www.noble.org/Ag/Wildlife/FireFuelLoad/index.html

Hazards and Precaution Areas

Hazards and precaution areas are present in nearly all prescribed burn locations. These are areas or objects of special concern due to their value, their inaccessibility, or their potential for causing accidents, fire escapes, or erratic fire behavior. Each hazard and precaution area should be identified as part of the burn planning process and incorporated into the burn plan, along with strategies that circumvent its potential for unintended consequences.

Hazards and precaution areas may be natural features or manmade structures. Many times natural features, such as a gully, have associated man-made features such as a bridge or culvert. Hazards and precaution areas can also be associated with particular types of vegetation or animal activity. Whatever their origin, hazards and precaution areas require attention prior to ignition.

Houses and other buildings, because of their value, deserve special protection. Avoid burning near a house. Construct a wide firebreak between the area to be burned and the house, and set headfires to burn away from the structure. Always notify the owner that you will be burning. Station extra fire equipment along the fire line when the fire is burning near the house.

Power lines and poles pose several hazards. Dense smoke can carry an electrical charge from overhead wires to the ground. Water sprayed onto power lines can also carry a charge. Burn crew members can be injured or killed by these electrical charges. Higher voltages and lines close to the ground increase the danger. Because of the danger of electrocution posed by overhead power lines, avoid standing near or under the lines when smoke envelopes the lines. Burn at right angles to the power lines to minimize the time the smoke is on the lines.

Power line poles can readily burn if fire is allowed to linger around the base of the poles. Power companies may charge the full costs of replacing each post. In areas where prescribed burning is common, poles frequently have metal collars around them at ground level. While helpful, these do not entirely eliminate the potential for the poles to burn.

Power line poles are obstructions to fire fighting equipment and can be damaged or cause damage when a vehicle runs into them. Smoky conditions can obscure power line poles, increasing the chances that they will be hit. When power line poles fall down or burn, high voltage lines on or near the ground can electrocute burn crew members. Power lines that fall on fences can cause the fence to become electrified and kill burn crew members and livestock that touch the fence far from the downed power line.

Oil and gas facilities typically have an area of bare or nearly bare soil around them. Mow or carefully burn a black line round these hazards prior to the main burn. Large burns may need to be reconfigured into a couple of smaller burns in order to avoid running a

headfire into these facilities. Oil and gas facilities can explode if they are exposed to too much heat. Always notify the oil or gas company about your intention to burn.

Tree plantings and windbreaks are typically located near the edge of the area to be burned. Construct a fireguard between the trees and the area to be burned. If the planting contains redcedar or juniper, make the fireguard wider than normal and set headfires to burn in a direction away from the trees.

Hay bales should be moved away from the area to be burned if at all possible. If they can't be moved, construct a firebreak around them.

Stubble fields and no-till fields with heavy residue can burn even though they are crop fields. Prepare a firebreak between these fields and the area to be burned.

Wildlife guzzlers (devices for capturing and storing rainwater) are typically found in Conservation Reserve Program (CRP) fields. If they can easily be moved, remove them before burning and replace afterwards. If they can't be moved and are installed using wood posts or frames or plastic barrels, burn a black line around them before lighting the main fire. Always check with Farm Service Agency (FSA) prior to engaging in any activity involving CRP land.

Another type of hazard is caused by plants, topographical features, or structures that influence fire behavior. Certain plants create fire hazards due to their structure or physiology. Redcedar and sagebrush contain volatile oils that ignite and can turn the plant into a flaming torch. Before beginning to burn, be sure that redcedars closest to the firebreaks are far enough away that they will not fall or send embers across the firebreak.

Kochia, a weed that is common in the western part of Kansas, has an arrangement of branches and leaves that are ideally positioned for rapid burning. Where there are tall, dense stands of dried kochia, the plants can burn with almost explosive rapidity. Kochia is also notorious for creating wind-borne embers and creating fire whirls under certain conditions. If the kochia patch is located in the middle of the area to be burned, alert burn crew members to the potential for a rapid increase in fire intensity as the kochia begins to burn. If the kochia patch is located near the firebreak, mow it prior to the burn.

Due to the extra moisture, ditches frequently have heavy fuel loads that can burn with greater intensity than the grazed grassland adjoining them. Be prepared with extra fire suppression equipment if you are trying to extinguish a fire along a ditch.

Grasses that form a heavy thatch, such as smooth brome which is often present in ditches, can smolder for a long time and reignite unexpectedly. Leaf blowers can be useful for extinguishing this type of fire. Trees and brush thickets can cause the fire to swirl as the wind moves through narrow spaces created by vegetative growth patterns. Tree snags can burn and shoot sparks up into the air. Trees such as cottonwoods also shoot embers upwards as they burn. Piled bush, such as redcedar cut and piled prior to the burn, can

burn with unexpected intensity and smolder for days, increasing the potential for wildfires.

Structures and topographic features that channel or constrict wind flow can affect fire behavior. These include culverts, narrow gullies, and box canyons. A box canyon exists when the topography is roughly configured like the end, bottom, and two sides of a shoe box. Fire increases in speed as it climbs up a slope. Box canyons can have rapid fire movement up all slopes, and can become a trap for any burn crew member caught on the bottom as the fire enters the canyon. If the fire burns down one side of a narrow canyon, it can leap across the bottom and begin burning upwards on the other side. Avoid using a burn plan that requires someone to be located in a box canyon before the fire has passed through it or for the fire to end somewhere in the canyon. Alert burn crew members to expect high fire intensity as the fire exits out the top of the canyon.

Culverts can create wind funnels (Venturi effect) that increase the speed of the fire. They are often located between the area to be burned and an unburned adjacent area. Embers blown through the culvert or debris and weeds in the culvert can carry the fire through the culvert and cause the fire to escape. To reduce the chance of fire escaping, clean or burn out the material in the culvert prior to the main burn or block off the culvert with a piece of metal, such as a length of corrugated sheathing steel temporarily laid across the end of the culvert and held it in place with a steel post.

Livestock and wildlife, even if they are not present, can create hazards and precaution areas. Highly uneven grazing patterns can create patches that burn with varying intensity and slightly change the direction of the fire as it follows an ungrazed patch. Cow chips and woodrat nests will smolder long after the rest of the fire is completed, and can later reignite unexpectedly if the wind comes up. Very rarely a small animal such as a rabbit will catch on fire and run across the fire line.

An additional category of hazards and precaution areas are those that create difficulties in moving the burn crew and fire vehicles around the burn area. Smoke can make it difficult to see these hazards. The burn crew can be in a hurry and not realize the hazard is in front of them. And sometimes, the hazard is simply unexpected.

Travel hazards include fences, powerline poles, trees (both standing and lying on the ground) and brush mottes, hedgerows, waterline risers, water developments and wildlife guzzlers, and corrals. Excavated hazards include road ditches, old terraces, pit silos, and cattle trail ruts. Topographical hazards include rock outcroppings, gullies, streams, mud holes and other water features, and steep terrain than can't be traversed by fire vehicles. Additional travel hazards include bridges that can't support the weight of fire trucks, culverts that extend out into the burn area, junk piles, old tires, old farm equipment such as harrows, inoperable gates, and abandoned vehicles.

Careful inspection of the area to be burned will allow hazards to be noted and marked on the map and crew members to be alerted during the pre-burn briefing. Hazards that can be removed, such as junk piles and old equipment, can be cleaned up prior to the burn.

If a hazard or precaution area increases the risk of the fire escaping, station a lookout to monitor the situation and report immediately if the fire leaves the prescribed area. Assign extra burn crew and water supplies near items and areas to be protected to reduce the chances of unintentional damage. Plan a route for fire rescue vehicles to reach these areas.

Consideration of hazards and precaution areas during the planning process can reduce burn crew injury or death, vehicle crashes or immobility, and decrease the chance of the fire escaping and becoming a wildfire. The extra time spent in preparation will result in a safer burn.

Field burning safety.

Be proactive, stay safe and prevent fire damage.

Power lines carry electricity across the prairie and throughout our communities. In rural areas, lines may cross wide swaths of agricultural land. Understanding how to safely burn fields where power lines are present, making a plan and following it can prevent dangerous -- even deadly accidents.

Before Burning:

- Mow and remove vegetation at least 10 feet (and preferably 15 feet) around any structure/pole
- Work the ground (i.e. tilling), or use a fire resistant ground cover
- Do not directly spray or treat the structure/pole
- Keep people and equipment at least 100 feet away from overhead lines
- Use back-burn/backfire techniques to create a fire break away from power lines, poles and other components

You are important to us, if you have any concerns or questions and need technical guidance, please contact Westar Energy at **855-Westar2** (855-937-8272)**.**

During Burning:

- Water and other chemicals used to extinguish fires should never be directed toward a power line, pole or structure
- Smoke and gases from a large fire can create a conductive path for electricity
- Electrical arcs (also known as flashovers) can endanger people, animals and property
- Fire and the by-products of burning can destroy wires, insulators and other components of the power lines in addition to the structure/pole
- If fire is threatening lives or property, call 911 immediately

Keep in Mind:

- Fires underneath or near power lines can be dangerous
- Assume any downed power lines are energized. STAY AWAY and call 911 immediately
- Follow state and local procedures and laws for permitting and notification

Landowners who damage the electrical system during field burns will be billed for repairs. Insurance may cover this cost. Please contact our claims team at 1-877-414-7887.

All rangeland fires produce smoke that is carried away from the burned area where it can be detrimental to air quality for thousands of people. Smoke does not readily disperse and can be carried like a cloud for long distances. Smoke elements that are of the most concern are particulate matter, ozone precursors, and the combination of both that results in regional haze. Each component is associated with negative effects on visibility, health, and air quality.

Particulate matter is a tiny piece of solid or liquid that is carried and suspended by wind. Particulate matter is defined by its diameter in microns[1] as PM_{10} and $PM_{2.5}$. About 70 percent of the particles produced are $PM_{2.5}$. Heavier particles generally settle close to the smoke source, while smaller particles can be carried by the wind for many miles. Particulate matter can be removed from the air by rain and snow and gravitational pull. If they are inhaled, smaller particles can cause health problems, including shortness of breath, coughing, and irregular heartbeat.

Ozone precursors consist of nitrogenous gases (NO_X) and volatile organic compounds (VOC) released by burning fuels that, under certain meteorological conditions, form ozone (O_3) downwind. Environmental conditions that increase the chance of ozone formation are sunshine, high temperatures, temperature inversions, and calm winds (Figure 1). Ozone is the major component of smog. It causes coughing, throat irritation, and worsening of asthma and emphysema. Ozone precursors are not cleaned from the air by precipitation but eventually disperse naturally. Ozone precursors from prescribed burns in Kansas have been detected as far away as New York.

Ozone affects both humans and plants. Human health effects include coughing, pain with deep breathing, reduced lung function, and shortness of breath. In plants, long-term exposure to ozone can kill trees, increase needle drop in conifers, and increase a tree's susceptibility to root rot.

Regional (or visible) haze — formed by the combination of NO_X and $PM_{2.5}$ — results in impaired visibility and atmospheric discoloration due to the scattering of light particles. Haze formation is exacerbated by high humidity and calm winds. Much of the concern with regional haze is aesthetic, although its formation indicates the presence of health-impairing components (see above).

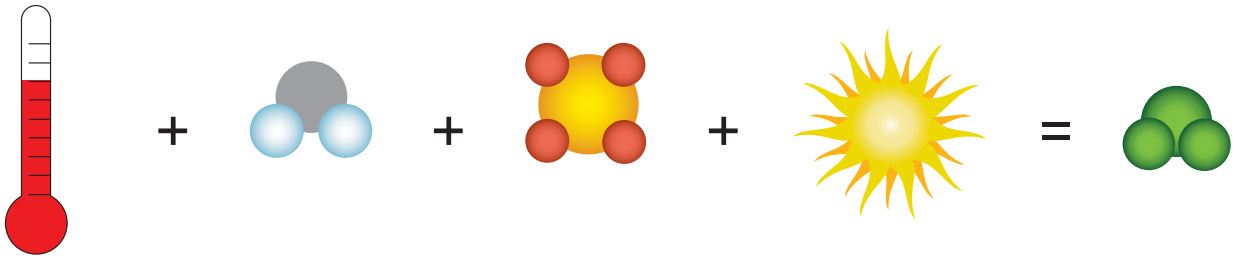
Fire management practices attempt to reduce the negative effects of smoke that impact air quality, visibility, health, and safety. Fire management practices reduce smoke-related air quality problems in three ways:

- **avoiding** smoke movement into sensitive areas;
- **diluting** smoke concentrations through management and planning; and
- **reducing** the total amount of smoke produced.

Avoiding air quality problems. Conduct prescribed burns when weather patterns are favorable for dispersion. Then smoke is carried away from sensitive areas that were identified as part of the prescribed burn

[1] The subscript in this measurement refers to the size of the particulate matter measured in microns. In this case, PM_{10} refers to particulate matter 10 microns in diameter.

Figure 1. *Factors Influencing Ozone Formation.*



Source: *Smoke and Air Quality for Land Managers*. 2010. NWCG Smoke Committee and University of Idaho, used with permission.

planning process. Weather components such as wind speed and direction, mixing height, transport winds, inversions, humidity, and atmospheric stability can affect the direction and distance smoke travels and how close to the ground it remains. Use weather predictions to determine optimal times to burn to avoid producing smoke that will affect sensitive areas. When available, use modeling predictions that indicate where smoke plumes will travel. Avoid burning when the plume is directed toward urban areas. One such model is available at *www.ksfire.org*.

When smoke has the potential to drift over sensitive areas and burning cannot be delayed, notify health authorities in advance so air quality alerts can be distributed and people notified to take action, such as staying inside, to avoid breathing the smoke.

Diluting the effects of smoke production. Scheduling burning activities so large quantities of smoke are not produced from the combined emissions from many fires. Coordinate burning activities across the air shed to spread them across a larger time frame to maintain air quality at attainment levels in sensitive areas.

Reducing emissions. Use fuel management to produce less smoke. Reduce the quantity of fuel burned and increase fuel combustion efficiency.

Less smoke is generated when fewer acres are burned if fuel loads are equivalent. Burn only when a specific management objective requires it. Some livestock management practices generate more fuel per acre. These include patch burning with grazing, deferred grazing rotations, and no grazing. In the case of patch burning, fewer total acres are burned each year, which offsets the higher fuel loads generated. Fuel loads are also reduced when burning occurs at frequent intervals, reducing fuel buildup, especially of woody species. Livestock or wildlife grazing decreases fuel loads, but range managers should be certain that enough fuel remains to carry the fire and meet management objectives.

Reducing the time fuels burn decreases the amount of time that smoke is produced. Woody fuels will smolder long after the fire front has passed. Burning rangeland at intervals that keep woody species from encroaching will aid smoke management. Extinguish smoldering fuels immediately after the burn. Where appropriate, piling fuels such as dead trees decreases burning time, but may have temporary negative consequences on the vegetation under the pile due to the high temperatures generated by the fire.

Efficient fuel combustion results in less smoke production. Smoke production is increased by the presence of green vegetation, which contains a higher concentration of water than dormant vegetation. Dry fuels burn more efficiently. Grasses and forbs burn cleaner than shrubs and woody species. Adequate wind speed is important for flaming combustion, which is more efficient than smoldering combustion. Combustion efficiency decreases all air quality pollutants in the smoke except NO_X and CO_2.

Consider trade-offs when selecting the fire management practices best suited to a particular situation. Backfires burn more efficiently than headfires, but headfires take less time to burn. Increased burning efficiency results in increased levels of NO_X and CO_2 in the smoke but fewer overall pollutants.

Frequent burning results in a larger number of acres burned each year, but also in more rapid burn completion times due to fewer woody fuels. Frequent burning can also reduce wildfire occurrence, extent, and severity. Wildfire conditions provide few options for smoke management.

When planning a prescribed burn, consider not only the effects of the burn on or near the area burned, but also the effects of smoke on areas downwind. Individual producers using practices that mitigate the effects of the smoke from their fire can reduce air quality effects from the combined smoke from many fires. Cleaner air benefits everyone.

Adapted from

National Wildfire Coordinating Group Smoke Committee. Publication year unknown. *Smoke management and air quality for land managers: An online training resource — Lesson 3: Smoke management techniques* (online). Idaho State University. *www.frames.gov/partner-sites/emissions-and-smoke/educational-resources/tutorial/* Downloaded 9 Nov. 2012.

Hardy, Colin C., Roger D. Ottmar, Janice L. Peterson, John E. Core, and Paula Seamon (ed.). 2001. *Smoke management guide for prescribed and wildland fire 2001 edition*. National Wildfire Coordinating Group. PMS 420-2, NFES 1279. p. 135.

Wade, Dale and Hugh Mobley. 2007. *Managing smoke at the wildland-urban interface*. U.S. Forest Service Southern Research Station Gen. Tech. Rep. SRS-103. p. 2-3.

Weather Components that Affect Smoke Dispersion

The following weather components affect smoke dispersion, both by themselves and in combination.

Air Pressure: Pressure is the force per unit area exerted by the weight of the atmosphere. Avoid burning during periods of high pressure, which cause stagnant air conditions that keep smoke from rising.

Atmospheric Stability: Atmospheric stability is the resistance of the atmosphere to vertical motion. Moderately unstable conditions improve smoke dispersal and are preferred for prescribed burning, but highly unstable conditions such as fronts increase the chance of a prescribed burn escaping and becoming a wildfire.

Lapse Rate: Lapse rate is the rate of decrease in air temperature as elevation increases. It is an inverse measure of atmospheric stability. A plume of smoke will continue to rise and expand until it cools to the temperature of the surrounding air, at which point the smoke may sink back toward the ground and negatively affect air quality. The location where the plume sinks may be many miles from the fire location.

Temperature Inversions: When a layer of warm air lies above a cooler layer of ground air, a temperature inversion exists. When rising smoke encounters this layer of warm air, it cannot disperse upward and remains near the ground. This can cause visibility and health problems in the area near the fire.

Mixing Height: Mixing height refers to the height above ground level at which vertical air mixing air occurs. A low mixing height indicates that the air is stagnant, and smoke is held close to the ground. The lowest mixing heights often occur at night and early morning, with the highest mixing heights occurring in mid- to late afternoon. Since the mixing height generally decreases rapidly from late afternoon to nightfall, plan to burn during the middle of the day, when mixing heights are typically highest.

Wind: While other factors control the vertical movement of smoke, wind is responsible for controlling its horizontal movement. Winds are typically light and variable when the atmosphere is stable. Wind speeds near the ground are often lower than transport wind speeds located higher in the atmosphere. As air cools at night, it becomes heavier and can drift down valleys and drainages. This type of wind is often responsible for overnight smoke intrusions into populated areas.

Humidity: Water vapor combined with smoke can decrease visibility to near zero. Smoke particles act as condensation nuclei, promoting the fog formation. Temperatures near the dew point and low wind speeds promote fog formation. The combination of smoke and fog results in extremely low visibility, which increases traffic fatalities.

Fog and smoke, alone and in combination, can move down drainage areas for miles, causing dispersion problems at locations distant from the actual fire. As smoke moves down the drainage basin, the air temperature becomes lower, the relative humidity becomes higher, and fog formation is more likely. Other locations where fog is likely to form are near streams, lakes, marshes, and wetlands.

Humidity affects fuel moisture. As fuel humidity increases, combustion is slowed and more fuel is consumed during the smoldering phase. Smoldering combustion produces twice the amount of particulates as flaming combustion. High humidity conditions result in a decrease of emissions carried into the smoke plume, and lower lofting of the smoke plume into the atmosphere, both of which decrease smoke dispersion.

Combustion of high-humidity fuels also releases water vapor that decreases visibility.

Rain removes small smoke particles from the air, reducing smoke concentrations and improving visibility.

MIXING HEIGHT, TRANSPORT WIND, and CATEGORY DAY

A system exists for dealing with the ability of the atmosphere to mix and transport smoke throughout the boundary layer (which can extend upwards of 5000 feet above the surface) and over large distances.

“Mixing Height” or “Mixing Depth” (ft or m) signifies the height above the surface throughout which a pollutant such as smoke can be dispersed. During times of surface temperature inversions (typically nighttime with clear skies), the mixing height goes to zero and smoke dispersion is minimal.

“Transport Wind” signifies the average wind speed (knots or m/s) throughout the depth of the mixed layer.

“Ventilation Rate” (VR) equals the product of the two (knotfeet or m*m/s) and represents the ability of the boundary layer to get rid of the smoke. When VR values are low, there is not much mixing potential and surface air quality suffers. When VR values are consistently low (day and night), it is possible to “smoke in” large areas for several days.

Ventilation Rate (m*m /s) = Mixing Height (m) x Transport Wind (m/s)

Based on these variables, a “Category Day” system has been developed relating ventilation rate to smoke dispersal. A set of burning guidelines based on VR and Category Day has been developed and is shown below:

Category Day	Ventilation Rate (m*m/s)	Burning Guidelines
1	< 2,000	No burning
2	2,000 - 4,000	No burning until 11 a.m. and not before surface inversion has lifted; fire out by 4 p.m.
3	4,000 - 8,000	Daytime burning only after surface inversion has lifted.
4	8,000 - 16,000	Burning anytime. For night burns use backfires with surface wind speeds greater than 4 mph.
5	> 16,000	Unstable and windy. Excellent smoke dispersal but burn with caution!

Typically this chart is used with afternoon ventilation rate values (using afternoon mixing heights, after any surface temperature inversion has dissipated). Note that on nights with surface temperature inversions, the mixing height goes to zero and so does the ventilation rate. Situations to be avoided are successive days with afternoon Category

Day values 2 and below (or even 3 and below), as these scenarios can lead to “smoke-out” situations.

The National Weather Service (NWS) offices covering the Flint Hills Counties (Topeka and Wichita) offer forecasts of mixing height and transport winds in their fire weather forecasts. These fire weather forecasts can be found at the following links:

Topeka: http://www.weather.gov/forecasts/wfo/sectors/topFireDay.php

Wichita: http://www.weather.gov/forecasts/wfo/sectors/ictFireDay.php

Air Quality Concerns of Prescribed Range Burning in Kansas

Author, *Zifei Liu, Ph.D., Biological and Agricultural Engineering, Kansas State University*

Introduction

Prescribed range/pasture burning is a long-standing practice in Kansas used to enhance the nutritional value of native grasses and control invading weeds, trees, and brush. However, smoke plumes originating from these fires, particularly from burning in the Flint Hills region of eastern Kansas, have contributed to air quality concerns in the Kansas City and Wichita areas, and have affected several states downwind of Kansas.

Particulate matter and ozone precursors (nitrogen oxides and volatile organic compounds) are the smoke constituents of concern. The Kansas Ambient Air Monitoring Network has recorded elevated concentrations of both particulate matter and ozone in the air during periods of intensive range burning. Particulate matter causes haze and visibility concerns, while the fine particulates in smoke can contribute to health problems for anyone with respiratory illnesses. Ozone may aggravate asthma symptoms and impair the breathing of healthy individuals. Ozone is the key pollutant of concern in the Kansas City and Wichita communities, due to monitored exceedances of air quality standards.

Air quality regulation trends

The National Ambient Air Quality Standards (NAAQS) are evolving as new standards are developed for ozone and fine particulates. In 2006, the fine particulate 24-hour $PM_{2.5}$ (Particulate matter less than 2.5 μm in equivalent aerodynamic diameter) standard was reduced from 65 to 35 μg/m^3. In 2012, the primary annual standard of $PM_{2.5}$ was reduced from 15 to 12 μg/m^3. In 2008, the 8-hour ozone standard was reduced from 0.080 to 0.075 ppm, and a potential further reduction of the primary ozone standard to a range between 0.060 to 0.070 ppm is under discussion.

The continued lowering of ozone and fine particulate standards, together with the Regional Haze Regulations, will require changes in air quality management. In non-attainment areas where air quality violates the NAAQS, control measures must be implemented, which add significant regulatory and economic burdens. Air quality regulators are under pressure to quantify all sources contributing to poor air quality at a time of ever-tightening standards.

Prescribed burning is an important part of range management.

Prescribed range burning plans must be negotiated with the understanding that these plans compete for limited and decreasing allowable impacts on air quality. The interagency linkages between land managers and the air quality regulatory community are growing. Managers of future prescribed range burning will need to use all available information to reduce the smoke hazard.

Flint Hills smoke management plan

Existing regulations on agricultural burning are primarily enforced by local fire and emergency management personnel. Their primary concern is safety. However, the integration of smoke management efforts into fire management decisions becomes increasingly more important. As a result of exceedances of the ozone standard, in 2010, the Kansas Department of Health and Environment (KDHE) worked with stakeholders to develop a smoke management plan that recommended practices to reduce the air quality impacts of prescribed range burning in the Flint Hills. The plan is evaluated each year using input from stakeholders, which include land managers, the U.S. Environmental Protection Agency, and environmental groups. The plan is largely voluntary. A data collection pilot program was developed and a smoke

planning checklist is available as a form on the Fire and Smoke Planning Resource website (www.ksfire.org). Land managers are encouraged to document the number of acres burned, fuel load, and weather conditions for the prescribed burning activities. The goal is to develop a reporting system that would make this information more accurate, while protecting the privacy of landowners. After each burn season, air monitoring data from the existing KDHE network, weather conditions, and remote sensing data from satellites are examined by KDHE and shared with stakeholders.

Smoke management best practices

Recommended smoke management practices are summarized in Figure 1. These practices included recommendations from *Basic Smoke Management Practices* published by the Natural Resources Conservation Service (NRCS, 2011), as well as from the Kansas Flint Hills Smoke Management Plan (2010). Land managers can implement these practices to address air quality concerns associated with prescribed range burning. Before burning, land managers have several tasks to complete, including identifying the burn objective and developing a comprehensive burn plan. Appropriate authorities, neighbors, and others potentially affected by smoke should be notified. While burning, it is important to monitor and retain information about the weather, burn, and smoke. If air quality problems occur, documentation helps analyze and address air regulatory issues. After the burn, an evaluation of the success and impact of the burn is recommended.

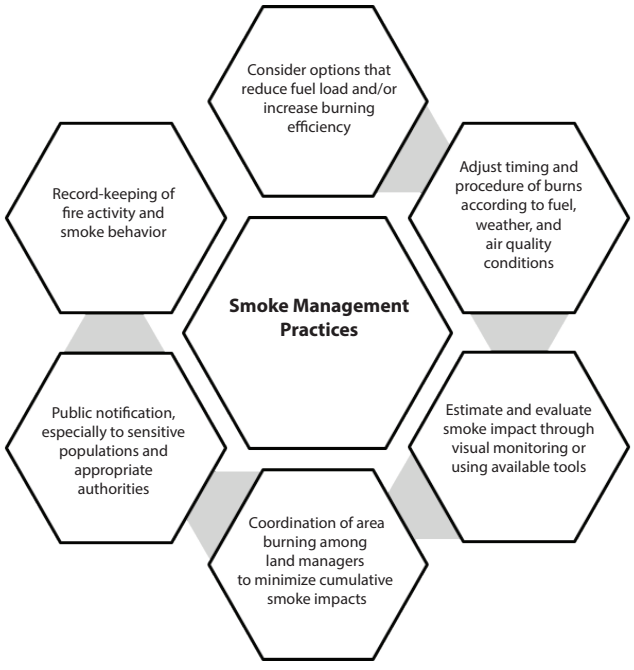


Figure 1. Smoke management practices to address air quality concerns. *(Adapted from NRCS Basic Smoke Management Practices, 2011, and Kansas Flint Hills Smoke Management Plan, 2010)*

Frequency of burns

One method of smoke reduction is to use a non-burning alternative, such as mowing or chemical control of invasive woody species. Another method would be to reduce the frequency of burns. Although scientific consensus supports the economic and ecological need for prescribed fires in native grasslands, there is debate regarding optimal burn frequency. While annual burns are preferred for optimal stocker cattle gains, other management goals (such as woody plant control) may be achievable with less frequent burns.

The frequency of burns usually varies from yearly to every third year, depending on the type of livestock operation (e.g., cow-calf, season-long yearlings, and short-season stockers), burning constraints, and weather/grass growth conditions. Frequent burning increases the number of acres burned each year, but it may also result in more rapid and complete burn due to less build-up of woody vegetation. Patch-burn grazing (PBG) has been suggested as a way to promote biological diversity in the Flint Hills and has the potential to reduce smoke emissions. Typically, one-third of a PBG range is burned each year on a rotational basis.

Timing of burning activities

The timing of prescribed burning activities is usually driven by specific management goals related to the desired vegetative conditions or animal weight gains. Timing of a burn also can significantly affect the production and dispersion of smoke. With air quality concerns, land managers should time their burns to ensure favorable fuel conditions and weather conditions to reduce smoke impact.

Burning at different times of the year results in different vegetative responses, although rangelands are resilient to fires at any time of year. Factors to consider when timing a burn are summarized in Figure 2. To maximize warm season tall grass production, prescribed burn activities in the Flint Hills are generally conducted during April. Weather conditions and safety issues further limit the number of suitable days for burning. Good air quality can be compromised when too many burns occur and a large amount of smoke is released into the air during a short time period. To partially address this problem, the Kansas Flint Hills Smoke Management Plan includes some restrictions on nonessential burning in April.

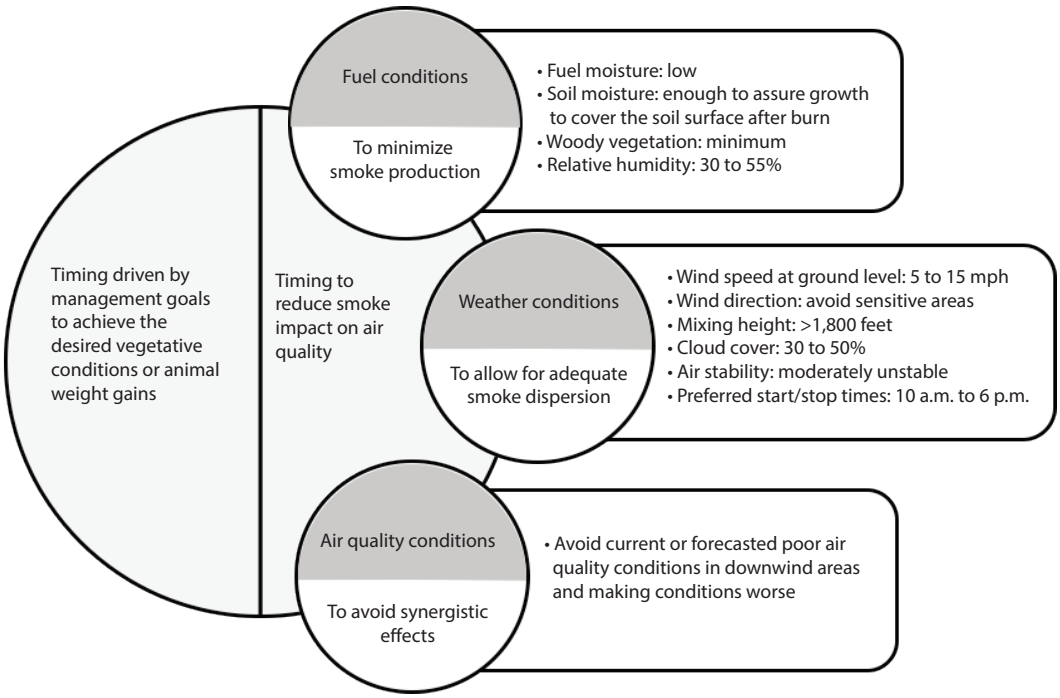


Figure 2. Considerations in timing of prescribed burning activities. *(Adapted from the Kansas Flint Hills Smoke Management Plan, 2010)*

Fuel conditions

Efficient fuel combustion results in less smoke production. High moisture levels in the fuel (grass/trees/brush) reduce combustion efficiency and produce more smoke. This water vapor from fire can condense onto fine particulate matter and increase haze formation. Grasses and forbs burn more efficiently than shrubs and woody species. Woody vegetation and denser canopy areas are often associated with smoldering conditions, which produce more smoke. Reducing fuel loads through management practices such as livestock grazing can reduce overall smoke emissions. Conditions contributing to efficient fuel combustion include minimal woody vegetation, low humidity of both air and fuels, ignition methods that create large, intense fires, and adequate winds to complete combustion.

Weather conditions

Wind and atmospheric stability influence the way smoke is dispersed. Desirable weather conditions allow for adequate smoke dispersion to reduce smoke impacts on air quality. Adequate wind speeds help disperse a plume, but strong winds also may cause a plume to bend over near the ground and inhibit vertical dispersion. Also, burning should occur when wind direction has minimal impacts on sensitive areas. Atmospheric stability refers to the atmosphere's ability for vertical motion, which is promoted by wind (causing turbulence) and heating effects (causing convection). In unstable conditions, the warmer, lighter air at ground level rises and mixes with the cooler air in the upper atmosphere, dispersing ground level pollution. In contrast, a very stable condition occurs when the air temperatures increase with height, which is referred to as a "temperature inversion," because the warmer air above cooler air acts like a lid, suppressing vertical mixing. For this reason, burning under a persistent temperature inversion is not recommended.

Mixing height defines the height above the ground through which relatively vigorous mixing will take place. Ideal mixing heights for burning generally occur during the day after the sun has adequately heated the ground. Mixing heights tend to decrease as the sun goes down. Clouds can reduce mixing heights because they prevent the sun from heating the ground, which is needed to promote convection. On the other hand, clouds are advantageous because they limit ozone formation through a reduction in photochemical reactions. Ideal burning conditions occur with cloud cover between 30 and 50 percent. Land managers can obtain information on weather conditions by accessing the National Weather Service Fire Weather Forecast website (www.srh.noaa.gov/ridge2/fire/).

Air quality conditions

When poor air quality conditions are observed or are forecasted in areas that may be affected by smoke, a burn should be rescheduled, if possible, to avoid making the conditions worse. Poor air quality is usually associated

with weather conditions that do not favor dispersion of air pollutants. However, on a day with suitable weather conditions for burning, too many burns may occur at the same time. Preferably, burning can be planned cooperatively so as not to overwhelm the ability of the atmosphere to disperse the smoke. Land managers can obtain air quality information from EPA's AIRNOW website: (www.airnow.gov/).

Estimation and modeling tools for smoke management

You may find the online smoke screening tool at ksfire.org useful when planning a burn. This tool can predict where and how smoke will travel and the potential for smoke from a particular location to affect concerned communities. The results help land managers determine whether burning should occur and to what extent it should occur to avoid air quality problems. More sophisticated modeling tools are being developed for better smoke management related to prescribed fires. Emission modeling tools take into account the fire activity information to calculate fuel consumption and to characterize smoke emissions. Smoke dispersion modeling tools take into account the weather conditions, along with the smoke emission data to evaluate impacts of smoke and the resulting concentrations of air pollutants to avoid exceedances of air quality standards. At a time of ever-tightening air quality standards, the need for further refinements of these tools continues to increase.

Smoke science and research

Ever-tightening air quality standards reinforce the need for increased knowledge and action on smoke issues and air quality. Currently, emission calculations for prescribed range burning are not accurate and reliable, due to a lack of information on areas burned, fuel load and combustion rates, and insufficient knowledge of emission factors. A high-quality smoke emissions inventory is critical in order to reduce uncertainty as to how fire should be managed. Also, in response to potentially more stringent ozone and fine particulate standards, air quality management is demanding higher levels of competency in smoke modeling as well as objective evidence that smoke models can provide accurate and reliable results. In circumstances where fire, climate change, and growing populations are interconnecting, it is clear that scientists and range managers need to improve understanding of the impact of smoke on human health and the health of the surrounding ecosystems, as well as the public perception of smoke. In 2010, the Joint Fire Science program conducted a wildland fire needs assessment and published a smoke science plan, which identified the following four linked and complementary research themes: smoke emissions inventory, smoke model validation, smoke and populations, and climate change and smoke.

Resources and references

Basic Smoke Management Practices. NRCS, 2011. Available at ftp://ftp-fc.sc.egov.usda.gov/AIR/smoke/BasicSmokeManagementPractices.pdf

EPA's AIRNOW website: www.airnow.gov

Joint Fire Science program Smoke Science Plan. 2010. Available at http://www.firescience.gov/documents/smoke/2010_JFSP_Smoke_Science_Plan_Final_Version_without_Appendix_B_1.0.pdf

Kansas Flint Hills Fire and Smoke Planning Resource website: www.ksfire.org

National Weather Service Fire Weather Forecast website: www.srh.noaa.gov/ridge2/fire/

National Smoke Management website: www.nifc.gov/smoke

The National Oceanic Atmospheric Administration (NOAA) Hazard Mapping System (HMS): www.osdpd.noaa.gov/ml/land/hms.html

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Kansas State University Agricultural Experiment Station and Cooperative Extension Service

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Considerations for Nighttime Smoke Dispersal

Introduction

Nighttime smoke dispersal from most prescribed fires is critical for public health and safety. For this reason, prescribed fire training and guidelines include detailed information about smoke management and remind burn managers to be constantly aware of weather, fuel, and other situations that might lead to smoke dispersion problems.

This fact sheet lists situations or conditions that fire management officers, burn bosses, and landowners should consider when planning and implementing an effective and efficient smoke management strategy for prescribed burns. A "yes" answer to the following questions may indicate a need to strengthen or modify smoke management plans and mitigation measures.

Planning the Burn

1. Are ignition activities, active burning, or smoldering planned during the period (1-hour prior to sunset to 1-hour after sunrise) when smoke problems are most likely to occur?
2. Are smoke sensitive sites, especially highways, down-drainage from the burn and within a distance (2 to 10+ miles) that smoke could flow into during the night? *The steeper the topography, the further smoke can travel.*
3. Are there structures or vegetation (trees) that would funnel smoke towards or into drainages?
4. Is there open water (streams, rivers, lakes, ponds) within or adjacent to the burn site?
5. Will the burn occur when the potential for fog is high? *The conditions most conducive for fog formation typically occur from late fall to late spring, when ground and water temperatures remain warmer than the nighttime air temperature.*
6. Is there potential for fog formation over nearby cool ground or water surfaces?
7. Does the burn unit contain pockets of woody fuels that could burn and smolder for long periods of time?
8. Is there a heavy duff layer or organic soil (peat) which could smolder for long periods if ignited?

Adapted from: Matthews, A. and V. Carver. 2011. Situation Awareness: Nighttime smoke and fog on prescribed burns. Southern Fire Exchange Fact Sheet 2011-2.

Implementing the Burn

1. Is the burn unit large with few options to stop the burn if things don't go as planned?
2. Does the local weather forecast warn of potential fog formation?
3. Are other burns occurring in the same airshed, potentially increasing nighttime smoke dispersion issues?
4. Is the smoke from the burn not dispersing as anticipated?
5. Are dew point and temperature predicted to move to within a few degrees of each (high relative humidity) other during the evening hours?
6. Are woody and heavy fuels igniting unexpectedly?
7. Are equipment breakdowns or changes in fire behavior causing delays in completing the burn, increasing the risk of active burning and smoldering into nighttime hours?
8. Are you relying on predicted nighttime winds to continue dispersing smoke? Nighttime smoke typically has no buoyancy to gain vertical lift and be influenced by upper winds; and regardless of forecasts, surface winds at night tend to be calm to light and variable, resulting in down- drainage movement of smoke.
9. Do any of the following National Fire Danger Rating System (NFDRS) indices fall within the stated range, indicating that heavy fuels may ignite and smolder?
   a. 100 hour fuel moistures less than 14 percent
   b. 1000 hour fuel moistures less than 19 percent
   c. KBDI (Keetch-Byram Drought Index) greater than 400
10. Is either of the following forecast indices in the range that indicates potential problems with nighttime smoke?
    a. LVORI (Low Visibility Occurrence Risk Index) greater than 5
    b. Nighttime dispersion index less than 4 (or 40, depending on scale)
11. Has a "new" event/activity resulted in a nearby area unexpectedly becoming a smoke sensitive site?

Careful consideration of the fuel type, local topography and nighttime weather conditions when conducting a prescribed burn can assist in making decisions that will avoid the deadly movement of smoke and smoke/fog combinations into sensitive areas, increasing the safety of the burn crew and the public.

Creating Firebreaks

Firebreaks are created or designated (if using natural features) to contain fires and keep them from spreading beyond the prescribed boundaries of the burn. Firebreaks work by restricting the fuel available to a fire. Firebreaks often serve as travel lanes for fire vehicles and burn crew. Technically, there are both firebreaks and fireguards. Firebreaks are areas of bare soil; fireguards are areas of reduced fuel; in the following discussion, firebreak will be used to cover both terms.

Check with your local Farm Service Agency (FSA) office prior to beginning any firebreak construction on Conservation Reserve Program (CRP) land to ensure compliance with program regulations. Contract modifications will need to be made when installing tilled firebreaks.

Firebreak width is largely determined by the fuel. Taller fuels require wider firebreaks. In general, a firebreak should be 10 feet wide for each foot of fuel height. An absolute minimum firebreak width is 6 feet. When highly flammable fuels such as redcedar, dead cottonwood, or kochia are near the edges of a burn unit, increase the width of the firebreak. These fuels burn with intensity, increasing the chances of embers flying across firebreaks and the fire escaping. Wider firebreaks should also be used when there are highly flammable fuels just beyond the firebreak, at locations where a fire is most likely to escape, or near valuable property such as a house.

Firebreaks can be either natural or constructed. Constructed firebreaks can be either tilled or non-tilled. The correct firebreak type depends on soils, topography, vegetation, degree of safety desired, and availability of natural features. In some instances, several firebreak types are used to encircle the area to be burned. Firebreaks can also be used in combination, such as mowing a strip on the inside of a tilled firebreak.

Tilled Firebreaks

Tilled firebreaks remove all fuel and expose mineral soil. These firebreaks are constructed using either a disk or a fire plow. Soils need to be dry enough to allow construction of these firebreaks without creating ruts or large clods. Because soils can stay damp for long periods of time during the winter due to snow as well as low temperatures and evaporation rates, tilled firebreaks need to be installed as early in the fall preceding the burn as practicable.

Disking is frequently used to construct firebreaks on CRP. It is rarely used on native rangeland unless there is a need to protect something extremely valuable near the fire. Since CRP fields have been farmed in the recent past, is it generally easy to get around the field with normal farm equipment. Disking should be done repeatedly (3-5 times) until the soil on top of the ground appears nearly pulverized and residue is buried. These tillage operations should be very shallow, only about 5 inches deep. Shallow diskings do not harm established grass roots, and perennial grasses will readily regrow. Avoid disking up and down slopes in a manner that will create erosion problems. Disked firebreaks can be combined with mowed firebreaks on CRP.

Fire plows create a narrow strip of bare soil. These plows do not turn over the soil but scrape the surface bare of vegetation. The firebreaks created by the fireplow are about 6 feet in width. Vegetation regrows from plant roots after the fire.

Tilled firebreaks can easily become muddy if precipitation occurs immediately prior to the burn. This can hamper fire vehicle movement on the firebreak.

Non-tilled Firebreaks

Non-tilled firebreaks work by reducing the amount of fuel on the surface of the soil. This slows fire speed and intensity, allowing easier fire line control. Non-tilled firebreaks may be the only practical method of firebreak construction in areas with rugged topography or rocky soil, and are preferred for native rangeland firebreaks in order to avoid the soil and plant disturbance caused by tilling.

Mowing is a common, low-cost method of firebreak construction. Mowed firebreaks allow easy movement of fire vehicles and are not subject to erosion. Mow low to the ground. Hay generated by mowing needs to be carefully raked and moved away from the firebreak. Raking the cut material into the area to be burned will allow the fire to consume it, but placing it too near the edge may increase the fire intensity and make fireline control more difficult. Damp hay can smolder for a long time, increasing chances of a fire escape after the fire crew has moved on. Wind can move hay across a firebreak, compromising its effectiveness. Move mowed material well into the area to be burned.

In some cases, baling the hay facilitates its removal. Bales can be taken off-site, or stacked in the field and allow to burn. Bales stacked in the field to be burned can burn so hotly that the grass beneath them is damaged, at least temporarily. Also, the bales can burn for a very long time after the rest of the fire has gone out, greatly increasing the duration of the post-fire monitoring period. These problems can be mitigated by opening the bales once they are transported into the burn area and re-spreading the material, but this requires additional time and labor. Bales from CRP firebreaks must be verified as destroyed. Contact your local FSA office for program regulations concerning firebreak hay on CRP land.

In extremely woody or brushy situations, firebreaks can be bulldozed. Emphasis should be on scraping away above ground vegetation, not excavating root wads. Large amount of fuel will be generated, so plan on either moving this material at least 100 feet inside the firebreak with out piling, or piling it inside the area to be burned and burning the pile prior to the overall burn. These coarse fuels will burn slowly, so choose a time to burn them when the weather is likely to remain stable for at least 24 hours.

Cattle can be used to remove vegetation in a pattern that can be used as a firebreak. Range cubes can be distributed or a mixture of 1/3 molasses to 2/3 water can be sprayed along the line where a firebreak is desired. Cattle will preferentially graze this area, reducing vegetation height. To use this method, begin during the grazing season prior to the spring when the burn is planned. One disadvantage of this method is that numerous

cow chips will be located on the firebreak, which will either need to be removed prior to burning or flipped into the fire during ignition.

The double-ring fire technique can be used to construct a burned fire break. A narrow fire line is allowed to burn, creating a small firebreak. A second fire is started 6-12 feet inside the firebreak and allowed to burn to the first firebreak. This method creates a secure firebreak using fire in a low-risk situation. This type of firebreak should be constructed prior to the day of the fire. This type of firebreak is also called a black line, and firebreak width can be increased by additional incremental fires inside the firebreak

Many firebreaks use existing features as either the firebreak itself or as a staring point for constructing a firebreak. Livestock trails or pasture roads can be utilized as part of a firebreak, especially as an edge off which a backfire can be lit. Mow any vegetation growing in the middle of the road. If trails are too close to a fence, it may be difficult to move fire vehicles into position alongside the ignition line.

Paved roads can be utilized as a firebreak, but be sure traffic will not be a concern. Ditches can present problems for fire vehicle movement and will likely contain higher fuel loads than grazed areas. Paved roads provide a smooth surface on which embers can slide, potentially causing fires on the far side of the road.

Relatively clean-tilled fields or those with growing cereal crops, such as wheat, can be used as a firebreak if the residue is not too heavy. However, the hot gasses created by a headfire can damage the wheat up to 150 feet inside the field even when the fire stops at the edge of the field. Avoid running a headfire into a growing crop.

Natural features such as rock outcroppings and streams can stop fires. However, fires can follow narrow cracks filled with roots, wind-blown debris, and vegetation in otherwise bare rock sites. These fires can smolder for hours and then reignite when they reach more dense vegetation, and thus require careful monitoring. Rock outcroppings can also be difficult to traverse with fire vehicles if the fire should escape to the other side.

Streams with water will stop fire if they are wide enough or the fire intensity is low enough to prevent embers from crossing the stream. Streams may have steep terrain or woody vegetation that restrict fire vehicle movement.

In many cases, pairing a natural feature with a constructed firebreak will minimize labor and increase the effectiveness of the firebreak.

Prepare firebreaks well in advance of the prescribed burn. Check firebreaks carefully the day of the burn to make sure tree branches, tumbleweeds, fence posts, or other flammable material is not lying on the firebreak and compromising its effectiveness. An additional benefit of firebreak construction is the protection it offers in case of wildfires. Firebreaks often provide emergency fire crews with a good location to begin control efforts. Thoughtful and careful construction of firebreaks is important to safe prescribed burning.

Firebreaks for Prescribed Burning

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Firebreaks, also known as fireguards, are one of the most important elements of a properly conducted prescribed fire. Firebreaks should be constructed by removing vegetation and exposing bare ground or mineral soil. This is done to keep the fire from creeping across the firebreak and escaping from the burn unit. Bare ground firebreaks are the safest to work with, but not the only type that can be used. Firebreaks serve several purposes, but the most crucial is to contain the fire within the boundary of the burn unit. Well-constructed firebreaks make burning safer and can reduce the amount of labor required on a prescribed burn.

Firebreaks are also used to define the boundary of the burn unit and help the crew know the area to be burned. Firebreaks allow access to the perimeter of the burn unit for personnel and equipment. Ease of crew movement is essential for watching for spotfires, monitoring potential problem areas, and mop-up after ignition. It is also safer and less strenuous on crew members to access the burn unit with vehicles rather than on foot.

Firebreaks can also be used to reduce fuel along the edge of a burn unit to make ignition safer. In situations when there are large quantities of fine fuel along the edge of the burn unit, flames can reach across a narrow firebreak causing the fire to escape. It can also create a tremendous amount of heat, which can put crew members at risk and damage equipment. Many prescribed fires are conducted inside a fence line. When the heat gets extreme, there is nowhere for the crew or vehicles to go because they are pinned against the fence. In these instances it may be necessary to mow a desired width inside the burn unit along the firebreak to reduce fireline intensity next to the firebreak. This will make ignition safer for personnel and equipment.

Firebreaks may not be difficult to build, but firebreak preparation is usually one of the greatest expenses when conducting a prescribed fire. Once the firebreaks are established, they should be maintained annually to keep future construction costs down. Using firebreaks as a road or disking them annually can maintain a firebreak indefinitely. Firebreaks that had to be dozed to remove trees or brush may need mowing or herbicide treatments annually to control regrowth.

Types of Firebreaks

The basic types of firebreaks are natural, existing, constructed, and mowed line/wet line. The type(s) and size of firebreak needed will be determined by fuel load, fuel type, topography, and weather conditions for each burn unit.

Natural Firebreaks

Most natural barriers such as bluffs, creeks, streams, rivers, and lakes make good firebreaks. Make sure the barrier being used as a firebreak is wide enough so the fire cannot burn across. One contingency is to have a plan in case the fire escapes across the firebreak. Can personnel and equipment be moved down, over, or across the barrier quickly enough to suppress the escaped fire before it gets too large? It may be necessary to place personnel on the other side of the barrier for added protection. When using streams beds, make sure they do not contain vegetation that will carry a fire. There are usually debris dams on streams which will allow fires to

Make sure the firebreak is wide enough to keep the fire from crossing. One item to consider is what to do if the fire crosses the firebreak. Can personnel and equipment be moved down, over, or across the barrier quickly enough to suppress the fire before it gets too large? It may be necessary to place personnel on the other side of the firebreak for added protection.

burn across if they are not removed or monitored. Often dry streams can have large amounts of vegetation grown up in the bed. Also in the late spring creeks and streams make good firebreaks, due to the fact that the areas along the banks green-up early making them less likely to burn.

Another type of natural firebreak is wet or damp vegetation. This entails burning fine fuels, such as grasses that are surrounded by timbered areas where the leaf litter is too damp or wet to burn. Typically, grass fuels will be dry enough to burn in a short period of time after a rain. The fire in the grass will burn into the wet leaf litter and go out. Prior to doing this, make sure that the leaf litter is too wet to burn by conducting a test fire. Once the fine fuels are burned and the leaf litter dries, the leaf litter can be burned into the blackened prairie openings. One thing to watch out for is large amounts of grass litter on the ground that did not burn. This fuel may now be dry enough to carry a fire.

Existing Firebreaks

Cultivated Fields

Cultivated fields or crop fields with non-flammable vegetation make prescribed burning very simple and safe. Make sure there are no crops planted in the field that will burn. If crops are present, do not allow a headfire to run into the field boundary. Heat from the fire can damage the crops for a considerable distance. If crops are present, it is best to backfire away from the field border.

Roads

Most roads make excellent firebreaks because they are bare ground and already in place. There are several types of roads that can be used as firebreaks. Two-track roads, or pasture roads, can be used as effective firebreaks. They work especially well when on the upwind side of the burn unit where the headfire will be set. They can also work for the downwind side of the burn unit where the backfire will be set. If a two-track road is used as a firebreak, make sure the road is down to mineral soil in the tracks. Mowing is normally used in conjunction with this type of firebreak. Often the center part of the road has tall grass in growing in it, so the road should be mowed before being used as a firebreak. It is also advisable to mow alongside the road on the side closest to the burn unit to reduce the height of the fuel, thus reducing fire intensity.

Gravel roads, county maintained roads and lease roads make good firebreaks because they allow for movement of fire equipment and personnel and are void of vegetation. Traffic on these roads should be considered as well, not only for the safety of those travelling on the road, but also for the person-

Two-track roads, or pasture roads, can be used as effective firebreaks. They work especially well when on the upwind side of the burn unit where the headfire will be set (as in this example). They can also work for the downwind side of the burn unit where the backfire will be set. If a two-track road is used as a firebreak, make sure the road is down to mineral soil in the tracks. Mowing is normally used in conjunction with this type of firebreak.

Gravel roads, county maintained roads and lease roads make good firebreaks because they allow for movement of fire equipment and personnel and are void of vegetation. Traffic on these roads should be considered as well, not only for the safety of those travelling on the road, but also for the personnel conducting the fire.

Paved roads can be used as firebreaks as well, but there are two major limitations. First, paved roads normally have more traffic, increasing the risk of an accident because of smoke or onlookers. Also, the fire crew is at increased risk working next to traffic on the road. Second, firebrands can easily slide across paved roads and cause spotfires.

nel conducting the fire. Most traffic on these roads occurs at specific times of day, usually in the morning or evening, so plan the burn appropriately. It may be necessary to plan for extra personnel to help with traffic control, or check to see if the local authorities can assist with these activities.

Paved roads can be used as firebreaks as well, but they have two major limitations. First, paved roads normally have a higher traffic load, increasing the risk of an accident because of smoke or on-lookers. Also, this puts the fire crew at risk working next to the road and traffic. Second, firebrands can easily slide across paved roads and cause spotfires. As with other types of roads, be sure to plan the burn according to traffic patterns and if possible request assistance with traffic flow from local authorities.

Constructed Firebreaks

Dozed or Scraped

Some of the best firebreaks are those that have been scraped to bare ground by a dozer or road grader/maintainer. Ideally, only the fine fuel is removed with little soil movement. Done properly, these firebreaks can be made economically and cause little erosion. Dozed or scraped firebreaks also provide a corridor for equipment and personnel to travel on safely and quickly. The main consideration for dozed or scraped lines is to find an equipment operator who is reliable and understands what you are trying to accomplish. Often equipment operators are not accustomed to scraping only the surface without moving a lot of soil. This type of operation can cause serious erosion problems and drastically raise the cost of the burn by increasing the time spent preparing the firebreak. It is also best to have the scraped soil placed away from the burn unit to reduce fuel build up that if ignited can smolder for days causing potential problems.

Some of the best firebreaks are those that have been scraped by a dozer or road grader/maintainer. The equipment operator should scrape only the surface in order to remove the fine fuel. Done properly, these lines can be made economically and cause little soil erosion.

Disked

Disking makes an excellent firebreak if done properly. It is usually best to mow first and then disk the firebreak until the ground is void of fuel. In some soil types, it may be necessary to disk the area two or more times. If this has to be done, it is best to disk in opposite directions. The main concern with disking is to incorporate the herbaceous material into the soil and not have continuous fuel across the firebreak. Even light amounts of contiguous fuels can cause a fire to escape across a disked firebreak; therefore it is very important that no contiguous fuel remains within the disked area.

The main concern with disking is to incorporate the herbaceous material into the soil and not have continuous fuel across the firebreak. Even light amounts of contiguous fuels can cause a fire to escape across a disked firebreak, so make sure there is no contiguous fuel left within the disked area.

Hand Lines

In areas that are forested, too steep for equipment, or where erosion will be a problem, hand lines may need to be used. Hand lines should be kept to the shortest distance possible because they require extensive labor to prepare. If leaf litter is the main surface fuel, leaf blowers and rakes can be used to remove the litter to bare ground. The best technique for preparing firebreaks in leaf litter is to have one or two crew members use leaf blowers to remove the leaf litter followed by personnel with rakes pulling limbs and logs out of the way. The person leading the crew should follow areas with lighter fuels and use natural firebreaks such as drainages and exposed rocks to make the operation easier. If the area is covered in grass, hand line preparation becomes harder and is less effective. Care should be used when burning off these lines and adequate water should be on hand for fire suppression.

Mowed Line/Wet Lines

Mowed firebreaks are usually used in conjunction with wet lines. A wet line consists of water sprayed on a portion of the mowed line, with the fire immediately ignited just inside the wet line. The wet line serves as the firebreak and the mowed line reduces the amount of fuel and fireline intensity. Extreme care should be exercised when using these types of firebreaks because the fire can still burn across them.

In areas that are forested, too steep for equipment, or where erosion will be a problem, hand lines may need to be used. These firebreaks should be kept to the shortest distance possible because they require a lot of labor to prepare.

To conduct a burn with a mowed line/wet line firebreak, the perimeter of the burn unit should be mowed as short as possible prior to the burn. Then just before ignition, spray water using a cone or fan type nozzle to a width of about 1 foot to 3 feet in the mowed area. Just spray to wet the ground; do not waste water by completely soaking the area unless there is an endless supply of water. Next, ignite the fire directly behind the person spraying the wet line and right next to the wet line in the dry area of the burn unit. Do not let the ignition person get too far behind the person spraying the wet line, because the wet line may evaporate and become ineffective. Be sure to light the fire as close to the wet line as possible and allow the fire to back away from the wet line. Remember, the only firebreak you have is a line of water. Be sure to have people come behind you to mop-up along the wet line.

One method that works very well when using mowed line/wet line firebreaks is to operate two waterlines from one pumper truck. The person on the first line sprays water right in front of the pumper truck. It is best to spray the wet line immediately in front of one of the tires on the truck, which allows the truck to press the water into the vegetation, making the wet line more effective. The ignition person follows behind the truck setting the fire. The person on the second waterline follows 50 to 150 feet behind the pumper truck extinguishing burning or smoldering vegetation next to the wet line and possible spotfires. The distance this crew member follows will depend upon the fuel load, flame height, and amount of heat being produced by the backfire. Crew members running the waterlines must be conservative with the amount of water they use, because this water will be needed for suppression if the fire escapes. Several crew members should follow the wet line and ignition crew with hand tools. A leaf blower can be used to completely mop-up along the edge by blowing smoldering mulch piles, cow chips, or small limbs back into the black of the burn unit. Lastly, have at least one other vehicle patrol and monitor for spotfires or fire creeping across the firebreak.

Remember – there is nothing to stop the fire from creeping across the mowed line/wet line firebreak. If not thoroughly

Mowed firebreaks are usually used in conjunction with wet lines. A wet line consists of water sprayed on a portion of the mowed line, with the fire ignited just inside the wet line. The wet line serves as the firebreak and the mowed line reduces the amount of fuel and fire intensity. Extreme care should be exercised when using these types of firebreaks because the fire can still burn across them.

monitored, fire can burn through the wet line and across the mowed line while the crew is not in the immediate vicinity. This results in an escaped fire and may cause a significant problem if not detected quickly. Remember, it takes more water, more equipment, and more personnel to conduct a burn when using mowed line/wet line firebreaks instead of bare ground firebreaks.

Be aware that mulch left over from mowing can cause problems as well. If the wet line is placed over the mulch piles, the underside of the piles combust, while the wet mulch on the top smolders. Later, when the wet mulch has dried the pile can re-ignite, causing an escape when the area is not being monitored. When using mowed lines, it is best to mow them right after a frost in the fall if the burns are to be conducted

There are several problems that can occur when using mowed line/wet line firebreaks. The main problem is that there is nothing to stop the fire from creeping across the mowed firebreak. Remember, it takes more water and more personnel to conduct a burn when using mowed line/wet line firebreaks instead of bare ground firebreaks.

in the late winter or spring. This allows for no re-growth of the mowed line and gives the mulch time to blow away and or decompose before being burned in the spring. Mowing firebreaks early and often can promote the growth of cool season plants that help make a green, less flammable barrier. Allowing livestock to graze the mowed lines will reduce fine fuel accumulation as well.

Width of Firebreaks

Firebreak width varies with each burn unit and depends on fuel load and type, topography, weather conditions, equipment, personnel, agency policy, and other factors. The Oklahoma Natural Resource Conservation Service (NRCS) recommends a minimum width of 10 feet or 10 times the height of the flammable vegetation in the area to be burned, on bare ground and mowed firebreaks. There are several fact sheets, books, NRCS technical guides, and other information on firebreaks that can be found throughout the United States. These documents should be used to gain additional information needed for constructing firebreaks and conducting prescribed burns in your area. For more information from the Oklahoma NRCS visit the following links:

Firebreak Standard 394
http://efotg.sc.egov.usda.gov/references/public/OK/394std.pdf

Firebreak Job Sheet
http://efotg.sc.egov.usda.gov/references/public/OK/394js_02.pdf

Prescribed Burning Standard 338
http://efotg.sc.egov.usda.gov/references/public/OK/338std_407.pdf

Special Considerations

Sometimes it may be necessary to mow inside the burn unit along the downwind sides of the firebreak to assist with the backfiring operation. Some fuels like sand sagebrush (*Artemisia filifolia*), annual broomweed (*Xanthocephalum dracunculoides*), and sand shinnery oak (*Quercus harvardii*) may not burn completely during backfiring or there may not be enough fine fuel for a backfire to carry. This makes backfiring unsafe because unburned fuels can carry a headfire into the backfire area and across the firebreak. Changing the structure and density of these fuel types helps to ensure that they will be completely burned next to the firebreak.

Brush Piles

A major problem that occurs when building firebreaks in areas with woody plants is what to do with the piles after clearing. Most equipment operators want to pile the brush next to the firebreak. This is a big mistake and will result in fires escaping from the burn unit and create unnecessary work. An alternative is to push the brush outside the burn unit or push and scatter the brush a safe distance inside the burn unit. The distance will vary with fuel type, fuel moisture, and fuel load, but 100 feet to 500 feet is usually recommended.

Grinders can be used to reduce brush piles along the firebreak. Grinders can reduce large trees into smaller piles of chips, which are much safer than large piles of whole trees.

Another option to reduce problems from brush piles is to pile the brush right next to the firebreak and place a bare ground firebreak around the pile to exclude it from the burn unit. This way, the unit can be burned without igniting the piles. After the unit has burned and conditions are favorable, burn the piles. Another option is to grind up the brush. There are grinders that can reduce large trees into smaller piles of chips, which are much safer than large piles of whole trees.

Preventing Erosion

When developing a firebreak, try to minimize potential erosions problems. On steep slopes, it may not be advisable to take the firebreak down to mineral soil. Instead, a mowed line/wet line firebreak may be the best option. Mowed line/wet line firebreaks and some hand line firebreaks can cause problems because they contain flammable material that may allow the fire cross if not closely monitored. For this reason, they should be limited to as short a distance as possible. There are several options that can minimize soil erosion on bare ground firebreaks. One option is to make water bars (i.e. terraces, cut-outs) to reduce channeling of the water. A second option is to use J-checking on plowed, disked, or dozed firebreaks, where the water is diverted every so often in the shape of a “J”. This prevents the water from following a long, continuous path and diverting it into or out of the burn unit onto the side slope. Still another option to reduce erosion is to plant a cover crop on the firebreak. When doing this, make sure the crop you plant is fire resistant and that it is green and actively growing when the unit is burned. Wind erosion on sandy soils is not a problem even with firebreaks that have been maintained for several years.

The Oklahoma Cooperative Extension Service
Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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BURNING METHODS AND TECHNIQUES

Methods of burning and several aspects of managing prescribed burns have been developed. Each offers opportunities under different conditions.

Smoke Management

From a public safety standpoint, smoke presents the greatest safety hazard. Houses, airports, and public roads are the major concerns.

Smoke moving over public roads creates a visibility problem and should be avoided. Two alternatives are available when burning next to public roads. The most desirable is to burn with the wind blowing away from the road. The other alternative would be to arrange for traffic control during the burning time. Such arrangements are often difficult to make due to the length of time involved and the need for more personnel or law enforcement.

Burning near an airport is similar to roads. Burn when the wind will blow the smoke away from the airport. In addition to poor visibility created by smoke, turbulence and updrafts within the smoke column can create control problems for light aircraft.

Smoke management criteria can be developed by understanding the factors that influence where smoke will travel. With no wind, smoke is carried vertically by the convection column (a chimney effect created by heat from the fire). As wind speed increases, the smoke column is bent down wind (Figure 1). The higher the wind speed, the farther the smoke column is bent toward the ground.

In addition to the convective lift and wind forces, smoke clouds spread horiziontally as they move down wind. The plot assumes that a burning firebreak exists on the down wind side of the burn area. Smoke can potentially spread at an angle approximately 30^{o} away from the outside edge of the burn. The major area of concern is the area defined by an arc drawn across the smoke path from the center of the burn area with a radius twice the distance across the widest part of the burn area (L in Figure 2). An additional area of concern is defined as the area an additional distance L downwind from the previous area. Topography can increase or decrease the size of the area. If the ground slopes up down wind, the distance is increased and vice versa.

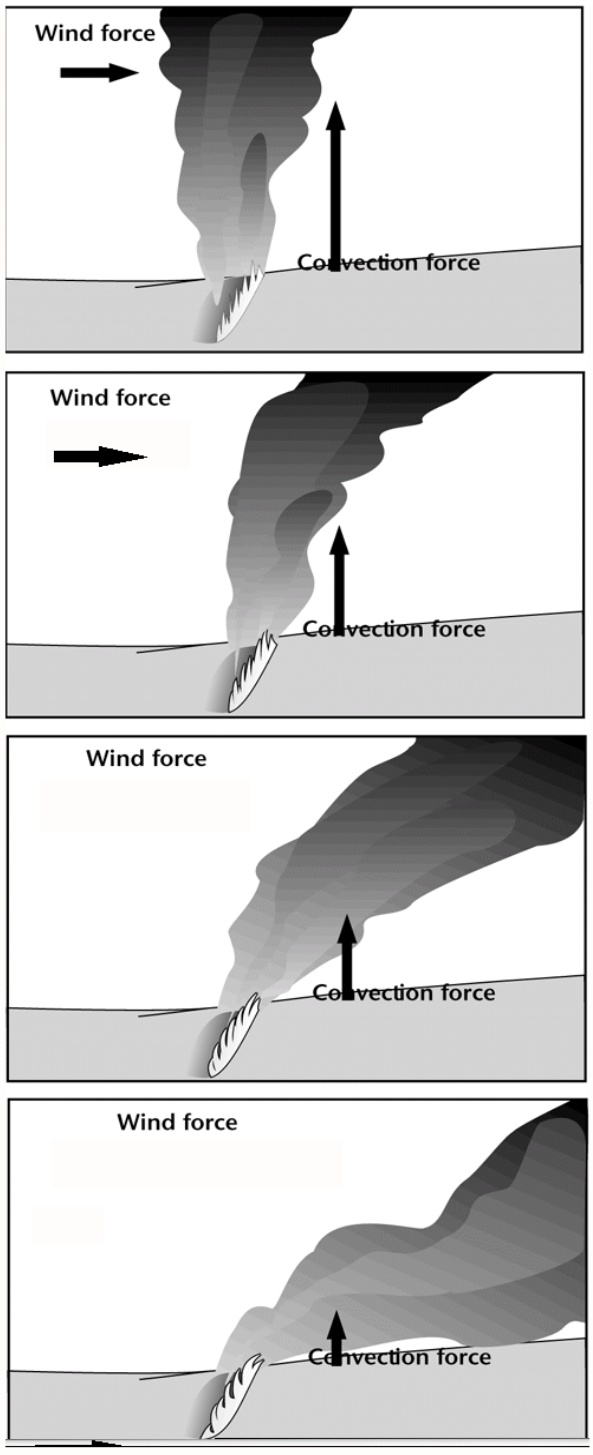

Figure 1 Wind has a major influence on behavior of the smoke column.

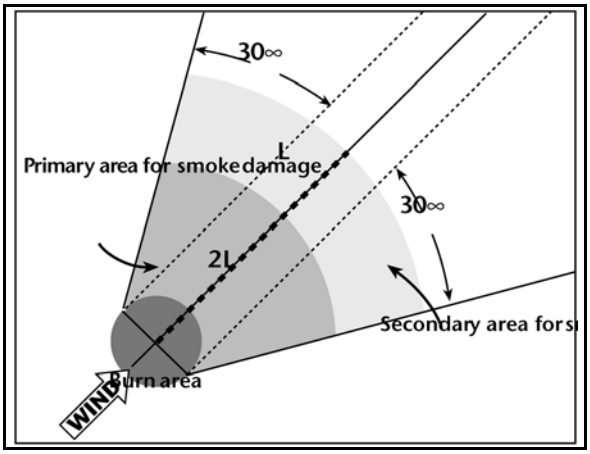

Figure 2 A plot of the smoke dispersion pattern from a prescribed burn

Within the areas defined, buildings, roads, and other structures or objects are potentially subject to damage. Care must be taken during planning to insure consideration is given to these areas.

Fire guards

Fire guards are narrow areas along the perimeter of a burn area prepared in advance of the burn to allow better control (Figure 3). A fire guard should be established well in advance of the burn date.

Fire guards are a necessary aid in conducting a prescribed burn (Figure 4). They are either burned or tilled. Burned fire guards are preferred since tilled fire guards on slopes tend to erode. Both types are effective if properly prepared. The width necessary varies according to vegetation height. A minimum width of six feet is required. Fire guards should be twice as wide as the tallest adjoining herbaceous material. Fire guards may be established in advance or at the time of the burn. Establishing fire guards during the dormant season is preferred.

Burned fire guards. Burned fire guards are established along the perimeter of the area, taking advantage of natural barriers such as livestock trails, heavily grazed areas, pasture roads, rock outcrops, stream beds, and other bare areas. When natural barriers are not available, mowing to reduce the vegetation height will aid in establishing the fire guard.

Fire guards are prepared by lighting short lengths of vegetation along a natural barrier or mowed area, moving into the wind on the downwind side of the fire guard area (Figure 3). The fire is allowed to back away. Exercise caution to prevent the fire from escaping. When both sides of the fire are extinguished, repeat the process on a new length of vegetation. Pre-burned fire guards must be relit before starting the headfire.

Cleared or tilled fire guards. Cleared fire guards are bare soil lines around the entire perimeter prepared by mechanical means. They should be used only where erosion is not a concern or where they can be prepared during dry periods before becoming wet during the burning period.

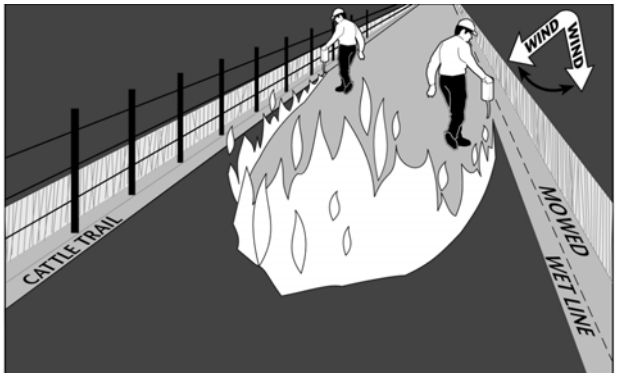

Figure 3 Firebreaks are a key part o prescribed burning. Begin by lighting next to a natural barrier (cattle trail) and moving into the wind. Ensure that the resulting headfire does not cross the downwind barrier.

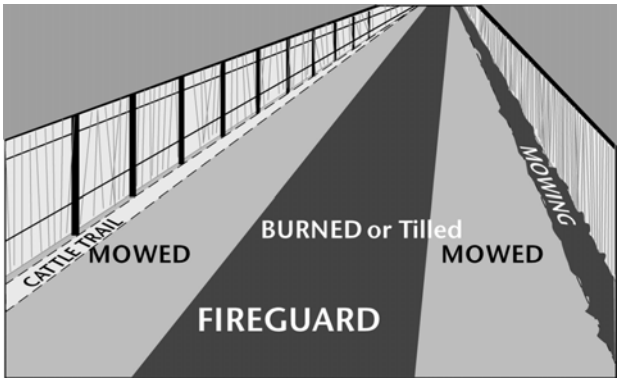

Figure 4 When mowing the edges of the burn area, the minimum width mowed must be a t least six feet, or three times the height of nearby vegetation, whichever is greater. This is necessary to prevent seed stalks or weed stems from falling across

BURNING METHODS

Three firing techniques are available to accomplish the completion of the burn: strip-head fire, flank fire, and ring fire. Each has a specific purpose and requirements.

Strip-head Fire Technique - The strip-head fire technique requires the setting of a line or series of lines of fire upwind from a fire guard or fire break so no single line can develop enough heat or convection to escape or cross the fire guard (Figure 5). The width of the strips is dependent on fuel type, amount of fuel, slope, and uniformity of the site. As the burned out area increases, the width of the strips can be increased. It is most useful to quickly widen firebreaks and burn areas adjacent to hazards (to control the size of fire and amount of smoke). Disadvantages of this technique include high heat concentration as the lines come together and must be used with a well developed fire guard system.

Flank Fire Technique - A flank fire requires several people walking in a straight line directly into the wind lighting a continuous line of fire (Figure 6). Extreme care must be taken to insure that everyone watches to see that the line remains straight and no one falls behind the line. This technique can be used to burn small areas when total control of the size of the fire and/or the amount of smoke is required.

Ring Fire Technique - A ring fire requires a firebreak downwind that provides adequate width to prevent the escape of the fire (Figure 7). On level to gently rolling topography, a minimum 150-feet-wide firebreak is adequate at the point where the head fire will have the longest run. Once the firebreak is secure, the remaining sides of the burn area are lit as rapidly as possible. The resulting head fire will sweep rapidly across the area. As the head fire builds in heat and size, a draft is created from the front and will draw the backing fires of the firebreak into the head fire.

A strong convection column develops in the center of the ring, increasing the speed of the fire as well as the intensity of the heat. Once the convection column develops, the fires are drawn rapidly to the middle of the burn area resulting in a rapid burn. Ring fires are the safest since once the ring is closed and the perimeter fires extinguished, little chance remains for the fire to escape.

Lighting Fires

A general rule for lighting fire lines is to light moving into the wind or down slopes unless one over rules the other. Following this guideline insures that the person lighting the fire is not put in a position that is dangerous.

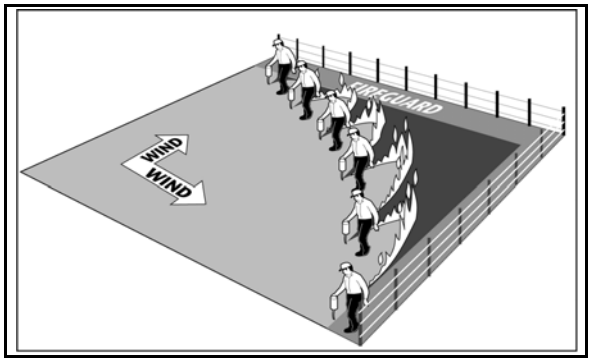

Figure 5 The strip-head fire technique is used to widen firebreaks and to burn areas where control of the size of the fire and/or the amount of smoke is required.

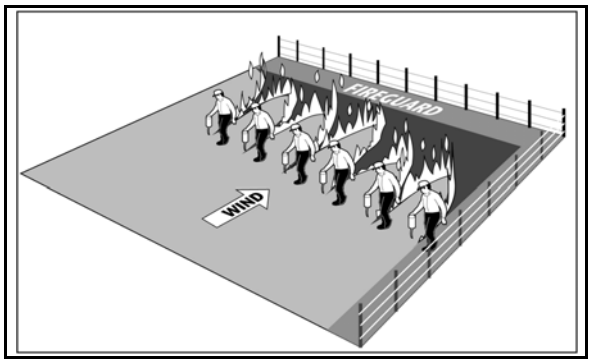

Figure 6 The flank fire technique is used to burn small areas where control of the size of the fire and/or the amount of smoke is required.

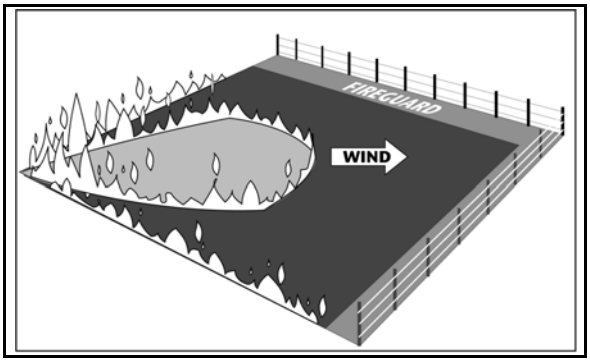

Figure 7 The ring fire technique is used to burn large areas. Once the ring is complete, the fire will burn itself out within the area.

After the Burn

Once the headfire has burned out, make sure small fires, burning logs, smoldering cow chips, and similar hazards are under control. Also, notify neighbors, fire department, and others. Clean up and repair all equipment.

Mop Up

Mop up is the process of checking the entire perimeter of the burn area to ensure that all fires or smoldering materials are out or removed to a safe area. This includes cow chips, logs and dead trees, small areas still burning, and fenceposts. Never bury cow chips as they can hold fire a long time. Water does not always extinguish the embers, but detergent mixed with water will help penetrate the cow chips.

Burning logs and dead trees can produce embers that are easily carried by wind to unburned areas. Carefully wet down and break apart or move logs from the edge of the burn. Dead trees that are burning should be cut down and treated the same as logs. Relight small areas of slow-burning grass and allow them to burn out rapidly. Check the perimeter at least twice.

Notification

After the burn and mop up are complete, notify the same list of people and agencies contacted before the burn. This will ensure that help will be summoned immediately if a wildfire or accidental escape occur due to incomplete mop up.

Clean Equipment

After the burn is complete, clean, repair and store all equipment. This prolongs equipment life and ensures that equipment is ready when needed again.

Source: Fick, W.H. 2006. A guide to understanding prescribed burning in agriculture. Kansas State University Research and Extension, Manhattan.

Even though the cedars were not completely consumed during the burn, the trees were scorched significantly and were killed by the enhanced heat provided by the "*cut and stuff*" cedar trees. Planning considerations should address concerns over the extreme heat and significant smoke produced with this technique.

Follow up burns in subsequent years will be needed to treat the proliferation of new seedlings that will come from the seed bank in the soil.

Kansas Prescribed Fire Council

Our Mission:

To promote greater understanding of the safe, legal and responsible use of prescribed fire as a natural resource management tool.

The council (KPFC) was established in September 2008 to protect private landowner rights and public land manager options to responsibly use prescribed fire as a grassland natural resource management tool.

Chairman:

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2610 Claflin Road
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Kansas Flint Hills Smoke Management Plan
http://www.kfire.org/

Partnering With:
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"Cut and Stuff"

to enhance the effectiveness of prescribed burning.

Fire is the original and most economical control method of eastern redcedar. Having adequate fuel and proper prescribed burning conditions, fire kills most cedars less than 4 feet tall. In order to kill larger cedars, land managers need to provide ladder fuels which allows the flames to reach taller trees.

Ladder fuels are alive or dead fuels that allows a fire to climb from the ground into the tree canopy. Common ladders fuels include tall grasses, shrubs, cut trees, and tree branches, both living and dead.

Planning Considerations:

Ladder fuels can be created by placing flammable material around the base of taller trees. When creating ladder fuels, to be most affective, material should be placed on the upwind side and at lower elevation of the taller trees to take advantage of fire behavior.

Creating this continuity in fuel from the ground to the tree canopy is an important task. Cedars cut from firebreaks are a good source of ladder fuels.

Burning cedars can throw embers a significant distance depending on relative humidity and wind speed, therefore, this practice should not be used within 500 feet of the firebreak.

Stuffed cedars should be cut and placed under live trees 1 to 9 months ahead of the planned burn date. Areas inaccessible to machinery can be treated by chain sawing trees on the perimeter.

Photos shows how the cut cedars are tightly stuffed against standing cedars to increase the effectiveness of the prescribed burn.

The resulting "*cut and stuff*" prescribed burns can render significant damage to large cedars in areas that fire normally would not have much impact.

K-STATE Research and Extension
Department of Agronomy MF3073 Prescribed Burning

Patch Burn Grazing

Patch burn grazing is a method of range management in which only a portion of a pasture or management unit is burned and then grazed, either by domestic livestock or native wildlife. The management unit can vary in size from just a few to several thousand acres. A single unit may have two or more patches, depending on management goals and pasture configuration. Patches that are burned are distributed spatially across the landscape and also may be distributed over time if burned at different times during the year.

Patch burn grazing is often used as part of a strategy to enhance habitat for specific wildlife species by increasing variability of the vegetative structure, which is referred to as heterogeneity. Patches will display a gradient of use as animals preferentially graze the most recently burned areas and avoid grazing on the areas not recently burned. Patch burning with grazing provides a wider range of grassland vegetation structure and composition than other burning and grazing regimes, which is important for certain wildlife species.

A patch burn grazing system is created by dividing a management unit into smaller units, generally not fewer than three units. Each subunit or patch should be relatively equal in size and forage production. The size and distribution of patches can vary widely. As an example, a 900-acre unit could be divided into three patches of 300 acres each, one of which is burned each year. Conversely, the same pasture might be divided into nine patches of 100 acres each, with three patches burned each year. The distribution of patches across the landscape would be vastly different in these two examples.

Natural firebreaks, such as streams and roads, often influence the location and distribution of patches. Each patch is burned in some system of rotation. Adjacent patches are not burned the same year when fire occurs only during one season (generally spring). A common fire return interval in eastern Kansas would be to burn each patch once every 3 years. Longer return intervals may be used in western Kansas where conditions are dryer and tree and brush invasion is slower.

Grazing distribution over the course of the multiple-year-burn rotation tends to be uniform, even in large pastures, reducing the need for cross fences. Existing cross fences can often be removed without sacrificing the overall grazing distribution. Fence removal results in less maintenance time and, for wildlife, fewer impediments to travel and decreased mortalities from collisions with fences. Removing cross fences also can result in revegetation of eroding trails along fence lines that no longer serve as livestock travel lanes. Fewer water developments may also be needed with patch burn grazing because the lure of high-quality forage will induce livestock to move longer distances from water sources. Since livestock congregate on the most recently burned patches, it is also easier to check the herd in large pastures.

Because fences do not separate patches, livestock and wildlife have access to the entire management unit during the grazing period. The reduced grazing pressure during the years when a patch is not burned allows desirable plants (decreasers) to regain vigor. Riparian and other sensitive areas also can benefit from a period free from heavy livestock use. Because the most recently burned patch will be grazed the most intensively, each year a patch needs to be burned to allow the vegetation in areas grazed heavily in the prior year to recover. In eastern Kansas, the recovery period generally takes 2 to 3 years.

In times of forage scarcity, the less recently burned patches can provide emergency forage. As forage is exhausted in the recently burned patches during a drought, or if growth is late to begin due to cold temperatures, livestock and wildlife can use the abundant but less nutritious forage in the unburned patches.

Patch burn grazing concentrates fuel (residual grass) in the lightly grazed areas. When burned, these patches will have hotter, more intense fires due to the increased fuel load. This may be useful in controlling undesirable plant species that are damaged by higher temperatures. Patch burn grazing may be less effective in pastures with a severe woody vegetation problem, where high burn frequency is necessary, but it could be used after woody vegetation is under control. Compared with annual burning of the entire unit, smoke production may be reduced if fewer acres are burned each year, but the reduction in acres may be offset to some extent by the higher fuel loads in the patches that are burned.

Although fewer acres are burned within a unit each year with patch burning, preparation and planning needs may increase. Additional firebreaks may be needed if natural fire barriers such as streams and roads cannot be used where patch boundaries occur. Constructed firebreaks may be more complex than when burning an entire unit and will likely exceed the length of firebreaks needed to burn the entire unit. Crew needs also may be greater than when burning the entire management unit. In general, more management, both in time and expertise, is required for patch burning. Costs for patch burning will likely exceed those for burning the entire management unit in a single burn.

Because patch burn grazing is a rotational burning regimen, it is important to burn the designated patches as scheduled to maintain the planned rotation. Weather and other factors may make it impossible to burn the patches as planned. Failure to burn designated patches during a given year will disrupt the burn rotation schedule.

While not applicable for all situations, patch burn grazing can be effective in achieving wildlife and grazing management goals. Patch burn grazing also may result in reduced costs, as fewer water developments and cross fences may be needed to achieve good forage use. The cost of implementing partial pasture prescribed burns may offset these savings, however. Ecological parameters, such as improved stream water quality, decreased erosion, and improved plant composition, also may be enhanced with patch burn grazing. Despite greater management requirements, patch burn grazing is a range practice worth considering when wildlife and habitat management is the primary goal. Patch burn grazing can provide a shifting mosaic of differently aged burns, resulting in greater heterogeneity important for meeting the varying habitat needs of many wildlife species.

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Common Problems with Burns

by Mike Porter, The Samuel Roberts Noble Foundation

Planning and preparation for prescribed burns should start several months or even a year prior to a burn. The following issues represent the most common problems we encounter regarding well-intended, but poorly prepared or executed burns:

- Little training and experience
- Inadequate fine fuel
- Absence of a well-prepared burn plan
- Poorly prepared fireguards
- Coarse or volatile fuels too close to fireguards
- Impatience (related to poor decisions)

Lack of training can be overcome by attending prescribed burning workshops and courses taught by qualified personnel, such as extension, universities, Natural Resources Conservation Service, the Noble Foundation, etc., and reading appropriate publications prepared by such entities. Experience can be obtained by helping on several burns conducted by knowledgeable, well-trained burn managers and asking questions while helping.

Inadequate fuel is generally a result of inadequate rest from grazing, low rainfall, infertile soils, poor range condition and/or excessive amounts of some woody species. Although inadequate fuel makes it difficult or impossible to accomplish burning objectives, it is seldom a safety or containment problem, unlike these other issues.

Well-prepared burn plans require time, study and thought, but force managers to carefully and thoroughly plan burns and adequately prepare for contingencies. After a good burn plan is completed for a tract of land, future burns on the same tract of land require only minor tweaking of the original plan.

Appropriate fireguard preparation depends on the quantity of fine fuels present, proximity and volume of coarse fuels, environmental conditions allowed in a burn prescription, skill of a burn crew, size of a burn, erodibility of soils and types of fire suppression equipment available. For example, two miles of 8-foot-wide disked backfire and flank fireguards through ungrazed tallgrass prairie would be inadequate for an inexperienced burn crew to accomplish a burn safely within five hours using a small volume power sprayer, such as a typical cattle/herbicide sprayer, with 40 percent relative humidity and 10-mile-per-hour winds. However, a burn with these parameters probably could be accomplished safely with a 12-foot disked fireguard adjacent to the fine fuels and 12-20 feet of short-mowed vegetation along the outside of the disked strip. Mowing should occur several weeks or months prior to a burn to allow most clippings adequate time to disperse and/or decompose. Sometimes, additional mowing or raking is necessary to break up clumps and scatter clippings.

Coarse and volatile fuels too close to backfire and flank fireguards are probably the most common problems that we encounter with inexperienced burn managers. Coarse fuels include things such as brush piles, logs, dead trees, hollow live trees, clumps of mowed grass or hay, and clumps or turnrows of mixed soil and grass. Volatile fuels include things such as eastern red-cedar trees and Ashe juniper trees. Volatile fuels too close to a fireguard can throw embers considerable distances beyond a fireguard. When burning several acres at a time, fuels next to a fireguard should burn out quickly and safely, so a burn crew can move on without risk of embers blowing across a fireguard. Preferably, coarse fuels and juniper trees should not exist in a burn unit within 50 yards from the outside edge of backfire and flank fireguards (farther for elevated coarse fuels such as dead or hollow trees).

An example of impatience would be a burn manager's decision to burn outside of a written prescription because he/she wants to accomplish a burn by a certain date or is nearing the end of a burning season. A major purpose of a burn prescription is to define the conditions when a burn can be conducted safely. Burning outside of a prescription invites problems. Impatience also pertains to ignition crews traveling too quickly while igniting backfires and flank fires. Ignition crews traveling along backfires and flank fires should create adequately wide blackened areas along the fireguards behind them as they progress.

There is much to learn and experience before a person becomes a skilled burn manager. However, most people can become proficient if they are willing to commit the time and effort.

http://www.noble.org/Ag/Wildlife/BurnsCommonProblems/index.html

Contingency Planning

Despite the most careful preparations, a prescribed burn can escape from the area intended for burning. Because the precise location and nature of the escape can't be known in advance, considering your response to an escape in advance of the prescribed burn can increase the possibility of early control and minimize damage to neighboring property.

Analyze what is likely to happen if the fire leaves the prescribed burn area. Adjacent land may consist of cropland which is unlikely to burn or miles of highly flammable grassland. Slopes and ravines can increase fire intensity. Nearby homes may be occupied. Pets and livestock may suddenly be in the path of fire. The new trajectory of the fire may cause it to lay smoke over roads.

Provide the burn crew with emergency procedure instructions, including the location of safe areas, during the pre-burn briefing. Point out the areas around the burn perimeter where a fire is most likely to escape or where homes or other valuable structures are nearby. Check to see that each vehicle has a copy of emergency notification phone numbers, and make sure the burn boss has the fire department phone number programmed into his/her cell phone. Identify multiple safe areas (safety zones) where crew members can go if a fire escapes and communicate how to get there. Be aware that gasses produced by the fire can be as lethal as the heat produced by flames. Because water bodies tend to be in low-lying areas, heavy gasses can collect above the water rendering them unsuitable as safety zones.

During the burn, keep abreast of changing weather conditions, especially wind speed and relative humidity changes that could increase fire intensity and volatility. Having an off-site person monitor weather data and report changing conditions can alert the burn boss to the increasing chance of escapes and the need for extra vigilance.

If a lookout has been posted who can see the exact location of the escape, the chance of immediately identifying and intercepting the escape is increased. The lookout can supply information to the burn boss, who can reassign crew and equipment to control the escape. Early intervention, when the escape is still small, increases the chances that the burn crew can handle the escape. Continue to monitor all fire lines at all times to prevent additional escapes, and reduce or cease ignition until crew members return to their usual locations.

If the escape is too large for the crew and equipment to handle, the fire department should be called. The burn boss is responsible for the decision to call. Call the fire department sooner rather than later. Give the location of any houses or confined animal operations in the path of the fire that will need special protection. Crew members should move out of the path of the fire into previously identified safe areas.

If you provided a copy of your burn plan to the fire department prior to burning and can tell them on the burn plan map where the fire escaped, they will have a good idea of where the fire is moving. Supply the location of the intersection closest to the escape,

using street names. Alert the fire department to known hazards that may be difficult to see and that can impede vehicle movement, such as trench silos, junk piles, or fences (especially old fences that have partially fallen down), Provide the location of field entrances, gates, and stream or ravine crossing points.

When the fire department arrives, they are in charge. Follow any instructions that are given. Assist the fire department in whatever way possible. Move your vehicles and crew out of the way if necessary. Provide the location of any nearby water sources, such as water tanks and rural water district standpipes. If there are nearby ponds or streams that could be used as a water source, show the fire department the best route to access this water. If possible, carry connectors that are compatible with fire department equipment and can be used to transfer water from your equipment to theirs.

If livestock may be impacted by the fire, contact the owner if there is time and follow his/her instructions for moving the animals. Open gates and allow livestock to move away from the fire, and close gates to keep livestock from moving towards the fire. Herd animals around the edge of the fire and into the blackened area where it has already burned. Cut fences if necessary and move livestock onto cropland, minimizing the damage to growing crops as much as possible. Release penned livestock from corrals and barns that may burn. Bolt cutters may be necessary to open padlocked gates if keys are not available.

If smoke is crossing a highway and the sheriff or highway patrol has not yet arrived, station crew members alongside the road at both sides of the smoke column to flag down cars and stop them from entering the smoke. Deaths from vehicle collisions due to smoke on the highway and its associated low visibility generally exceeds the number of deaths of fire-fighting crew members. As daylight decreases, the chance of smoke causing a vehicular injury increases.

Planning for the worst can decrease reaction time, increase fire crew speed and efficiency in handling the escape, and decrease the negative consequences of an escaped fire. Early intervention can keep a small escape from becoming a raging wildfire.

Notification and Emergency Information

Landowner/Operator _____

Land legals _____

Directions to fire (road names) _____

_____

_____

Phone number/Contact Information	*Intent to Burn*	*Fire Lit*	*Fire Out*
Dispatcher _____	○	○	○
Fire Department _____	Don't hang up in an emergency. Wait for instructions.		
Neighbor 1 _____	○	○	○
Neighbor 2 _____	○	○	○
Neighbor 3 _____	○	○	○
Neighbor 4 _____	○	○	○
Off-site Weather Monitor _____		○	○

Attach map with delineated burn area to this sheet.

Pre-Burn Briefing

Review the burn plan and make sure everyone understands it.

a. Burn objectives:
    a. Why are we burning?
    b. What do we hope to accomplish (objectives)?
b. Review Burn Unit features and Map
c. Explicitly identify burn boundaries.
d. Point out important hazards.
e. Identify anticipated fire movement/behavior related to terrain and fuels.
f. Identify which direction smoke will be travelling.
g. Point out safe zones, critical holding points, and escape routes.

Make crew assignments.

a. Hand out lists with the names of all crew members.
b. Define everyone's role during the burn.
    1. Burn Boss
    2. Team Leaders/Line Boss/holding and firing crew
    3. Equipment operators
    4. Lookout/weather updater

Review the weather forecast.

a. Review current forecast.
b. Point out approximate time of anticipated wind changes.
c. Describe expected fire behavior.

Communications

a. Assign communication devices.
b. Demonstrate hand signals and their meanings.

Operations

a. Describe ignition plan and sequence.
b. Assign crew locations.
c. Assign vehicle locations and operation parameters (lights).
d. Review required PPE.
e. Point out known hazards: terrain, wildlife, smoke.
f. Review contingency plan.
    1. Location of safe zone/escape routes.
    2. Crew member responsible for summoning assistance (escapes and injuries).
    3. Crew member responsible for leading attack on escaped fire.
    4. Crew member responsible for directing crew on original fire.
    5. Review suppression strategy for escaped fire.

Pre-Burn Checklist

Equipment

- Equipment has been tested and is correctly functioning.
- Spare parts for critical components are on hand.
- Equipment is on site and positioned correctly.
- Radios are all on same channel.

Firebreaks

- Firebreaks are prepared according to prescription.
- Firebreaks have been checked to make sure nothing is compromising their effectiveness (tumbleweeds, fallen post/trees, too much remaining litter).

Weather

- Recent (less than 2 hours old) forecast is in hand.
- Weather is within prescription.
- No major fronts are expected within 24 hours.
- Projected smoke trajectory will not create hazards.

Notification

- Dispatcher/fire department/law enforcement has been notified.
- Appropriate permits have been obtained.
- Neighbors have been notified.

Crew

- All crew members are present and ready for burn.
- Crew members have been fully briefed.
- Look-out is in position and in communication.

Operations

- List of emergency numbers and land location (street and legals) are in every vehicle.

Test Fire

- Test fire has been lit and fire behavior observed.

Go or No Go?

Mop-Up and Post-burn Briefing

Mop-Up

1. Patrol perimeter and make sure fire is out at all edges.
2. Check hot spots (coarse and compacted fuels) repeatedly. a. Break apart fuel and add water to extinguish fire
3. Add additional ignition to slow-burning areas (such as cool-season grass) to complete burn rapidly.
4. Notify dispatcher and neighbors that burn is complete. Fire and smoke seen after this notification indicate a wildfire.
5. Monitor until all smoldering embers are completely out. Break apart smoldering fuels and douse with water. Move smoldering fuels to interior of the burn (away from firebreaks).
6. Clean, repair, and store equipment.

Post-burn Briefing

1. Did the burn go as planned?
2. What problems were identified during the burn?
    a. Unpredicted fire behavior observed
    b. Difficulties controlling the fire
    c. Communication failures
    d. Dangerous situations that developed
3. What could be improved next time?

Post-burn Evaluation

a. Were burn objectives accomplished?
b. When will next burn be needed?
c. Will burn plan need adjustment for next burn?
d. Were there injuries, escapes, equipment malfunctions, or complaints?
e. Did fire behave as expected? If not, why?

PRESCRIBED FIRE GO/NO-GO CHECKLIST

(Prescribed Fire Plan, Element 2B)

Preliminary Questions	**Circle YES or NO**
A. Have conditions in or adjacent to the ignition unit changed, (for example: drought conditions or fuel loadings), which were not considered in the prescription development? If **NO** proceed with the Go/NO-GO Checklist below, if **YES** go to item B.	YES NO
B. Has the prescribed fire plan been reviewed and an amendment been approved; or has it been determined that no amendment is necessary? If **YES**, proceed with checklist below. If **NO, STOP: Implementation is not allowed. An amendment is needed.**	YES NO

GO/NO-GO Checklist	**Circle YES or NO**
Have ALL permits and clearances been obtained?	YES NO
Have ALL the required notifications been made?	YES NO
Have ALL the pre-burn considerations and preparation work identified in the prescribed fire plan been completed or addressed and checked?	YES NO
Have ALL required current and projected fire weather forecast been obtained and are they favorable?	YES NO
Are ALL prescription parameters met?	YES NO
Are ALL smoke management specifications met?	YES NO
Are ALL planned operations personnel and equipment on-site, available and operational?	YES NO
Has the availability of contingency resources applicable to today's implementation been checked and are they available?	YES NO
Have ALL personnel been briefed on the project objectives, their assignment, safety hazards, escape routes, and safety zones?	YES NO

If all the questions were answered "**YES**" proceed with a test fire. Document the current conditions, location and results. If any questions were answered "**NO**", DO NOT proceed with the test fire: Implementation is not allowed.

After evaluating the test fire, in your judgment can the prescribed fire be carried out according to the prescribed fire plan and will it meet the planned objective? **Circle: YES or NO**

Burn Boss Signature:_____ Date:_____

Fire Management Practice (FMP) Checklist

Preburn

- Identify the area to be burned, the burn objectives, site characteristics, and desired atmospheric conditions.
- Area Identification – location, size, proposed dates of burns.
- Objectives of the prescribed fires – forage improvement (yield, quality), weed/brush control (target weeds – recommended timing), wildlife habitat enhancement, CRP contract requirements.
- Site characteristics – fuel condition (moisture, loading, type), soil moisture, hazards.
- Desired atmospheric conditions – wind direction, wind speed, relative humidity, air temperature, and cloud cover.

Day of Burn

Identify the conditions on the day of the burn. Check the Fire and Smoke Planning Resource web site (http://www.ksfire.org). It is also recommend that a test fire be used to ensure the conditions are favorable for burning.

- Time fire started _____
- Wind Speed _____
- Wind Direction _____
- Relative Humidity _____(30%-55%)
- Air Temperature _____
- Cloud cover _____ (30%-50%)
- Trans. Wind Speed _____(8-20mph) (7-17 knots) (3.6-8.9 m/s)
- Mixing Height _____(min. 1800ft. or 548m)
- Soil Moisture _____(saturated, moist, dry)
- Fuel Moisture _____(moist, dry)
- Model Run _____ yes _____ no
- Test Fire Behavior

  _____
  _____
  _____
  _____

Post Burn

- Hotspots Extinguished _____
- Date/Time Fire Extinguished _____
- Mop-up Completed _____
- Final Perimeter Checked _____
- Equipment Collected _____
- Local Officials Notified Fire is Out _____
- Total Acres Burned _____

Objectives accomplished? (weed control, forage improvement, wildlife habitat enhancement, other)

Other issues (fire behavior, intensity and control, weather issues, fuel conditions, equipment problems, staff report out, complaints, etc.)

A Written Prescribed Burning Plan Helps to Accomplish Goals

by Mike Porter, The Samual Roberts Noble Foundation

Prescribed burning is one of the most important land management tools available to manage native plant communities for wildlife habitat or cattle forage in south-central Oklahoma and North Texas. When properly used, it helps accomplish land management goals, but it can impede accomplishment of goals when applied incorrectly. This article addresses the importance of a written prescribed burning plan.

I, like most land managers, would prefer to not write prescribed burning plans. I would prefer to "get on with it" and simply apply the tool of fire. However, safe and successful application of fire to accomplish specific land management objectives is far from simple. Sure, it is simple to light a match; but to make fire work for you in a safe, predictable manner is a much more complicated matter.

A well-written prescribed burning plan accomplishes several positive things: it forces us to thoroughly plan a burn; it forces us to understand and define the conditions when fire can accomplish our goals; it forces us to understand and define the conditions when it is not safe to burn; it makes us prepare contingencies for problematic situations that might develop; it helps us recognize our knowledge, equipment and preparation limitations for a prescribed burn; and it helps minimize our liability when we adhere to the plan because it demonstrates we are knowledgeable about fire and do not negligently apply this tool.

A prescribed burning plan can be prepared for any legitimate situation. The following items and issues should be addressed in most prescribed burning plans:

- Preparer's name
- Date of last revision prior to burn
- Legal description of burn unit and directions to it
- Map of burn unit
- Plant communities and topography in burn unit
- Prior burn history
- Goals and objectives for burn
- Fireguards, grazing deferment and other burn unit preparation
- Fire boss and fire crew
- Equipment list addressing vehicles, ignition, fire- fighting, safety and clothing
- Protection of fire sensitive locations within burn unit
- Fire and smoke sensitive areas outside burn unit and plans to minimize impact
- Civil authority and neighbor notification procedures and applicable permits
- Desirable and unacceptable burn dates and times
- Desirable and unacceptable fuel types and fuel loads

Flank fire ignition using the mowed wet line fireguard technique at Lake Murray Field Trial Grounds (photo by M.D. Porter).

- Desirable and unacceptable relative humidities and air temperatures
- Desirable and unacceptable wind directions and speeds
- Desirable and unacceptable 1-hour dead and live fuel moistures, such as grass and juniper
- Desirable and unacceptable near surface soil mois tures
- Desirable and unacceptable atmospheric mixing con ditions
- Ignition procedures
- Contingency plans for spot fires, escaped wild fire and other problematic scenarios
- Mop up and monitoring procedures
- Post burn management
- Records of forecasts examined prior to starting the burn
- Records of actual conditions measured at start and end of burn
- Post burn evaluation

Land managers should continually strive to learn more about fundamentally important land management issues, such as fire ecology. Acquisition and application of such knowledge is necessary to effectively manage native plant communities.

NATURAL RESOURCES CONSERVATION SERVICE

CONSTRUCTION SPECIFICATIONS

PRESCRIBED BURNING

1. Criteria

This practice will be applied in accordance with all state and local laws and ordinances. Refer to Section I, in the electronic Field Office Technical Guide (eFOTG). Contact the local fire department to determine current county burn policy.

All Natural Resources Conservation Service (NRCS) employees must have the proper certification and training to plan and to participate in prescribed burning activities. (Refer to General Manual Title 190, Ecological Sciences, Part 402.)

A 24-hour weather outlook is required prior to doing a prescribed burn.

The burned area must be incorporated into a system of management allowing for the response of the desired plant community. Refer to Conservation Practice Standards and Construction Specifications 528, Prescribed Grazing, and 511, Forage Harvest Management.

When wildlife habitat improvement is an objective, refer to the Habitat Appraisal Guides or Conservation Practice Standard and Construction Specifications 645, Wildlife Upland Habitat Management, for the desired plant community for the management species.

Plan precautionary measures to protect sensitive wildlife habitat, headquarters, oil and gas sites, windbreaks, highly erodible areas, archeological/cultural, or other areas that would be unsafe or undesirable to burn.

Prescribed burn plans shall be developed using the Form KS-ECS-338, Prescribed Burn. Burn plans shall include the necessary personnel, equipment, and firebreaks to conduct a safe burn.

Smoke management considerations should be addressed in the burn plan and included on the map or sketch.

Dimensions and types of firebreaks will be designed for each burn and recorded in the Prescribed Burn Plan. The effective width should be approximately 10 times the height of the vegetation being burned. The width of the firebreaks includes the constructed firebreaks and the burned firebreak. (Refer to Conservation Practice 394, Firebreak.)

Generally, create burned firebreaks or blacklines under the following criteria:

Wind velocity: 4 to 6 mph
Relative Humidity: 40 to 60 percent
Air Temperature: < 60°

When burning volatile fuels with potential for down-range spotting, a 300 to 500 feet minimum width shall be used for firebreaks.

Follow the manufacturer's label when using fire retardant.

Burning is not recommended when: (1) air temperature exceeds 80 degrees F (except for reclamation burns), (2) wind velocities exceed 20 mph, (3) relative humidity is less than 20 percent, or (4) variable or no-wind conditions.

The fireboss will be the sole leader and coordinator of all prescribed burning activities.

Burning is not recommended within 12 hours of a predicted wind shift.

For specific purposes and conditions for burning, see Table 1.

2. Considerations

Timing of the burn is the most critical element for obtaining the desire results from the burn. The kinds and amounts of various plants in a rangeland area can be changed by fire. Forage yield is affected by burning dates. The earlier the burning date, the lower the forage yield.

If down-range spot fires from volatile fuels are a concern, conduct the burn with air temperature below 50 degrees and relative humidity above 35 percent (See Figures 1 and 2).

When a portion of a pasture is burned, grazing management should be based on the burned area within the context of the long-range management plan. Burning will alter grazing patterns and can mediate erosion on heavy use areas.

Some unwanted plants may be increased following burning such as sericea lespedeza. Remedial action should be recommended to prevent an increase in unwanted plants.

The rooting depth should have enough moisture to support recovery of the desired plant species following the burn.

Firewhirls can be caused by burning under "nowind" conditions, burning headfires into backfires, and in canyons or hilly terrain.

Summer, fall, or winter burning may result in wind erosion on sandy soils (erosion on other soils is dependent upon the topography) even though burning may have occurred historically. Usually sufficient plant material remains to prevent excessive erosion.

Burning in the fall or during dry conditions can result in crown damage to bunchgrasses, which may be an objective for certain wildlife habitat management practices. The decision to use fall burning vs. spring burning depends upon the forage management objectives of the client, risk, and the species of concern.

In light fuel loads, continuity is more important for a continuous fire front than fuel loading.

Mop up is the process of checking the entire perimeter of the burn area to ensure that all fires or smoldering materials are out or removed from the edge of the perimeter to a safe area inside the burned area. Maintain close observation of the burned area until the fire is extinguished. Cow chips, logs and dead trees, stumps, small areas still burning, and fenceposts may smolder for several days after the burn if left untreated.

Fire is only one tool in an overall management plan. The decision to burn should be compatible with the long-term objectives of the resource and the client. In many cases, a long-term regime of prescribed burning will be needed to achieve objectives, not one single burn.

3. Plans and Specifications

Specifications (a Prescribed Burn Plan) shall be prepared for each burn in which NRCS is an easement holder or if a request is specifically made by a producer or client. The client and the certified NRCS employee designing and approving the burn shall sign the burn plan.

4. Operation and Maintenance

All NRCS employees who participate in prescribed burning must have the proper certification and training.

All burn crewmembers will wear flame resistant clothing or cotton or wool, leather gloves, and leather boots. Polyester clothing will not be worn on a prescribed burn. Protective eyewear, hat, and aspirator or breathing apparatus is desirable.

Prescribed burning can be physically strenuous. All crewmembers should be in good physical condition to enable them to perform all necessary tasks.

Operation and maintenance requirements are not applicable for this practice.

NRCS, KS
May 2007

5. References and Other Reading Material

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Engle, D. M., and Stritzke, J. F., 1995. Fire behavior and fire effects on eastern redcedar in hardwood leaf-litter fires. Int. J. Wildland Fire 5(3):135-141.

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Wade, Dale D. et.al. 1989. A Guide for Prescribed Fire in Southern Forests. Technical Publication R8-TP 11.

Engle, D. M., Bidwell, T. G., 2001, The response of central North American prairies to seasonal fire. J. Range Management 54:2-10.

Table 1. Criteria for Burning

Vegetative Type and Specific Purpose	Season	Wind Velocity	Relative Humidity	Air Temp	Lbs. Fuel [1/]	Frequency of Burning
Improve Quality/Quantity of Forage for Wildlife, Livestock Grazing Distribution, and to Stimulate Seed Production						
Warm Season Grasses	late winter to	4-15 mph	30-80	30-80	2000+	as needed
	green-up					
Improve Browse or Cover Structure	mid Jan. to 3 weeks prior to green-up of browse	4-15 mph	30-80	30-80	2000+	as needed
Increase Forbs and Low Panicum Production	8/15 to 9/15	4-15 mph	20-80	30-80	2000+	Approximately 3 years depending upon need
'Jose' tall wheatgrass [3/]	early winter to green-up	4-15 mph	30-80	30-70	2000+	as needed
Mature Oak	Fall/spring	4-15 mph	30-80	30-70	2500+	[6/]
Control of Undesirable Vegetation						
Prickly Pear Cactus	winter to green-up	4-15 mph	20-80	30-80	2000+	as needed
Juniper <6' tall	winter to green-up	4-15 mph	20-80	30-80	2500+	as needed
Juniper >6' tall	winter to green-up	4-15 mph	20-80	30-80	3000+	as needed
Annual herbaceous plants	after germination	4-15 mph	20-80	30-80	2000+	as needed
Annual cool season	before area is	4-15 mph	20-80	30-80	2000+	as needed
plants	too green to burn					
Annual threeawn or broomsedge bluestem (w/20% desirable grasses) [2/, 5/]	8/15 - 11/1	4-15 mph	20-80	30-80	2000+	annually for 3-5 years or until desired results achieved
Broomsedge bluestem (w/20% desirable grasses) [2/, 5/]	late winter to green-up	4-15 mph	20-80	30-80	2000+	annually for 3-5 years or until desired results achieved
Annual threeawn (w/20% desirable grasses) [4/, 5/]	after germination	4-15 mph	20-80	30-80	2000+	annually for 3-5 years
Suppression or Maintenance of Unwanted Vegetation						
Postoak, Blackjack. and associated hardwoods	fall and spring	4-15 mph	20-80	30-80	3000+	prior to canopy closure limiting fuel loading and/or in years with heavy hardwood leaf litter with dry fuel conditions

Table 1. Criteria for Burning (Continued)

Vegetative Type and Specific Purpose	Season	Wind Velocity	Relative Humidity	Air Temp	Lbs. Fuel [1/]	Frequency of Burning
Sand sagebrush	winter to green-up	4-15 mph	20-80	30-80	3000+	three to five years
Blackberry, Sumac, Plum	winter to green-up	4-15 mph	20-80	30-80	3000+	At least every 3rd year until desired level of control is achieved. Thereafter, as needed for desired level of suppression.
Buckbrush	winter to green-up	4-15 mph	20-80	30-80	3000+	as needed
Site Preparation, control of plant disease, slash and debris removal, reduction of wildfire hazard (Forestland or Woodland). For these practice purposes, contact the Oklahoma Department of Agriculture, Forestry Services for developing and/or approving fire plans.						

FOOTNOTES

[1/] Fuel continuity must be considered along with fuel loading. If a complete burn is the objective, continuity must be high. If a mosaic burn is desired there should be areas of discontinuous fuel.

[2/] Burning during dry periods can damage the crown of broomsedge bluestem and shift the successional advantage to rhizomatous grasses as long as the desirable grasses exist. Studies are currently under way in the use of fall burning for broomsedge management. Fall burning of broomsedge bluestem will tend to break the allelopathic cycle and allow desirable plant communities to re-establish. Fall burning will reduce winter forage availability and increase the opportunity for cool season annual plants to germinate. This effect should only last the season after the burn. The standing seed crop of the annual threeawn will be destroyed if burned before the seeds fall to the ground.

[3/] 'Jose' tall wheatgrass is only approved for burning when seed production is desired or to maintain non-use fields such as Conservation Reserve Program (CRP).

[4/] Burning annual threeawn in the spring after germination will: (a) destroy the current season's germinated annual threeawn crop (reducing the abundance of a fall seed crop), and (b) tend to break the allelopathic cycle giving desirable plant communities the advantage to restart growth.

[5/] Management of broomsedge bluestem and annual threeawn should be accomplished by using fire as a tool along with soil fertility management, pest management, and grazing management to increase desired plant communities. If there are not enough desirable forage species present, such as in an old field, reseeding may be needed.

[6/] Burning in mature oak stands thins the understory and very gradually thins the overstory. Burning is best accomplished soon after leaf-drop and before leaves become weathered or get matted down by winter storms. It will take many years and multiple burns to open up the overstory with burning alone. Burning initially can prune lower limbs and scar the bark on the base of trees, which starts the process of disease invasion. Gradually, as sunlight penetrates to the ground, herbaceous vegetation increases and with prescribed grazing accumulates fuel loads for subsequent hotter burns.

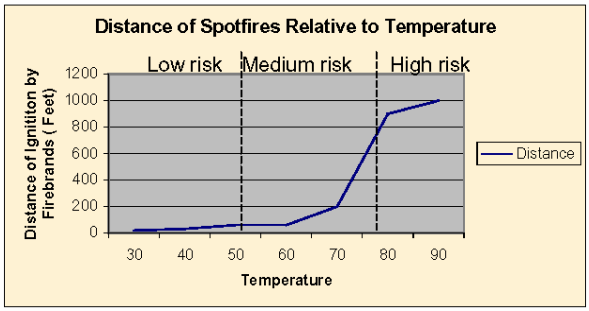


Figure 1. The maximum distance of spot fires from prescribed fires in relation to air temperature. Spotfires that started when temperatures were below 60 degrees were primarily by flaming firebrands. (From Bunting and Wright 1974)

(Risk factors have been added to the chart to offer guidelines as to the risk associated with temperature.)

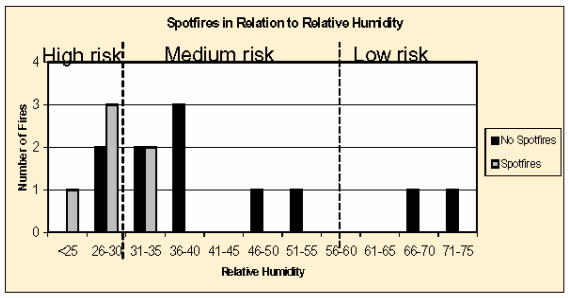


Figure 2. Spotfires were caused by fire brands from crowning cedar trees, fire brands from 60 ft. pine trees crowning, fire creeping across mowed lines, and oak leaves blown over the firebreak. Spot fires were related primarily to a critical level of relative humidity. (From Weir, 1999)

(Risk factors have been added to the chart to offer guidelines as to the risk associated with temperature.)

Name: _____ Date Plan Developed: _____ Ident No.: _____

Legal Desc.: _____ County: _____ Field No.: _____

Date burn will be implemented: _____ Burn Permit Required: Yes ☐ No ☐
(Contact county offices for information on the requirements for legal burns in your county.)

IMPORTANT NOTICE: Parties initiating prescribed burns may be liable for damages resulting from the fire and cost of suppression by others, should the fire escape from the designated area.

A. OBJECTIVE OF BURN: (Check all that apply) (WSG = warm season grass; CSG = cool season grass)

Control woody plants (full leaf)	☐	Improve wildlife habitat (before WSG emerge)	☐
Stimulate WSG (1 to 3 inches)	☐	Remove litter on WSG (1 to 3 inches)	☐
Reduce CSG (1 to 3 inches)	☐	Stimulate forbs (before forbs grow)	☐
Distribute grazing on WSG (1 to 3 inches)	☐	Reduce wildfire hazard on WSG (1 to 3 inches)	☐

B. DESCRIPTION OF BURN AREA:

1. Present plant cover:

Woody Plants

Species	Size/Height	Plant/Acre

Herbaceous Plants

Species	Cured	Plants/Acre	Lbs/Acre	Height
CSG				
WSG				
Broad Leaf Plants				

2. Describe existing firebreaks and identify contingency firebreaks: (Show on burn plan map.)
(Use arrow key to advance to next line.)

C. PREPARATION

1. Obtain burn permit, if required.
2. Fireboss: _____
3. Firebreak construction: (Show on burn plan map.) *Date = Date or month the firebreak will be constructed.

	Plowed	Disked	Mowed	Burned	CSG
Width					
Length					
*Date					

Legal Desc.: _____

4. Specified conditions for backfire, flankfire, and headfire:

	Backfire	Flankfire	Headfire
a. Air temperature (30° to 80° F)			
b. Relative humidity (20 to 80%)			
c. Wind direction			
d. Wind speed (4 to 15 mph)			
e. Soil moisture conditions			

5. Adjacent areas:
   a. Describe special precaution areas: (Show on burn plan map.) (Use arrow key to advance to the next line.)

   b. Describe potentially hazardous areas: (Show on burn plan map.) (Use arrow key to advance to the next line.)

   c. Describe protection plan for potentially hazardous areas: (Show on burn plan map.) (Use arrow key to advance to the next line.)

   d. Necessity of snag felling: Required ☐ Not Required ☐
   If required, describe plan: (Show on burn plan map.) (Use arrow key to advance to the next line.)

D. IMPLEMENTATION

1. Starting time of burn: _____
2. Equipment and manpower:

To activate this Table, open and save Form KS-ECS-338wksht.xls to the hard drive of your personal computer. Double click the Table to enter values. Position the Table and click outside the Table to exit and save entries.

Minimum Requirements (calculate columns per number of firelines)					
Execution of Burn **Number of firelines 0**	**Vehicles per fire or fireline**	**Drip Torch**	**Manpower**	**Maps**	**Communication equipment**
Four-wheeler unit w/spray equipment (1 per fireline, 1 person per unit)	0		0		
Drip torch (1 per fireline w/supplemental fuel, 1 person per torch)		0	0		
Site and plan maps (1 per vehicle)				0	
Communications equipment (1 per fireline)					0
**Fire suppression unit (1 per fireline, 2 persons per unit)	0		0		
Mop-up					
Communication equipment (1 per fireline)					0
Fire suppression unit (1 per fireline, 2 persons per unit)	0		0		
Totals	**0**	**0**	**0**	**0**	**0**

Legal Desc.: _____

2. Equipment and manpower continued:

Auxiliary water supplies located in a strategic defensive position: (Show location of auxiliary supply on burn plan map and describe.) (Use arrow key to advance to the next line.)

**Auxiliary fire suppression unit: (Show location of unit on burn plan map and describe.) (Use arrow key to advance to next line.)

Equipment or manpower needed in addition to the minimum requirements: (List and explain.) (Use arrow key to advance to the next line.)

Location map: Import ArcView image, reference conservation plan map, or provide a sketch denoting field boundary, field number, land use, acres, and scale used.

Technical Service Provider

Layout by	Date
Designed by	Date
Checked by	Date
Approved by	Date

Producer's Statement

The design of this practice has been discussed with me, and I concur with the design. **No substitutions are allowed without the approval of the technical service provider.**

Signature	Date

Scale: _____

Certification

This applied practice meets Kansas standards and specifications.

Technical Service Provider	Date

This practice has been applied as designed.

Producer	Date

Pre-Burn Checklist

Legal Desc.: _____

Fireboss: _____

Weather forecast within parameters to specified conditions: Yes ☐ No ☐

Planned firebreaks constructed: Yes ☐ No ☐

Planned tools, equipment, and manpower at site: Yes ☐ No ☐

Appropriate notifications made:

Adjacent landowners (within 24 hours of burn)

_____ _____ Yes ☐ No ☐
Name Phone number

_____ _____ Yes ☐ No ☐
Name Phone number

_____ _____ Yes ☐ No ☐
Name Phone number

_____ _____ Yes ☐ No ☐
Name Phone number

Local fire department: _____ Yes ☐ No ☐
Phone number

Sheriff: (within three hours of ignition)

_____ Yes ☐ No ☐
Phone Number

Others: _____ _____

_____ _____

I have reviewed the pre-burn checklist and determined the site preparations, conditions, manpower, and equipment are adequate for the planned prescribed burn, and the appropriate landowners and officials have been notified.

_____ _____
Fireboss signature Date

Post-Burn Evaluation

Legal Desc.: _____

Date of burn: _____ Acres burned: _____

Actual weather at time of burn:

Air temperature: _____ Relative humidity: _____

Wind direction: _____ Wind speed: _____

Fire behavior:

	None	Few	Many
Spotting	☐	☐	☐

	Yes	No
Difficulty in control	☐	☐
Convention column	☐	☐
Fire whirls	☐	☐

Additional comments: (Use arrow key to advance to the next line.)

Objective accomplished: (Use arrow key to advance to the next line.)

Additional remarks: (Use arrow key to advance to the next line.)

I have completed the post-burn evaluation.

_____ _____
Fireboss signature Date

Follow-up Evaluation: (60 – 90 days after burn)

Legal Desc.: _____ Date: _____

Continued benefits of accomplished objective: (Use arrow key to advance to the next line.)

Estimated need for future burn: _____

Additional remarks: (Use arrow key to advance to the next line.)

I have completed the prescribed burn follow-up evaluation.

_____ _____
Signature Date

Ness County

Example: Prescribed Burn Plan for CRP

General:
Area consists of CP-25 grass mix to be burned using back burns and a ring fire.

North adjacent: growing wheat, rangeland/fence, grass area, CRP, county road, milo stalks, wheat stubble

East adjacent: two-track trail, CRP, post hazard, kochia

South adjacent: rangeland/fence, two-track trail, kochia, CRP

West adjacent: trees, two-track trail, CRP

Notes:
Fuel load consists of 1500-2000 lbs/ac, 1-2' tall of warm season grasses to be burned with several back burns and a ring fire.

Hazards include rangeland/fence, grass area, CRP milo stalks and wheat stubble to the north, CRP, post hazard and kochia to the east, rangeland/fence, kochia and CRP to the south, trees and CRP to the west and rough areas and guzzler posts in the field to be burned. See Map.

Precautions include county road to the north and farmstead to the west 1 mile. See Map.

Safety Zones are county road to the north, growing wheat to the northeast and west and any black zones created by fire. See Map.

Traffic control on county road to the north.

Southwest wind is planned.

Planned Burn: March 1 – April 15.

Materials:
7 ATV units
2 water trucks
2 patrolling on road for traffic control
2 drip torches
2 butane lighters
Extra fuel
Shovels
Hand radios for crew

Fence Pliers for crew
10 plans/maps
13 people
2 flappers

Pre-burn Preparation:
Disk 30' guards around perimeter of field, see map
Mow 60' guards inside of disk zone (90' total mowing/disking), see map
Wet line perimeter (foam may be used so it stays wet longer)

Burn Procedure:
Adjacent land users and local sheriff and fire department notified
Obtain current forecast – NOAA (www.noaa.gov)
Temperature: 50-80 degrees F
Humidity: 25-45%
Wind Speed: 5-10 mph southwest
Start time: 12:00 – 2:00 depending on humidity
Adequate soil moisture
Lookouts, ATV's, fire trucks and igniters posted, see map

The northwest quarter is planned to be burned with strip fires in several strips. One igniter will start in the NW corner and travel east, lighting a back burn. Once the fire has moved in 100 feet, another igniter can start on the west end, just north of the growing wheat, and travel to the east end, lighting another back burn. Let the back burn move in 100 feet before continuing this process until the northwest quarter has been burned out.

The southwest quarter is planned to be burned with a ring fire. Igniters will start in the NW and NE corners of remaining acreage to be burned. No back burn is needed due to the black zone created by the strip fires. Igniters will travel south to the SW and SE corners, lighting the flank fires. Let the flank fires burn in 150 feet. Igniters can then travel to the south central unit, lighting the head fire. Once igniters get within 75-100 feet from each other they can stop to leave a gap for wildlife to escape. Fire will close in behind.

Burn Plan

Date: 2/9/2009

Customer(s):

District: NESS COUNTY CONSERVATION DISTRICT

Approximate Acres: 236.7

Legal Description:

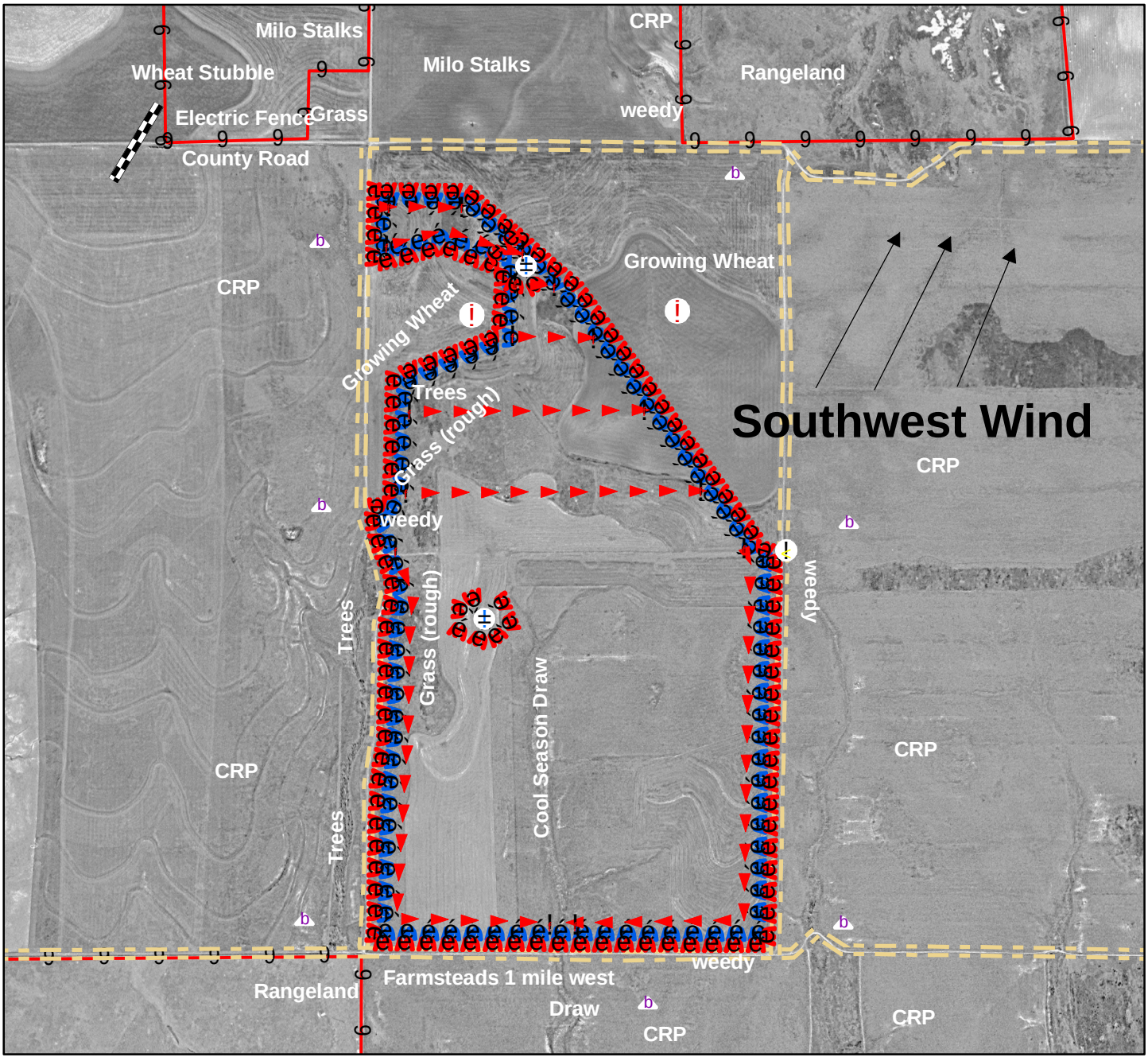
Field Office: Ness City Field Office

Agency: USDA-NRCS

Assisted By: Ness County

State and County: KS, NESS

Land Units: Tract:



Legend

- b Lookouts
- Road Block
- Wind Direction
- ! Igniters
- Burn Line
- ! Post Hazard
- ± Guzzler Posts
- Disk
- Mow
- Two-track Trail
- 9 Fence
- ! Safety Zones

1:12,000

770 0 770 1,540 2,310 3,080 Feet

Example: Rangeland Burn — Prescribed Burn – 338ECS-338
USDA — NRCS — 7/03

Name: John Rancher Date Plan Developed: 3/5/2010 Ident No.: N/A

Legal Desc.: SEC TWP RNG County: Geary Field No.: 2

Date burn will be implemented: 4/6/2010 Burn Permit Required: Yes ☒ No ☐
(Contact county offices for information on the requirements for legal burns in your county.)

IMPORTANT NOTICE: Parties initiating prescribed burns may be liable for damages resulting from the fire and cost of suppression by others, should the fire escape from the designated area.

A. OBJECTIVE OF BURN: (Check all that apply) (WSG = warm season grass; CSG = cool season grass)

Control woody plants (full leaf)	☒	Improve wildlife habitat (before WSG emerge)	☐
Stimulate WSG (1 to 3 inches)	☒	Remove litter on WSG (1 to 3 inches)	☐
Reduce CSG (1 to 3 inches)	☒	Stimulate forbs (before forbs grow)	☐
Distribute grazing on WSG (1 to 3 inches)	☒	Reduce wildfire hazard on WSG (1 to 3 inches)	☐

B. DESCRIPTION OF BURN AREA:

1. Present plant cover:

Woody Plants

Species	Size/Height	Plant/Acre
Dogwood	4'	200
Smooth Sumac	3'	100
Elm	10-20'	10

Herbaceous Plants

Species	Cured	Plants/Acre	Lbs/Acre	Height
CSG	Green	na	200	3"
WSG	X	na	1500	4-6"
Broad Leaf Plants	X	na	100	4-6"

2. Describe existing firebreaks and identify contingency firebreaks: (Show on burn plan map.)
(Use arrow key to advance to next line.)
Dozed in firebreaks exists in the steep, treed areas in the NE corner of the ranch. A firebreak will be burned in around the entire ranch except where roads and highways provide an adequate firebreak. A mowed firebreak will be used in the SE corner. This will be done to provide protection to the 9 farmsteads that surround the ranch.

C. PREPARATION

1. Obtain burn permit, if required.
2. Fireboss: John Rancher - Owner
3. Firebreak construction: (Show on burn plan map.) *Date = Date or month the firebreak will be constructed.

	Plowed	Disked	Mowed	Burned	CSG
Width	20'		30'	50'	250'
Length	11,000		1300'	28,584	1900'
*Date	3/20/10		3/20/10	4/6/10	Smooth Brome - Existing

Legal Desc.: SEC TWP RNG

4. Specified conditions for backfire, flankfire, and headfire:

	Backfire	Flankfire	Headfire
a. Air temperature (30° to 80° F)	50-65	50-80	50-80
b. Relative humidity (20 to 80%)	40-60%	30-80%	30-80%
c. Wind direction	SW	SW	SW
d. Wind speed (4 to 15 mph)	4-8	5-10	10-15
e. Soil moisture conditions	Moist	moist	moist

5. Adjacent areas:

a. Describe special precaution areas: (Show on burn plan map.) (Use arrow key to advance to the next line.)

East - Ungrazed native grass & timber/leaf litter, fractured limestone ledge with flamable plant material.
North - Timber/leaf litter, 5 houses, backfire prior to starting head fire.
West - 3 houses, backfire prior to starting head fire.
South - 1 house, backfire prior to starting head fire.

b. Describe potentially hazardous areas: (Show on burn plan map.) (Use arrow key to advance to the next line.)

Power lines - very high, 100+ feet off the ground
Deep/Steep draws with thick caprock - Difficult to get out of on an ATV, no access for water truck.

c. Describe protection plan for potentially hazardous areas: (Show on burn plan map.) (Use arrow key to advance to the next line.)

Stay out of smoke as it enters powerlines, check power poles as soon as fire passes and smoke is cleared.
Be certain of exit points and safe areas before entering draws.

d. Necessity of snag felling: Required ☒ Not Required ☐

If required, describe plan: (Show on burn plan map.) (Use arrow key to advance to the next line.)

Clear trees and branches from firebreaks.

D. IMPLEMENTATION

1. Starting time of burn: 9:00 AM

2. Equipment and manpower:

To activate this Table, open and save Form KS-ECS-338wksht.xls to the hard drive of your personal computer. Double click the Table to enter values. Position the Table and click outside the Table to exit and save entries.

Minimum Requirements (calculate columns per number of firelines)					
Execution of Burn **Number of firelines 2**	**Vehicles per fire or fireline**	**Drip Torch**	**Manpower**	**Maps**	**Communication equipment**
Four-wheeler unit w/spray equipment (2 per fireline, 1 person per unit)	2		4		
Drip torch (1 per fireline w/supplemental fuel, 1 person per torch)		2	2		
Site and plan maps (1 per vehicle)				10	
Communications equipment (1 per fireline)					2
**Fire suppression unit (1 per fireline, 2 persons per unit)	1		4		
Mop-up					
Communication equipment (1 per fireline)					2
Fire suppression unit (1 per fireline, 2 persons per unit)	2		4		
Totals	**3**	**2**	**10**	**10**	**2**

Legal Desc.: SEC TWP RNG

2. Equipment and manpower continued:

Auxiliary water supplies located in a strategic defensive position: (Show location of auxiliary supply on burn plan map and describe.) (Use arrow key to advance to the next line.)

2 water supply trucks - 300 gallon capacity each - Centeral location in denuded area of the pasture.

3 spring tanks rigged to fill ATV sprayers at about 2 gal/min.

Well at headquarters

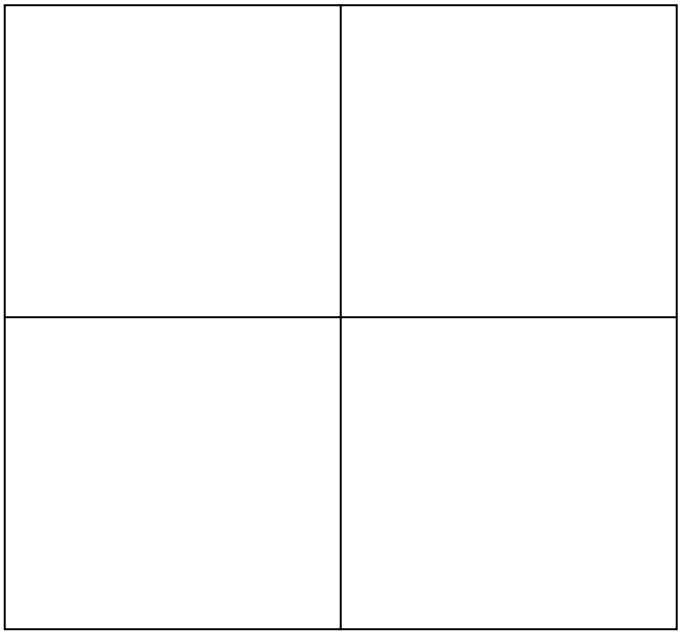
**Auxiliary fire suppression unit: (Show location of unit on burn plan map and describe.) (Use arrow key to advance to next line.)

None

Equipment or manpower needed in addition to the minimum requirements: (List and explain.) (Use arrow key to advance to the next line.)

None

Location map: Import ArcView image, reference conservation plan map, or provide a sketch denoting field boundary, field number, land use, acres, and scale used.



Scale:

Map Notes: The Danger/Warning areas are houses, The solid yellow line is the property line. You will see in 3 areas where we are burning the neighbors property at the same time. The water refill points are developed springs that are setup to fill an ATV sprayer.

See Attached "Prescribed Burn Plan Map"

Technical Service Provider

Layout by _____ Date _____

Designed by _____ Date _____

Checked by _____ Date _____

Approved by _____ Date _____

Producer's Statement

The design of this practice has been discussed with me, and I concur with the design. **No substitutions are allowed without the approval of the technical service provider.**

Signature _____ Date _____

Certification

This applied practice meets Kansas standards and specifications.

Pre-Burn Checklist

Legal Desc.: SEC TWP RNG

Fireboss: John Rancher

Weather forecast within parameters to specified conditions:	Yes	☐	No	☐
Planned firebreaks constructed:	Yes	☐	No	☐
Planned tools, equipment, and manpower at site:	Yes	☐	No	☐

Appropriate notifications made:

Adjacent landowners (within 24 hours of burn)

Name	Phone number	Yes	☐	No	☐
Name	Phone number	Yes	☐	No	☐
Name	Phone number	Yes	☐	No	☐
Name	Phone number	Yes	☐	No	☐
Local fire department:	238-2261 or 911 Phone number	Yes	☐	No	☐

Sheriff: (within three hours of ignition)

	238-2261 Phone Number	Yes	☐	No	☐

Others: _____ _____

_____ _____

I have reviewed the pre-burn checklist and determined the site preparations, conditions, manpower, and equipment are adequate for the planned prescribed burn, and the appropriate landowners and officials have been notified.

_____ _____

Fireboss signature Date

PRESCRIBED BURNING PLAN MAP

Date: 4/14/2010

Customer(s): Example

District: GEARY COUNTY CONSERVATION DISTRICT

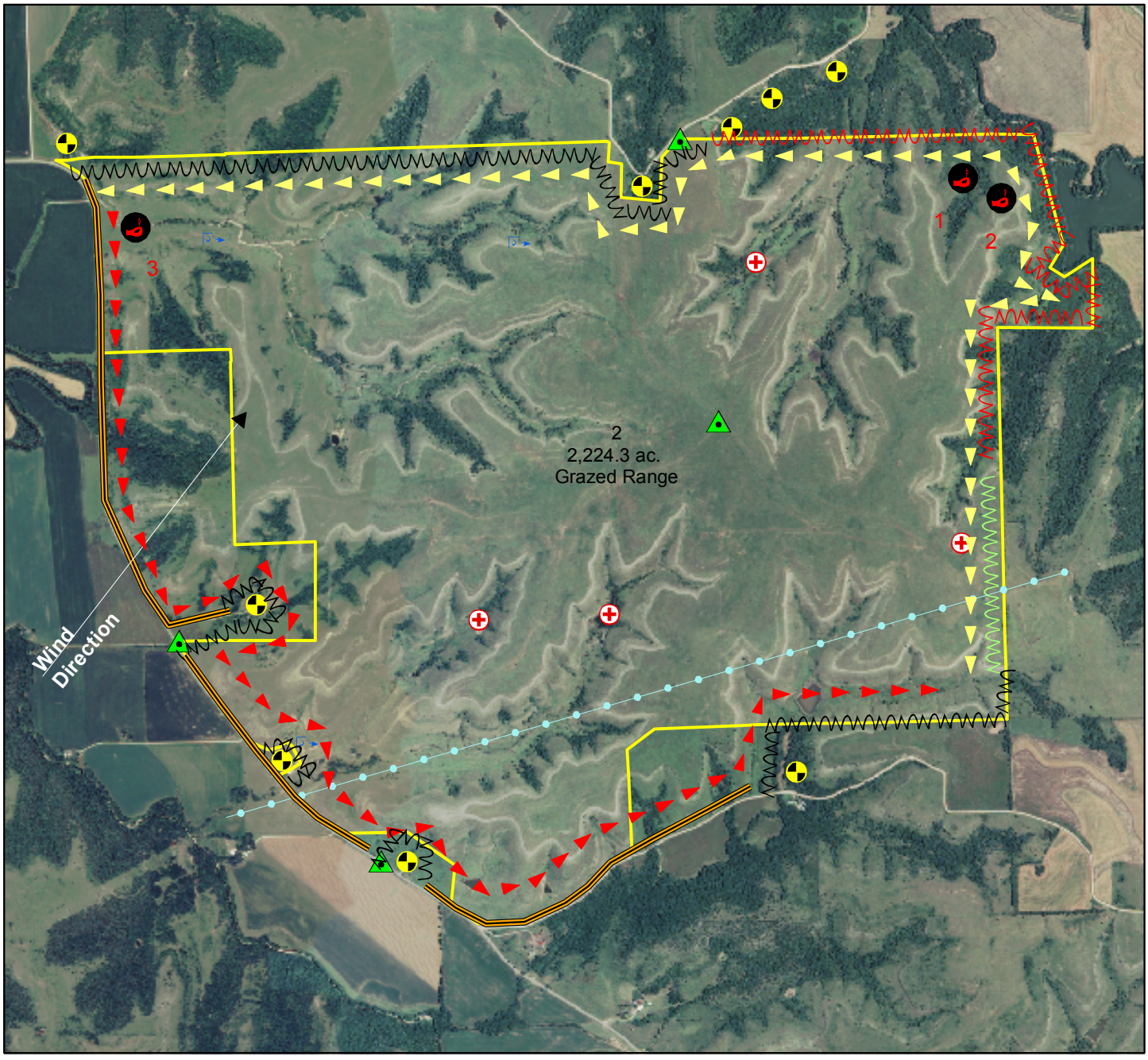
Field Office: JUNCTION CITY SERVICE CENTER

Agency: USDA-NRCS

Assisted By:

State and County: KS, RILEY

Legal Description:



Burn Plan Lines

LINETYPE

- Backfire
- Burned Firebreak
- Dozed Firebreak
- Head Fire
- Mowed Firebreak
- Power Line
- Road Firebreak
- Wind Direction

Burn Plan Points

- <all other values>

POINTTYP

- Safe Zone
- Water Truck
- Water Refill Point
- Ignition Point
- Danger/Warning

1,100 0 1,100 2,200 3,300 4,400 Feet

N

USDA
NRCS

Example: Prescribed Burn for Patch Burn

ECS-338
7/03

Name: Example Date Plan Developed: 4/24/2010 Ident No.: B

Legal Desc.: _____ County: Riley Field No.: B

Date burn will be implemented: 4/21/2010 Burn Permit Required: Yes ☒ No ☐
(Contact county offices for information on the requirements for legal burns in your county.)

IMPORTANT NOTICE: Parties initiating prescribed burns may be liable for damages resulting from the fire and cost of suppression by others, should the fire escape from the designated area.

A. OBJECTIVE OF BURN: (Check all that apply) (WSG = warm season grass; CSG = cool season grass)

Control woody plants (full leaf)	☒	Improve wildlife habitat (before WSG emerge)	☐
Stimulate WSG (1 to 3 inches)	☒	Remove litter on WSG (1 to 3 inches)	☐
Reduce CSG (1 to 3 inches)	☒	Stimulate forbs (before forbs grow)	☐
Distribute grazing on WSG (1 to 3 inches)	☒	Reduce wildfire hazard on WSG (1 to 3 inches)	☐

B. DESCRIPTION OF BURN AREA:

1. Present plant cover:

Woody Plants

Species	Size/Height	Plant/Acre
Roughleaf Dogwood	36"	20
Eastern Red Cedar	12"-24"	10

Herbaceous Plants

Species	Cured	Plants/Acre	Lbs/Acre	Height
CSG	Green		100	2"
WSG	X		1500	6-12"
Broad Leaf Plants	Green		100	2-4"

2. Describe existing firebreaks and identify contingency firebreaks: (Show on burn plan map.)
(Use arrow key to advance to next line.)
Creeks will be used as a firebreak on the SE and NW side of the burn. Mowed and burned firebreaks will be created along the north, south, and west boundries.

C. PREPARATION

1. Obtain burn permit, if required.
2. Fireboss: Landowner
3. Firebreak construction: (Show on burn plan map.) *Date = Date or month the firebreak will be constructed.

	Plowed	Disked	Mowed	Burned	CSG
Width			30'	30'	
Length			6500'	7500'	
*Date			4/1/2009	4/15/2009	

Legal Desc.: _____

4. Specified conditions for backfire, flankfire, and headfire:

	Backfire	Flankfire	Headfire
a. Air temperature (30° to 80° F)	45 - 75	45-75	50 - 75
b. Relative humidity (20 to 80%)	35 - 60	35-60	35 - 60
c. Wind direction	SSW	SSW	SSW
d. Wind speed (4 to 15 mph)	4 - 12	4-12	4 - 12
e. Soil moisture conditions	Moist	Moist	Moist

5. Adjacent areas:

a. Describe special precaution areas: (Show on burn plan map.) (Use arrow key to advance to the next line.)

Neighbors native grass on the south, west and north.

b. Describe potentially hazardous areas: (Show on burn plan map.) (Use arrow key to advance to the next line.)

Deciduous Treed areas along burned firebreak. Cedar trees will be avoided or removed from the firebreak.

c. Describe protection plan for potentially hazardous areas: (Show on burn plan map.) (Use arrow key to advance to the next line.)

If the leaf litter will burn, a mineral soil firebreak will be constructed through the trees to the creek. These 2 areas will be monitored until the fire is out.

d. Necessity of snag felling: Required ☒ Not Required ☐

If required, describe plan: (Show on burn plan map.) (Use arrow key to advance to the next line.)

Downed limbs will be removed from the firebreak in the treed areas.

D. IMPLEMENTATION

1. Starting time of burn: 10:00

2. Equipment and manpower:

To activate this Table, open and save Form KS-ECS-338wksht.xls to the hard drive of your personal computer. Double click the Table to enter values. Position the Table and click outside the Table to exit and save entries.

Execution of Burn **Number of firelines 1**	**Vehicles per fire or fireline**	**Drip Torch**	**Manpower**	**Maps**	**Communication equipment**
Four-wheeler unit w/spray equipment (1 per fireline, 1 person per unit)	2		2		
Drip torch (1 per fireline w/supplemental fuel, 1 person per torch)		1	1		
Site and plan maps (1 per vehicle)				3	
Communications equipment (1 per fireline)					2
**Fire suppression unit (1 per fireline, 2 persons per unit)	1		4		
Mop-up					
Communication equipment (1 per fireline)					2
Fire suppression unit (1 per fireline, 2 persons per unit)	1		4		
Totals	**3**	**1**	**7**	**3**	**2**

Legal Desc.: 12-9-6

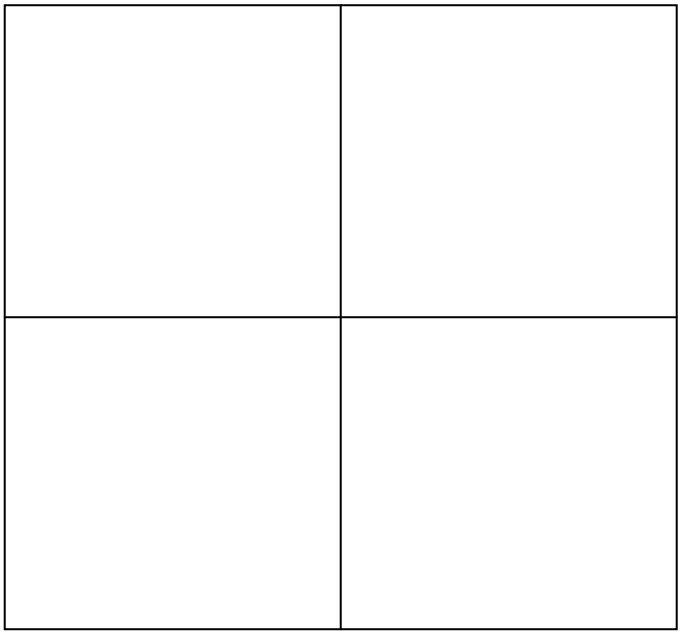
2. Equipment and manpower continued:

Auxiliary water supplies located in a strategic defensive position: (Show location of auxiliary supply on burn plan map and describe.) (Use arrow key to advance to the next line.)
300 gallon Water truck will be located in the firebreak on the south side of the pasture to fill ATV's as needed.

**Auxiliary fire suppression unit: (Show location of unit on burn plan map and describe.) (Use arrow key to advance to next line.)
Rural Fire Department

Equipment or manpower needed in addition to the minimum requirements: (List and explain.) (Use arrow key to advance to the next line.)
None

Location map: Import ArcView image, reference conservation plan map, or provide a sketch denoting field boundary, field number, land use, acres, and scale used.



Technical Service Provider

Layout by _____ Date _____

Designed by _____ Date _____

Checked by _____ Date _____

Approved by _____ Date _____

Producer's Statement

The design of this practice has been discussed with me, and I concur with the design. **No substitutions are allowed without the approval of the technical service provider.**

Signature _____ Date _____

Scale: See attached Aerial Photo

Certification

This applied practice meets Kansas standards and specifications.

Technical Service Provider _____ Date _____

This practice has been applied as designed.

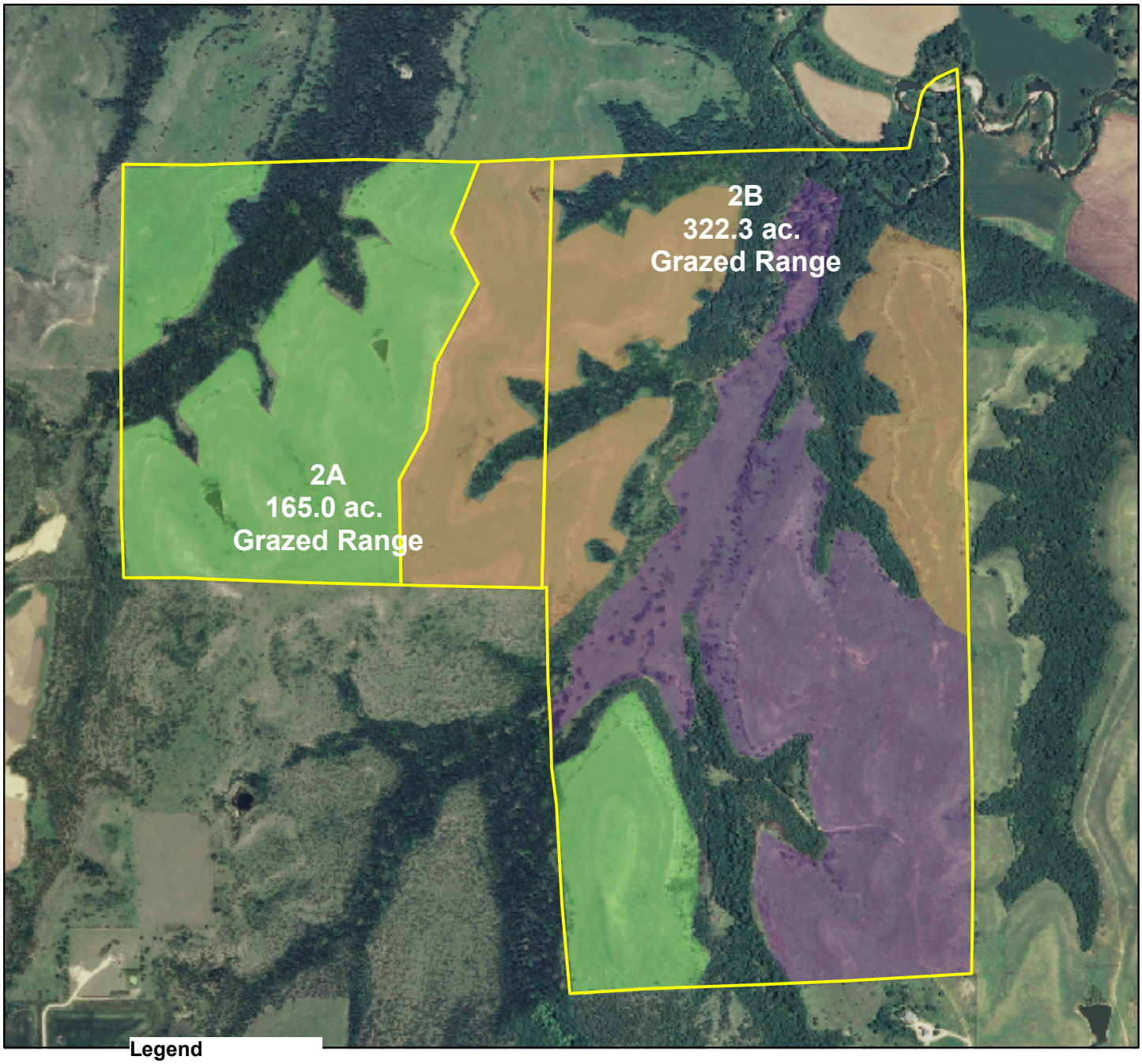
Producer _____ Date _____

PATCH BURN PLAN

Date: 4/19/2010

Field Office: MANHATTAN SERVICE CENTER
Agency: NRCS

Legal Description:



Legend

Consplan

Patch Burn Areas

POLYTYPE

Year 1

Year 2

Year 3

520 0 520 1,040 1,560 2,080
Feet

N

Example: Urban/Natural Area Burn
Sternberg Prairie Restoration
SE ¼ 27-13-18
Prescribed Burn

Burn 1: 2.9 ac
Burn 2: 6.4 ac
Burn 3: 0.4 ac
Burn 4: 0.5 ac

Objectives:
Eliminate standing cover for restoration of interpretive native trail
Improve warm season natives
Suppression of Smooth Brome
Reduce litter
Brush management
Improve wildlife habitat

Adjacent Land Uses
North: Mowed state right of way, I-70, Rangeland, Sorghum stubble
East: Nursing Home, Sternberg museum
South: Creek bottom, Residential houses
West: Creek bottom with trees, Residential houses

Burn 1:
North: Mowed state right of way, I-70, Rangeland, Sorghum stubble
East: Burn Area 2
South: Creek bottom, Residential houses
West: Creek bottom with trees, Residential houses

Burn 2:
North: Mowed state right of way, I-70, Rangeland, Sorghum stubble
East: Burn Area 3, Sternberg Museum
South: Creek bottom with trees, Residential houses
West: Burn Area 1 (Black)

Burn 3:
North: Mowed state right of way, I-70, Rangeland, Sorghum stubble
East: Grass area, Sternberg Museum
South: Creek bottom with trees
West: Burn Area 2 (Black)

Burn 4:
North: Burn Area 2 (Black)
East: Trees, Burn Area 2 (Black)
South: Residential houses

West: Burn Area 1, Trees, Residential houses

Notes:

1. Obtain weather report 2 hours prior to start of fire
2. Notify County sheriff, fire department, Kansas Highway Patrol, Kansas Department of Transportation, utility company, and all landowners/homeowners 24 hours and 3 hours before starting. Also notify all the County sheriff, fire department, Kansas Highway Patrol, Kansas Department of Transportation after mop up.
3. Smoke Management: Notify sheriff's office and Highway patrol that smoke will be over Interstate 70.
4. Lookouts, water, and ATV's needed to be posted as shown on map.
5. Hazards:
    a. Interstate 70, Windbreak,
    b. Over head power line(smoke and water into) Do not water down poles prior to burn
6. All trees will be cut and larger branches removed. Scattered small branches that will be laying in the burn areas
7. Fuel Loads: 1000-3000lbs 50% warm season/50% cool season. Height 6"-24"
8. Burn Window: **February 15 – April 1 2011**
9. Notify Hospital to south east (has a helicopter). Notify airport 4 miles south east.
10. Notify campus police about crowd control
11. KDOT to supply electronic billboard on I-70.

Conditions: Very stable weather pattern; High ceiling

Wind: South/South West 5 - 10 mph
Relative Humidity: 25%-45%
Temperature: 40-80 degrees
Start Time: 10am to Noon. All flames out by 6pm

Man Power/Equipment

10-13 people
2-4 ATV with Spray tanks
5 shovels
5 flappers
1000 gallons extra water
10 gallons torch fuel
2-3 drip torches
10-13 radios
Extra radio batteries
4 butane lighters
10-13 maps/plans
4-5 engines

Pre Burn Plans

1. Smooth Brome on north side of the fence along I-70 is mowed to 3 inches tall
2. All trees in burn areas cut down, large trunks and branches removed; small pieces scattered in field.
3. Firebreaks are mowed as low as possible with a rotary mower all the way around the burn area 30' wide. Then use a wheel rake or side delivery rake to rake duff and vegetation over into the area to be burned a minimum of 20 feet.

Safety Zones & Escape Routes

Any black area and the Sternberg museum parking lot

Procedures:

1. All fire strips need to be perpendicular to the wind. (The actual strips may not look like what is on the map depending on slight wind direction variations)
2. These fires will use a mowed area with a wet line for firebreaks. A wet line is accomplished by sending one engine to pre-water a 5'strip in front of the igniter. The igniter will then light the fire on the inside of the wet line. Another engine will follow behind the igniter extinguishing the fire that tries to creep over the firebreak. This will be done for all fire breaks.

Burn 1:

Start fire 30' from fence on the south side of firebreak in the North West corner and move to the east corner. Hold until the fire has back burned in 50'. Then the igniter can start the next strip which will be a head fire into the back fire. Continue on using strip fires at 50' to 75' increments. Make sure all fires out before moving on to next burn area.

Burn 2:

Start fire 30' from fence on the south side of firebreak in the North West corner and move to the east corner. Hold until the fire has back burned in 50'. Then the igniter can start the next strip which will be a head fire into the back fire. Continue on using strip fires at 50' to 75' increments. This one will take 6 or 7 strips. Make sure all fire out before moving on to next burn area.

Burn 3: Start fire 30' from fence on the south side of firebreak in the North West corner and move to the east corner. Hold until the fire has back burned in 50'. Then the igniter can start the next strip which will be a head fire into the back fire. Continue on using strip fires at 50' to 75' increments. Make sure all fires out before moving on to next burn area.

Burn 4: Optional Burn:

Engine will not be able to cross drainage but everything to North will black. Place engines as noted on map for back protection. All ATVs will be on the same side as igniter. Igniter will start in the North West corner, lighting the back fire along the drainage. An ATV with water will follow. Again once the back fire has moved in 50' the next strip can be lit. Continue with the strip fire method at 50'-75' increments.

Mop Up:

Everyone needs to help patrol the field making sure everything is out and hot spots are taken care of. Any wood that is on fire needs to be put out.

Burn Plan

Customer(s): FORT HAYS ST UNIVERSITY

Agency: NRCS
Assisted By: TONI FLAX

CRP Maintenance

The information contained in this handout is subject to change in policy and program regulation. Always check with your local FSA office before conducting any maintenance or management practices on acreage under an active CRP contract to ensure you have the most up-to-date information.

Always contact the local FSA office prior to conducting any type of burn or maintenance activity on acreage that is under a CRP contract.

Maintaining acres under an active CRP contract is a requirement and must be maintained in order to stay in compliance with the CRP program.

CRP maintenance practices are the responsibility of the CRP participant and will be carried out without additional cost share - the CRP maximum payment rate calculation considers the cost of maintenance for the participant for the life of the contract, or CRP-1 period.

CRP participants will work with NRCS and FSA to plan appropriate maintenance practices, such as mowing, spraying, or prescribed burning.

Maintenance practices are different than management practices.

Management practices are a required element for CRP contracts, and must be carried out during certain times during the lifespan of the contract, depending on the length of the contract. For instance: under a 10 year contract, the required management practice must be completed by the end of year 6, on an 11-15 year contract, the required management practice must be completed no later than the period of year 6 thru 9.

CRP participants must ensure:

- that adequate approved vegetative cover is maintained to control erosion for the contract period.
- Compliance with State noxious weed laws
- Control other weeds that are not considered noxious
- That undesirable vegetation, weeds (including noxious), insects, rodents, etc., that pose a threat to existing cover or adversely impact other landowners in the area are controlled

Burning and the Conservation Reserve Program

The following are things that should be considered when planning a prescribed burn on land enrolled under an active CRP contract:

Prescribed burning can be either a maintenance practice without cost-share or a management practice with cost-share.

- realize if a burn is selected as a management practice in the Conservation Plan of Operations, then the burn must be carried out in the timeframe applicable to the CPO

Firebreaks, fire lanes, and fuel breaks may be authorized on a case-by-case basis providing:

- they are at the producer's expense
- Clean Till Firebreaks Must be included in the CPO
- they are approved by the COC
- cover destroyed by the producer is replaced at his/her cost

Clean tilled firebreaks:

- may be installed only if NRCS certifies and County Committee approves prior to installation, there will be no erosion problems
- shall not exceed 30 feet in width and shall only be permitted adjacent to the identified high-risk areas

Establishment of short-mown fuel breaks is encouraged over clean tilled firebreaks if pre-fire preventative measures are performed. If approved by the County Committee:

- short-mown fuel breaks, with or without residue removed, may be established up to a maximum of 300 feet. If residue is removed:
  - it must be destroyed without use
  - an inspection to verify destruction must be paid.
- firebreaks and fuel breaks may include a combination of clean tilled and short-mown areas not to exceed a total width of 330 feet.

References

Page 1 information: National Handbook 2-CRP (Rev. 5) Amend. 2, paragraphs 427 & 428. Publicly available at
http://www.fsa.usda.gov/FSA/webapp?area=home&subject=empl&topic=hbk

Page 2 information: Kansas Supplement to National procedure. 2-CRP (Rev. 5 KS Amend. 3, KS Page 13-8. Publicly available through the Kansas Farm Service Agency.

Prepared by Michael Martin, FSA, Ellsworth, KS Feb. 2010
Updated by Rod Winkler, FSA, Manhattan, KS Aug. 2011

Required Management Practices and Applicable CRP Practices (Continued)

B Prescribed Burning

- NRCS Practice and Standard Specification No. 338, Prescribed Burning, will be used for this management activity.
- This management activity shall not occur until the cover is established.
- Prescribed Burning for wildlife habitat:
  - Soils with an "I" value of 86 or greater (these are sandy soils) have an allowable burning period of April 1 thru April 30.
  - All other soils in the western part of the State from Smith to Barber County and all counties west thereof have an allowable burning window from February 1 thru April 30 (15 days into the Kansas nesting period).
  - All other soils in the counties east of the line described in the previous bullet have an allowable burning widow from February 1 thru April 15.
  - **Effective with 2011, an additional burning window statewide from July 16 thru August 31 except soils with an I value of 86 or greater.**
- A firebreak is permitted with Prescribed Burning if completed according to the standard and specifications.
- The first Prescribed Burn conducted under Practice CP25, Rare and Declining Habitat, may be considered either a management practice with cost-share or as a non cost-share maintenance burn.
- Counties shall establish this average cost in future years.
- Prescribed Burning (burn with cost-share) cannot be conducted in two consecutive years on the same acreage or in the same year as managed haying or grazing.
- For maintenance burns without cost-share see KS Par. 427

Note: Although burning is not recommended for Sand Sage and Sand Prairie it can be performed one time based upon recommendations of the District Conservationist under the right conditions. Moisture conditions must be favorable (good re-growth) and the burning conducted towards the end of the burning window (quick re-canopy). Burning should not be performed on the acreage planted to shrubs.

A prescribed burn planned as a management practice for a certain year of the contract may need to be delayed to another year if NRCS recommends conditions are not right to complete a burn on these types of soils.

Required Management Practices and Applicable CRP Practices (Continued)

C Interseeding

- NRCS Practice and Standards Specification No. 645, Wildlife Upland Habitat Management, will be used for this management activity.
- Eligible costs include those items that are normally associated with vegetative cover establishment (seed, seeding, etc.).
- Can include herbicide to control invasive cool season grass suppression under seedbed preparation.
- Use cost-share rates currently established in the county.
- This management activity shall not occur until cover is established.
- This management activity is limited to one time on the same acreage unless the inter-seeding failed due to reasons beyond the participant's control.
- The interseeding shall be limited to species not established in the original mix for plant diversity.
- If interseeding in Practice CP25, Rare and Declining Habitat, only native species shall be used.

D Light Disking

Light disking can be performed on established CRP fields to promote early successional vegetation in order to create plant diversity that will benefit wildlife. Light disking operations can begin after plant dormancy in the fall and must be completed prior to April 15. Disking operations will be performed in accordance with CRP policy.

The following practice policies apply to light disking:

1. Light disking is available only on well established stands. It is available on:
   - new contract seedings no earlier than the fourth year
   - re-enrolled improved stands (interseeded with additional species) no earlier than the fourth year
   - re-enrolled stands (original seeding) in the first year.
2. Light disking is available only on those practices shown on the chart in KS Exhibit 5, Page 1.
3. Light disking is NOT allowed in high risk areas of noxious weed colonization. Producers are reminded they must abide by the Kansas Noxious Weed Law on CRP acreage and must avoid disking areas that would create a noxious weed violation.

Required Management Practices and Applicable CRP Practices (Continued)

D Light Disking (Continued)

4. Light disking shall NOT be performed:

   - more than once in a three-year period on the same acres. The number of times light disking may be performed during the contract period may be limited by the cost-share limitation.
   - in the final year of the contract
   - on more than 50 percent of the contract acres in any one year. Any "contract" acres under 25 acres can be disked in their entirety. All other light disking policies apply.
   - on any soils with I value of 134 or greater
   - in a manner that is detrimental to existing conservation practices. For example, disking over terrace tops.

5. Cost-shares will be applied for only one disking operation regardless of the number of passes the producer makes over the acreage.

6. Light Disking is intended to increase plant diversity and temporarily reduce grass vigor. Under no circumstances shall cost-sharing be provided to re-establish the stand if destroyed or if the disked area does not provide adequate protection from wind or water erosion.

7. Light disking shall be performed according to NRCS Standards and Specifications No. 645.

   - Disking depth should increase plant diversity and temporarily reduce grass vigor without creating an erosion problem.
   - Not all soil types or fragile areas are well-suited or compatible with light disking without creating a resource concern.

8. Light disking shall be performed on the contour, where feasible in a manner that enhances wildlife habitat, but does not create conservation, water quality or erosion problems.

9. Light disking operations shall be performed after dormancy in the fall and prior to the beginning of the nesting season (April 15). Light Disking is NOT permitted during the nesting season (April 15 – July 15).

10. A Light Disking Producer Information Sheet has been developed and is included in KS Exhibit 13 as a requirement for county office use for participants utilizing light disking.

    Note:
    - all contract participants shall review and sign the sheet
    - provide a copy to each participant and file a copy in the contract folder.

National CRP Practices (Continued)

CP25 Rare and Declining Habitat (Continued)

H Practice Maintenance

Prior to October 26, 2011, all CP25 ecosystems except Sand and Sand Sage Prairie required prescribed burning as a maintenance practice at least one time in a ten year contract as reference in NRCS Tech. Guidance No. 80.

In October of 2011, the Kansas State FSA Committee considered recommendations from the Kansas Technical Committee and Conservation Partners to review the required maintenance burn policy on CRP practice CP25 Rare and Declining Habitat. This Kansas policy dates back to the original development of this practice in the early to mid 1990's prior to the required management practices passed in the 2002 Farm Bill.

The input was clear, the policy needs to encourage burning under proper conditions but should not "require" burning under below optimal conditions in the western part of the state which can result in undesirable results. Greater emphasis must be placed on prescribed management activities based upon site specific conditions.

On October 26, 2012, the State Committee repealed required maintenance burns on CP25 in the following determination:

"Eliminate the CP25 maintenance burn requirement statewide but "Encourage" burning in the Tall Grass Prairie Region, or other regions where prescribed burn achieves the desired results, to complete a Managed prescribed burn with cost-share assistance."

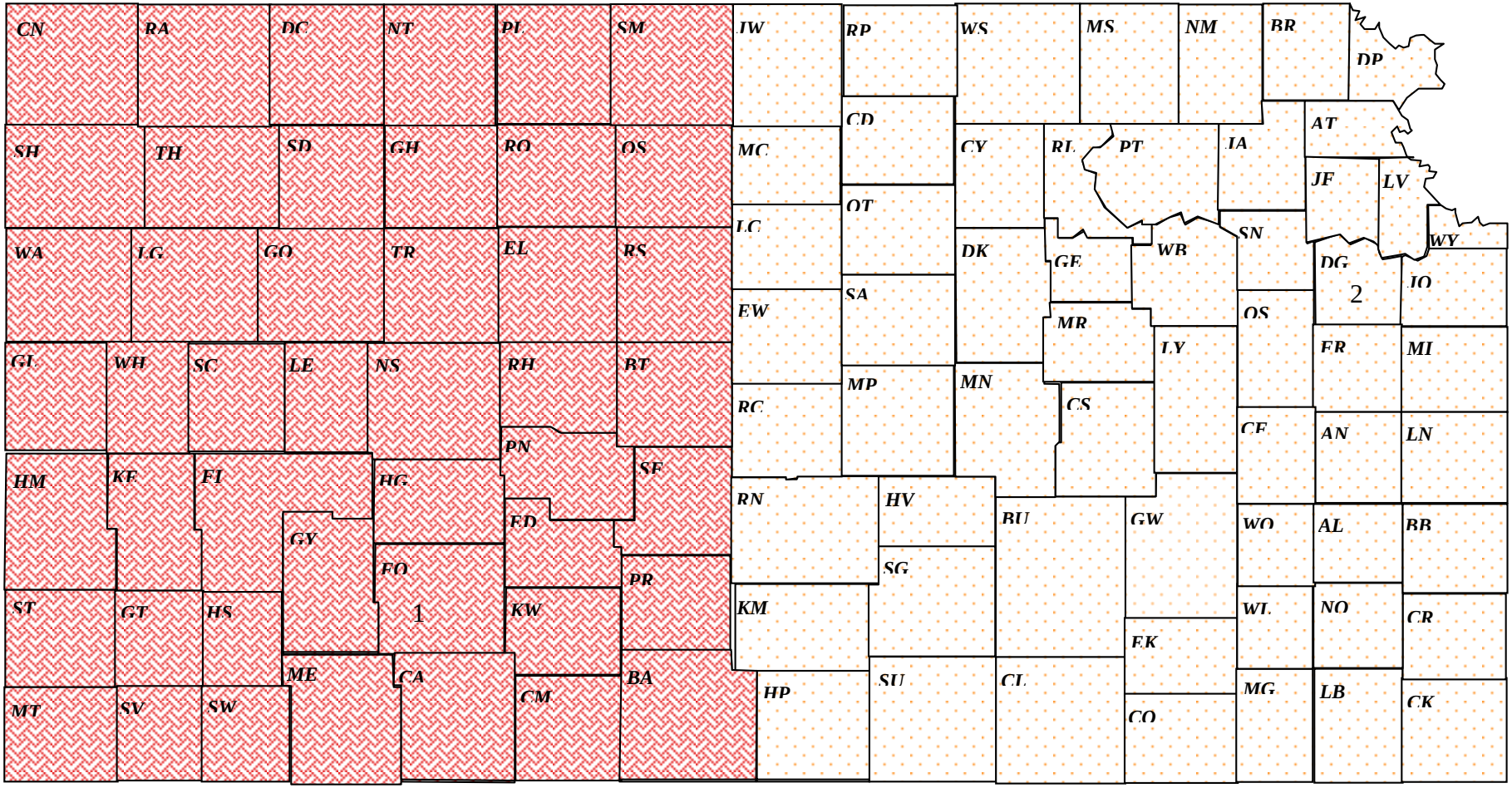
"In addition, the State Committee determined previously completed maintenance burns would be considered to retroactively meet the management practice requirement, however, no additional cost-share would be paid."

I Management Activity

Prescribed burn may be used as a management practice before or after the non cost-share maintenance burn.

FSA CRP Burning Dates

For sites with "I" value of 86 or greater (some sandy soils), burning dates are April 1-April 30.



February 1 – April 30 AND *July 16 - August 31*

February 1- April 15 AND *July 16 - August 31*

Always check with your local FSA office prior to initiating any activity on CRP acres.

Decision Considerations for Expiring CRP Contracts

Department of Agronomy
Department of Agricultural Economics

MF-2827 CRP

The Conservation Reserve Program (CRP) is a valuable tool for moderating the effects of soil erosion and providing reliable income.[1] It also provides wildlife habitat and water quality benefits.[2,3] As of April 2006, there were 3 million acres enrolled in the CRP in Kansas through government contracts with private landowners.[4] More than half of Kansas CRP acres (2.4 million acres) came up for renewal or release in 2006.[5] Many of these acres have already been re-enrolled in new contracts or short-term, 2- to 5-year, extensions, which were offered on expiring CRP land. The ability to re-enroll these acres in long-term CRP contracts depends on the inclusion of renewed CRP funding in the upcoming farm bill.

This publication is intended to help landowners and operators plan for the future of their CRP land.

Local economic conditions can be either favorably or unfavorably affected by CRP enrollment.[6] Stable income for participants may change how money is spent in their communities. It is possible that with reduced crop acreage, more money could be spent on personal living and less on farm inputs.[6] Local water supplies and air quality have been positively affected by CRP enrollment, but these benefits are difficult to quantify.[6] Returning land to crop production may negatively influence crop prices as surpluses accrue. Using CRP vegetation for grazing or haying may negatively influence livestock prices as livestock numbers climb.

There are seven broad options open to those with expiring CRP contracts: 1) re-enrollment in the CRP or enrollment in other conservation programs; 2) returning CRP land to crop production; 3) retaining CRP vegetation for livestock or forage production; 4) leasing or selling CRP land; 5) using the land for non-agricultural purposes such as leased hunting; 6) selling easements on the CRP land while retaining ownership; and 7) selling carbon credits. The best strategy depends on a producer's circumstances, expectations, and goals.[6]

CRP land from one tract can be split between options or used for multiple options. CRP-established vegetation along a stream could be retained as a buffer when converting to cropland. Retaining contour grass strips instead of constructing terraces could decrease the costs of converting land to crop production while meeting government program compliance. Leased hunting could be complementary with forage production and carbon credit sales.

1. ***Re-enroll in the CRP or other government programs.*** Short-term re-enrollment may be available. The duration of the re-enrollment period is determined by the environmental score on the CRP evaluation done at the first enrollment.
   - *Guaranteed annual cash rental payment.* Re-enrolling acreage in the CRP provides a guaranteed annual rental payment that can equal or exceed the land's cash rental value at time of enrollment.[6] These payments can decrease the overall risk of the farm operation.[6] However, CRP rates are locked in for multiple years and do not respond to inflation increases. Changes in CRP program rules may require more inputs or management to qualify for re-enrollment.
   - *Decreased labor requirements*. CRP participation allows controlled ownership with less management than returning the land to crop farming, freeing labor for a second job[12] or retirement, while retaining the ability to capture possible increases in land values.
   - *Improved condition of adjacent land.* Land in the CRP may mitigate the need for conservation structures on adjacent land and improve overall environmental conditions.
   - *Increased land values.* Land value may be positively affected by re-enrolling land in the CRP.[13]
   - *Enrollment in other government programs.* Enrollment in other government programs such as Environmental Quality Incentives Program (EQIP), Wetlands Reserve Program (WRP), or continuous CRP may be possible.
2. ***Return the land to crop production.***
   - *Increased income potential.* Crop production may be more profitable than CRP payments.
   - *Increased input purchases.* Labor, equipment, management, and input costs would be increased. Local purchase of supplies might support agricultural businesses in the community.

- *Ability to change operators.* Returning land to crop production offers the opportunity to change farm operators, which can be difficult while under a CRP contract.
- *Conversion costs.* Existing CRP vegetation will need to be destroyed by tillage or chemical methods. Depending on the producer or the operation, no-till or reduced till cropping systems could be the most cost-effective method of returning the land to crop production by using chemicals in place of deep tillage for destroying CRP vegetation and immediately planting a crop. Underlying weed problems (residual seed in the soil) can become important when the land returns to production. Higher than normal nitrogen rates may be required for 2 years after conversion.[14]
- *Ability to participate in government programs.* Expired CRP acres returned to crop farming may be eligible for participation in government programs. Government programs provide some income protection and risk reduction, as well as cost-share opportunities and technical assistance. Changes in the farm program may change the economics of participation. CRP acres protected with CRP[15] agreements have protected base acres. However, base acres plus CRP acres combined cannot exceed cropland acres on a farm. Acres that exceed this amount are permanently subtracted from the base acres. If CRP land is returned to crop production, a reduced base acreage may decrease government program benefits. For CRP contracts expiring or terminated before October 1, 2007, base acres can be restored. Contracts expiring or terminated after that date will be subject to the regulations of the new farm bill.
- *Compliance costs for highly erodible land.* Conservation practices may be required to comply with government program requirements when returning highly erodible land (HEL) to crop production. Compliance costs are up-front and may increase the owner's debt load. Cost-share funds may be available from the state or EQIP. Leaving contour grass strips when converting CRP land to cropland may meet some of the HEL compliance requirements. Some conservation practices, such as grassed waterways and buffer strips, decrease the amount of land available for cropping. Conservation structures require maintenance, which increases cost and management. Without compliance, up-front costs are lower, the conversion to cropland is rapid, and early income is maximized. There is neither income protection from declining commodity prices nor any ability to benefit from cost-sharing or other program incentives.
- *Environmental costs.* The decreased soil protection associated with removing perennial vegetation may lead to increased sediment, herbicide, and fertilizer runoff, and may affect adjacent land, which may subsequently need conservation treatment. Soil compaction would also increase. Soil and water resources can be protected when returning CRP land to crop production by leaving a buffer of CRP vegetation around surface water such as streams and in areas prone to erosion, or by cropping only the most productive acres and managing the remaining CRP vegetation as hay and forage. Buffers may be eligible for continuous CRP (CCRP) enrollment, even if the rest of the field is ineligible for re-enrollment. Implementing conservation practices can delay income from crop production but also protect future yields by conserving topsoil from wind and water erosion.

3. Retain existing CRP vegetation for hay and forage.

- *Low conversion costs.* Using the expired CRP vegetation for hay or forage may require less up-front investment than returning the land to cultivation. Maintenance and management costs may be lower than for crop farming, although some grazing options are management intensive. Leaving expired CRP land in grass and/or trees gives continued protection to the land from water and wind erosion, enhancing water quality. Hay and pasture income is generally less than crop income. Under current rules, expired CRP is treated as pastured cropland, making it eligible for higher Conservation Security Program (CSP) payments than native rangeland. CSP base payments will be lower than CRP payments, but additional income can be realized from haying and grazing.
- *Management flexibility.* Expired CRP vegetation provides management flexibility since

it can be used as either hay or forage. Hay can be fed or sold depending on the relative economics each year. Hay can provide immediate, first growing season income with little or no expenditure on permanent improvements. Haying costs may include harvesting equipment, custom harvesting fees, and forage marketing. Labor demands may be greater than with grazing. Haying may be detrimental to wildlife at certain times of the year[7] but beneficial at other times.[8] Good grazing management, including prescribed burning, will be required to maintain productivity and species composition.

- *Leasing opportunities.* The inability of operators or landowners to handle the debt associated with stocking former CRP land can be avoided by leasing the land to another livestock owner. There may be an opportunity for the landowner to provide management of the operator's livestock as an additional source of income.
- *Special use opportunities.* Former CRP land allocated to grazing can be used to provide winter-feeding sites, birthing pastures, and to serve as a forage reserve for drought periods. It can be incorporated into grazing systems that improve herd performance, maximize grass health, and provide wildlife cover. Fencing and water development costs can be substantial, but cost sharing is available.[5] Grazinglands located adjacent to croplands can provide opportunities for complementary grazing, which can extend the grazing season and improve profitability.[11] This may be the best use of small CRP acreages where separate fencing is not economically viable.

4. Lease or sell CRP land.

- *Realize the increased value of the land.* For some landowners, selling former CRP land allows them to capture capital gains generated by land value increases while the land was enrolled in CRP. This can free labor and management for other activities and provide money for other investments. Retaining ownership, but leasing the land, can capture potential future capital gains while freeing labor and management for other enterprises. Landowner costs are associated with converting CRP land to cropland or grazing. Rental rates can be adjusted downward to reflect operator contributions toward conversions or improvements. Multiple-year leases increase the economic incentive for operators to improve and conserve the land. Leases need to specify who controls hunting rights.

5. Use the land for non-agricultural purposes.

- *Utilize intrinsic values.* Expired CRP land can have recreational, environmental, and aesthetic values.[2, 9, 13] Neighboring land uses can enhance or decrease these values. To capture these values, a marketing plan will have to be developed and implemented. CRP land can provide good hunting opportunities in some locations, especially if it provides habitat for a desirable species.[3] Hunting leases can provide a source of income for the landowner or operator. Management needs vary with the site and with the intensity of wildlife production desired. Wildlife plantings may improve hunting success and thus increase lease rates, as well as costs and management. In some instances, grazing is a compatible, and even desirable, component of wildlife management.[8]

6. Leave the land in grass and protect it with an easement.

- *Retain agricultural use of land.* Urban sprawl can place pressure on expired CRP land for development. Where available, conservation easements[5] can provide an economically viable alternative to development.[10]

7. Contract carbon credits.

- *Garner additional income from carbon credits.* About 50 percent of the carbon sequestered in the soil is lost by tillage. It can be re-sequestered by reducing tillage operations or planting grass. A market for carbon sequestration credits is emerging. In a pilot program, the Chicago Climate Exchange (CCX) is contracting with Farm Bureau and Farmers Union, which are functioning as a carbon credit aggregators.[15] Producers in parts of Kansas can contract carbon credits on no-till crop acres or land seeded to grass that meet specific criteria. Currently, land established in grass before 1999 cannot be contracted, but this may change in the future. Current rates are $1 to $2 per acre; land must be maintained according to contract terms for 4 years.

Summary

Economics will undoubtedly dictate how CRP acres are managed. Landowners have several options, including keeping land under CRP contract, converting land to crop production, or using the land for forage and/or livestock production. These alternatives can be compared using the CRP decision tool and spreadsheet available at: *http://www.agmanager.info/livestock/budgets/production/default.asp*

Click on *CRP Decision Tool: For managers with expiring CRP contracts*. In addition to economics, landowners may also consider the environmental benefits of retaining CRP land in permanent vegetative cover.

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Kansas State University Agricultural Experiment Station and Cooperative Extension Service

MF-2827 March 2008

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As of 2009, Kansas had just over 3 million acres enrolled in the Conservation Reserve Program (CRP). Established in 1985 to protect highly erodible and other environmentally-sensitive lands, CRP has created valuable habitat for many species of wildlife, including popular game species such as pheasants, Bobwhite Quail and prairie chickens. By 2011 over one-half of the CRP contracts in Kansas will have expired. Due to a national reduction in authorized acres some of these expiring acres will not qualify for re-enrollment.

When a CRP contract expires, landowners are faced with management decisions that will affect wildlife populations, water quality, soil erosion and income producing opportunities. The basic alternatives include returning all or part of the land to crop production, retaining the vegetation for livestock or forage production, using the land for recreational purposes such as hunting or enrolling at least parts of the land into other conservation programs or some combination of these. Economics will generally determine land use decisions, and each alternative will need careful consideration. The real estate value of rural land with good wildlife habitat is increasing as many buyers look for opportunities for outdoor activities.

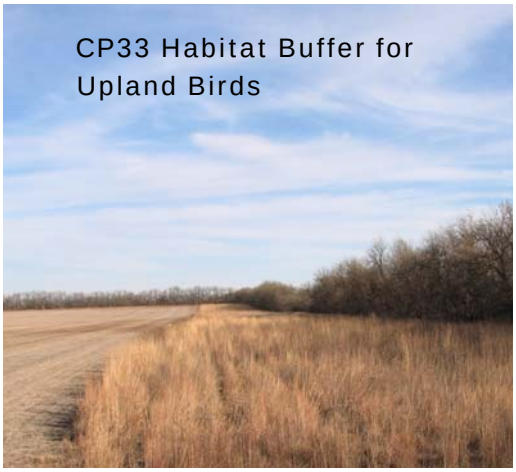
Most land enrolled in the CRP was highly erodible and difficult to farm. Returning such land to crop production requires meeting highly erodible land conservation compliance rules to retain eligibility for U.S Department of Agriculture (USDA) commodity or conservation programs. Landowners should consider “farming the best and leaving the rest” if the land is returned to crop production. Fortunately, the Continuous Conservation Reserve Program (CCRP) can help landowners do exactly that. Marginal lands with the least potential for profitable farming may be eligible for payments through the CCRP and therefore could be maintained as permanent vegetation and left for wildlife. The CCRP practices can diversify farm income and maintain the environmental benefits achieved by CRP. Under CCRP, USDA’s Farm Service Agency (FSA) may enroll eligible land devoted to certain conservation practices at any time. The FSA accepts qualified offers without a bid process. CCRP contracts are for 10-15 years and may pay an enhanced rental rate.

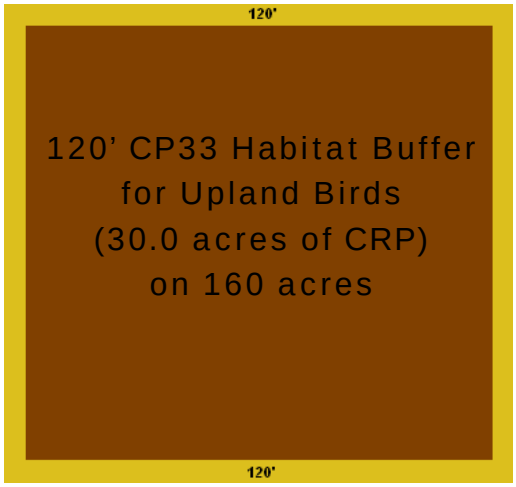
Options for Re-enrolling Parts of the Field in Continuous Conservation Reserve Program (CCRP)


CP21 – Filter Strip Adjacent to Stream

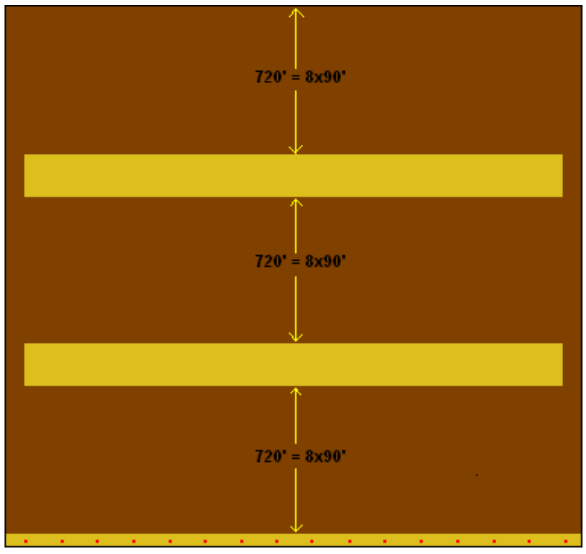
Careful planning before breaking out CRP grassland will help maintain critical habitat for wildlife and provide other environmental benefits. Areas around streams and other water bodies can be protected with CP21, Filter Strips. Wetlands within cropland may be eligible for protection and restoration providing valuable habitat for waterfowl and pheasants using continuous practices CP23, CP23a, CP27 and CP28. Practices devoted to creating habitat for wildlife include CP33, Habitat Buffers for Upland Birds and CP38E, State Acres for Wildlife Enhancement (SAFE). These practices and others may give landowners financial incentives to maintain nesting, brood rearing, travel corridors and winter cover that is often lacking within intensively farmed areas.

By combining multiple CCRP practices on the same field it may be possible to maximize re-enrolled acres on expiring CRP. These examples were laid out to accommodate a 90 foot sprayer but can be tailored for any planter, sprayer or drill width. Landowners should contact their local Natural Resources Conservation Service (NRCS) office for planning assistance.

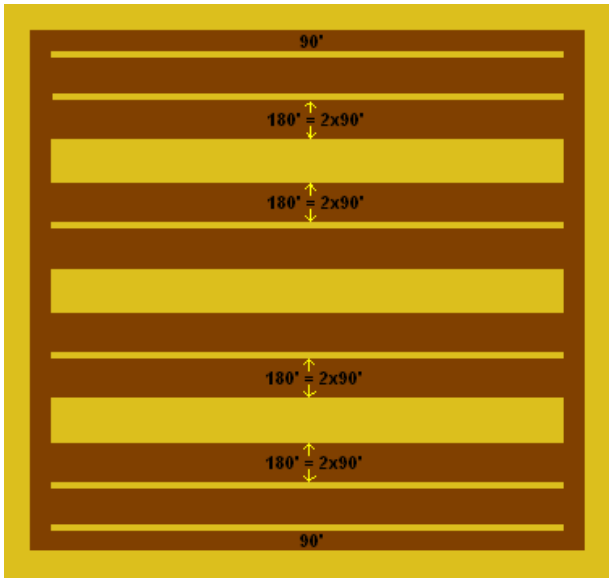





Waterway straightened to facilitate farming with "Flexible Buffer" CP38E State Acres for Wildlife Enhancement (SAFE)



(2) 200' CP38E Safe Buffers and (1) 60' CP38E SAFE Buffer underneath the power line adds up to 26.0 acres of CRP.



Multiple CCRP practices adds up to 66.0 acres of CRP on 160 acres. 120' CP33 Habitat Buffer (3) 200' CP38E SAFE buffers and (6) 25' CP24 Cross Wind Trap Strips.

Ranching and wildlife management are generally very compatible. Good rangeland management and good wildlife management, go hand in hand, especially for prairie chickens. Because CRP land was formerly cropped, adequate fencing and water sources are often lacking. Landowners who want to use expired CRP for livestock production should check with the local NRCS office about the Environmental Quality Incentives Program (EQIP), which offers cost-share funding for cross-fencing, watering, controlling invasive trees, managed grazing and prescribed burning on eligible land. Landowners with an interest in improving habitat for wildlife can contact their local wildlife biologist and check on cost share opportunities and planning assistance through the Wildlife Habitat Incentive Program (WHIP) and Kansas Department of Wildlife and Park's Landowner Incentive Program.

For additional information on Continuous CRP visit: http://www.fsa.usda.gov

For information on EQIP and WHIP visit: http://www.ks.nrcs.usda.gov/programs/

To contact a Kansas Department of Wildlife and Parks Biologist go to: http://www.kdwp.state.ks.us/news or call 620-672-5911

For additional information on the economics of alternative uses of CRP go to: www.oznet.ksu.edu/library See - MF-2827 "Decision Considerations for Expiring CRP Contracts" March 2008.

Examples of Continuous CRP Practices that can maintain many of the benefits achieved with CRP

CP8A Grass Waterways
CP15A Contour Grass-Strips
CP15B Contour Grass Strips on Terraces
CP21 Filter Strips
CP23 Wetland Restoration, Floodplain
CP23A Wetland Restoration, Non-flood plain
CP24 Cross Wind Trap Strips
CP27 Farmable Wetlands
CP28 Farmable Wetlands Buffer
CP33 Habitat Buffers for Upland Birds
CP38E State Acres for Wildlife Enhancement (SAFE)

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

FSA
FARM SERVICE AGENCY

KANSAS WILDLIFE & PARKS

Grazing and Haying CRP Ground after Contract Expiration

As CRP contracts expire, some landowners are considering what needs to be done to transition the acres into a productive grazing or haying enterprise. Maintaining these acres with a perennial grass cover will reduce erosion, improve water quality, enhance wildlife, and reduce sedimentation.

Grazing

Getting CRP ready to graze will probably require fencing and water development. Fence off CRP that is adjacent to native rangeland. Experience has shown that animals will not utilize seeded grass as well as native sod when given a choice. One can partially overcome this problem by using grazing distribution tools such as water development, placement of salt and mineral, and burning. Care should be taken in determining where to place water developments. If feasible, water developments should be positioned in a way that will encourage uniform grazing of the land.

Most CRP stands coming off contract are initially not in condition for full grazing pressure. A management strategy covering 2 to 4 years may be necessary to condition the plants to use. After years of non-use the plants are in a state of low vigor and may have a limited root system. Loss of topsoil from previous cropping and large spacing between grass plants is common, often resulting in low total forage production.

Increasing plant density and vigor is the first step to improving the stand for use as pasture. If the land has not been burned for a few years, it would be a good idea to conduct a prescribed burn. Spring burning is an effective method of removing the standing dead material and mulch to allow sunlight to reach the crown of the plant. If allowed to remain, previous years forage growth will dilute the diet of grazing animals and suppress growth of young plants. Burning will also help control undesirable plants such as eastern red cedar.

Burning will not only get rid of old dead material, but should increase tillering and help the grass stand continue to develop. Frequent burning is not recommended in western Kansas. In eastern Kansas, do not burn unless heavy growth remains. Avoid annual burning until the stand is completely developed (2 to 4 years).

Mowing or haying in March or April is another method to remove litter, although hay removed at this point would be relatively low in protein and energy. A 2009 study by B. Andersen from the University of Nebraska indicated that burning was the most effective in improving subsequent production with grazing and haying providing intermediate improvement compared to shredding or no treatment.

Year-end yields following one year of treatment on CRP: Nebraska, 2009	
Treatment	Yield (lbs/acre)
Burn	4420
Graze	3200
Hay	3080

Shred	2160
Control	2130

A three-year study by K-State from 1994-96, with sites in Edwards, Greeley, Kearny and Reno counties, compared spring burning or spring mowing in year one to non- treated CRP. At the Edwards County site, calves from cow-calf pairs showed similar gains with all treatments.

Effect of CRP Mowing and Burning on Calf Gains: Edwards County			
	Average Daily Gain (lbs/day)		
	1994	1995	1996
No treatment	2.36	2.20	2.36
Mowed, spring 1994	2.44	2.22	2.48
Burned, spring 1994	2.48	2.12	2.32

Stocking rate (cow/calf pair): 212-267 lbs/acre; Days grazed: 144 (1994); 168 (1995); 130 (1996)
Source: Langmeier, et al. K-State Cattlemen's Day 1997 Cattlemen's Day 1997
http://www.ksre.ksu.edu/library/lvstk2/srp783.pdf

Season-long stocker grazing was done at the Kearny and Reno county sites. Stocker gains were generally highest where the CRP was burned. Stocker performance increased 6 to 38 percent after spring burning compared to no treatment.

Effect of CRP Mowing and Burning on Stocker Gains from Season-Long Grazing: Kearny County			
	Average Daily Gain (lbs/day)		
	1994	1995	1996
No treatment	1.16	1.61	1.57
Mowed, spring 1994	1.27	1.60	1.57
Burned, spring 1994	1.93	2.10	1.96

Stocking rate: 112-156 lbs/acre; Days grazed: 130 (1994); 103 (1995); 94 (1996)

Effect of CRP Mowing and Burning on Stocker Gains from Season-Long Grazing: Reno County			
	Average Daily Gain (lbs/day)		
	1994	1995	1996
No treatment	2.01	1.15	1.79
Mowed, spring 1994	2.55	1.24	1.44
Burned, spring 1994	2.65	1.39	1.68

Stocking rate: 162-169 lbs/acre; Days grazed: 103 (1994); 141 (1995); 112 (1996)

The Greeley County site tested early intensive heifer grazing. Prescribed burning increased grazing performance at that location, largely due to the magnitude of the difference the first year.

Effect of CRP Mowing and Burning on Heifer Gains from Early Intensive Grazing: Reno County			
	Average Daily Gain (lbs/day)		
	1994	1995	1996
No treatment	2.73	2.49	1.31
Mowed, spring 1994	3.07	2.21	1.39
Burned, spring 1994	3.47	2.27	1.22

Stocking rate: 175-196 lbs/acre; Days grazed: 58 (1994); 74 (1995); 79 (1996)

When grazing any CRP ground for the first time, it's best to use a light stocking rate to allow good plant growth the first year. Adjust stocking rates in subsequent years based on stand development.

Since burning and mowing won't fit all situations other options should be considered. CRP acres could be used as a calving pasture and would provide plenty of bedding and clean ground. Lactating cows would need supplementation to meet both protein and energy needs.

"Extreme grazing" has a goal of leaving little residual forage. It is achieved by using a very heavy stocking for a short period of time (80 - 100 cows per acre for one to seven days). This results in trampling the dead litter into the soil and opening up new areas for seedlings and tillers. Temporary electric fencing is often needed to concentrate animals in a smaller area and then allow movement to the next section. If grazed as early as allowed in the fall, nutrient content will be relatively higher, reducing supplement needs.

Haying

Management decisions related to hay production include fertilization, burning, and time of cutting. Most CRP in Kansas was seeded to warm-season native grasses. Although fertilization with nitrogen and/or phosphorus might increase production, it is not recommended because of potential changes in plant composition. Cool-season grasses and broadleaf plants will be stimulated by fertilization.

If you want to fertilize, it would be best to start by treating a small area. Observe and measure what happens. Warm-season grasses will respond to early May applications of 30 pounds per acre nitrogen, 10 pounds per acre phosphorus, and 0 to 30 pounds per acre potassium. Fertilization of cool-season grasses such as smooth brome and tall fescue should be based on a soil test. Follow recommendations found in the Kansas State University Research and Extension publications:

Smooth Brome Production and Utilization C-402
http://www.oznet.ksu.edu/library/crpsl2/samplers/c402.asp

Tall Fescue Production and Utilization C-729.
http://www.oznet.ksu.edu/library/crpsl2/samplers/c729.asp

If the land has not been burned for a few years, it would be a good idea to conduct a prescribed burn. Burning will remove mulch and standing dead litter. Although this material will add yield when baled, forage quality will be reduced.

The proper time to hay native warm-season grasses in Kansas is during July. Crude protein will drop a half percentage point every week during July, but will usually be 6 to 8% during this time. Peak yield on warm-season grasses will probably not occur until

August, but by that time crude protein content will be less than 5%. A mid-July haying date on native grass is a good compromise between yield and quality. Cool-season grasses should be hayed during the heading to full bloom stage to optimize yield and quality.

Other considerations

Other limiting factors in CRP productivity are undesirable weeds and brush. These problems may be best addressed while still under contract since herbicide options are broader for CRP than for use for hay or grazing. Mechanical control may be needed for larger trees and brush. Goats may be an option for biological control of some weed species. In the long run, increasing the vigor of the stand through good grazing management is the best weed control.

-- Walt Fick, Rangeland Management Specialist
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-- Sandy Johnson, Northwest Area Livestock Specialist
sandyj@ksu.edu

eupdate Feb 12, 2010

Factors to Consider Before Burning Wheat Residue

Many producers may be planning to burn their wheat stubble this summer to help control volunteer plants, weeds, and certain diseases. While burning is inexpensive, producers should understand the true value of residue ahead of time. Some of the information below comes from K-State Extension publication MF-2604, *The Value of Crop Residue*, available at your local county Extension office or at: www.ksre.ksu.edu/library/crpsl2/mf2604.pdf/

There are four main factors to consider.

Loss of nutrients

The products of burned wheat stubble are gases and ash. Nutrients such as nitrogen (N) and sulfur (S) are largely combustion products, while phosphorus (P) and potassium (K) remain in the ash. When residue is burned, about one-third to one-half of the N and S will combust. The nutrients in the ash may remain for use by the plants, if it doesn't blow away first. Therefore, instead of cycling these important plant nutrients back into the soil, they can essentially become air pollutants when the residue is burned.

Amounts of nutrients remaining in wheat stubble (assuming 50 bu/ac yield)	
Nutrient	Pounds present in 5,000 lbs of wheat straw
N	27.0
P_2O_5	7.5
K_2O	37.5
S	5.0

Protection from soil erosion

Bare soil is subject to wind and water erosion. Without residue, the soil will receive the full impact of raindrops, thus increasing the amount of soil particles that may become detached during a rainfall event. Bare, tilled soils can lose up to 30 tons per acre topsoil annually. In no-till or CRP systems where residue is left, annual soil losses are often less than 1 ton per acre. The detachment of soil particles can lead to crusting of the soil surface, which then contributes to greater amounts of sediment-laden runoff, and thus, reduced water infiltration and drier soils.

Leaving residue on the field also increases surface roughness, which decreases the risk of both wind and water erosion. Most agricultural soils in Kansas have a "T" value, or tolerable amount of soil loss, of between 4 and 5 tons per acre per year, which is about equal to the thickness of a dime. To prevent water erosion, 30% ground cover or greater may be needed to reduce water erosion to "T" or less, especially in fields without erosion-control structures such as terraces.

Standing stubble is more effective at preventing wind erosion than flat stubble.

Moisture infiltration rates and conservation

Wheat residue enhances soil moisture by increasing rainfall infiltration into the soil. Residues physically protect the soil surface and keep it receptive to water movement into and through the soil surface. Without physical protection, water and soil will run off the surface more quickly.

Ponded infiltration rates were measured at Hesston in September 2007. Very low infiltration rates (1.9 mm/hr) were observed for continuous winter wheat in which the residue was burned each year prior to disking and planting the following crop. In contrast, high infiltration rates (13.3 mm/hr) were observed for a no-till wheat/grain sorghum rotation.

Another way residue increases soil moisture is by reducing evaporation rates. Evaporation rates can decline dramatically when the soil is protected with residue. Residue blocks solar radiation from the sun and keeps the soil surface cooler by several degrees in the summer.

Soil quality concerns

Over time, the continued burning of cropland could significantly degrade soil organic matter levels. By continually burning residue, soil organic matter is not allowed to rebuild. Soil organic matter is beneficial for plant growth as it contributes to water holding capacity and cation exchange capacity. Soil organic matter binds soil particles into aggregates, which increases porosity and soil structure and thus, increases water infiltration and decreases the potential for soil erosion. One burn, however, will not significantly reduce the organic matter content of soil.

If producers do choose to burn their wheat stubble, timing is important. It's best to burn as late as possible, close to the time when the next crop is planted. This minimizes the time that the field will be without residue cover and vulnerable to erosion. Before choosing to burn residue, producers should check with the USDA Natural Resources Conservation Service and/or the Farm Service Agency to find out if this will affect their compliance in any conservation programs.

-- DeAnn Presley, Soil Management Specialist
deann@ksu.edu
eUpdate July 8, 2011

Technical and Financial Support Available for Prescribed Burning

A wealth of information and assistance is provided by federal, state, and local agencies. For more information about prescribed burning, contact the following:

KANSAS DEPARTMENT OF WILDLIFE, PARKS, AND TOURISM
http://kdwpt.state.ks.us/Services/Private-Landowner-Assistance/Wildlife

Kansas Department of Wildlife, Parks and Tourism (KDWPT) private land wildlife biologists can provide information and recommendations to landowners about the impacts to wildlife depending on the size, intensity, frequency and timing of the prescribed burn. Considering the needs of wildlife during the planning process can enhance wildlife habitat and minimize potential harmful effects to wildlife from the burn.

Many private land biologists have training to help assist on prescribed burns but will not be in charge of the burn on private land. Biologist have various kinds of prescribed burning equipment available for loan to private landowners and other equipment only used by KDWPT staff assisting with a burn. KDWPT biologist can also help locate other equipment available from local conservation organizations. To contact your private lands biologist call 620-672-0760.
Matt Smith, KDWPT Wildlife Biologist

NATIONAL WILD TURKEY FEDERATION
http://www.nwtf.org/in_your_state/lists.php?STATE=KS

The NWTF purchases prescribed burn equipment for agencies that can check the equipment out to landowners for their use in conducting prescribed burns. Additionally, the NWTF sometimes provides funding for partner programs offering assistance to landowners for prescribed burn planning and implementation.
Jared McJunkin, NWTF Conservation Field Supervisor

PHEASANTS FOREVER and QUAIL FOREVER
http://www.kansaspfqf.org/

Pheasants Forever Farm Bill Biologists are private lands wildlife biologists that work in a partnership with PF/QF chapters, NRCS, and KDWPT in Kansas. There are five biologist positions in the state, covering 44 counties, and all have experience applying prescribed fire. Farm Bill Wildlife Biologists work directly with landowners and can provide technical assistance on burn plan development and a number of other conservation practices. While they cannot actively assist with prescribed burning during work time, they can offer advice and work with partners to ensure that landowners get well thought out plans that will minimize risk of fire escape or personal injury. Many Farm Bill Biologists also work closely with local prescribed burn associations and may volunteer their free time to help associations complete prescribed burns. In addition, Farm Bill Biologists work directly with NRCS and other agency staff to develop necessary plans and contracts that can provide financial assistance for prescribed burns. In some cases, the Farm Bill Biologist will be the first point of contact on prescribed burning through the NRCS office.

Pheasants Forever and Quail Forever also have 48 local chapters across the state that work with landowners to help them with their upland habitat goals. Prescribed burning is a habitat management tool that many Kansas chapters actively support. Please visit www.PheasantsForever.org or www.QuailForever.org to find your local chapter and contact them about your prescribed burning needs.
Zac Eddy, PF Senior Farm Bill Wildlife Biologist

NATIONAL WEATHER SERVICE
http://www.weather.gov/
See Weather section of the handbook for a description of services and contact information.

KANSAS MESONET
http://mesonet.k-state.edu/
See Weather section of the handbook for a description of services and contact information.

CONSERVATION DISTRICTS
https://agriculture.ks.gov/divisions-programs/division-of-conservation/conservation-districts

Each county in Kansas has a Conservation District that directs and assists with natural resource conservation efforts in the county. Some Conservation Districts have prescribed burning equipment available for rent or to use at no cost. Equipment typically available may include spray units, drip torches, and fire swatters. Conservation District equipment inventory varies widely from county to county, so check with your local Conservation District to determine what is available and the rules for its use.
Pamela Hays, Ellsworth Count Conservation District

FARM SERVICE AGENCY
http://www.fsa.usda.gov/FSA/stateoffapp?mystate=ks&area=home&subject=prog&topic=landing

As a Management Practice under the Conservation Reserve Program, cost-share assistance is provided to landowners and operators by FSA for completing prescribed burns to enhance the cover as a mid-contract management practice. Maintenance burns are also permitted under the program without cost-share, but if completed as a management practice, the prescribed burn is eligible for cost-share assistance.
Rod Winkler, USDA FSA Program Specialist Conservation Reserve Program

NATURAL RESOURCES CONSERVATION SERVICE
http://www.nrcs.usda.gov/wps/portal/nrcs/main/ks/contact/

Individuals who request technical assistance from NRCS are provided technical assistance by an approved Prescribed Burn Planner. Depending upon the complexity of the proposed burn area, (size, fuel amount, and fuel type) an approved planner will meet with and help the producer develop a prescribed burn plan. After NRCS develops and approves the plan the producer will then have the plan reviewed with them to assure understanding and responsibility. This is done at no cost to the producer or landowner.

Only NRCS employees with Job Approval Authority can plan or approve prescribed burns developed by NRCS. However, a producer can perform a prescribed burn without NRCS assistance and still meet NRCS specifications as long as a NRCS employee reviews and certifies that the completed burn meets the purpose and intent for which prescribed burning was included in a conservation plan of operations.

In both EQIP and WHIP, NRCS will financially assist producers to complete prescribed burning at the rate of $5.25/acre. Those are the primary funding sources for assisting landowners or producers with prescribed burning.
David Kraft, USDA NRCS State Rangeland Management Specialist

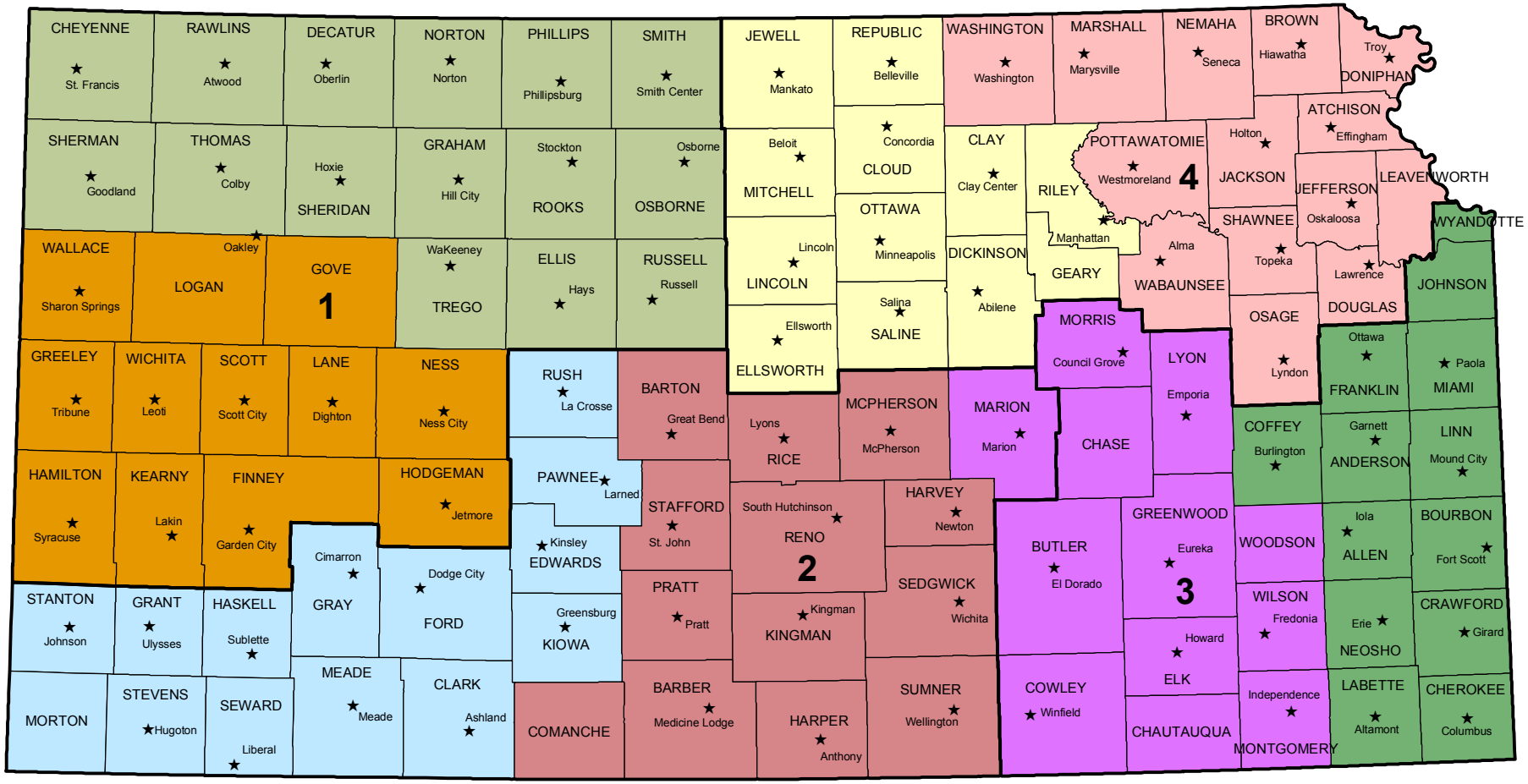
FOR COUNTY CONTACT INFORMATION FOR CONSERVATION DISTRICTS, FSA, NRCS
http://offices.sc.egov.usda.gov/locator/app?state=ks&agency=fsa

KANSAS FOREST SERVICE
https://www.kansasforests.org/programs/fire/prescribedfire.shtml
https://www.kansasforests.org/about/staff.shtml

KANSAS STATE UNIVERSITY EXTENSION
http://www.agronomy.k-state.edu/extension/range-and-forage/prescribed-burning.html
http://www.ksre.ksu.edu/Map.aspx

USDA United States Department of Agriculture

Kansas
Rangeland Management Specialist Map



County Boundaries

NRCS Administrative Areas

★ NRCS Field Offices

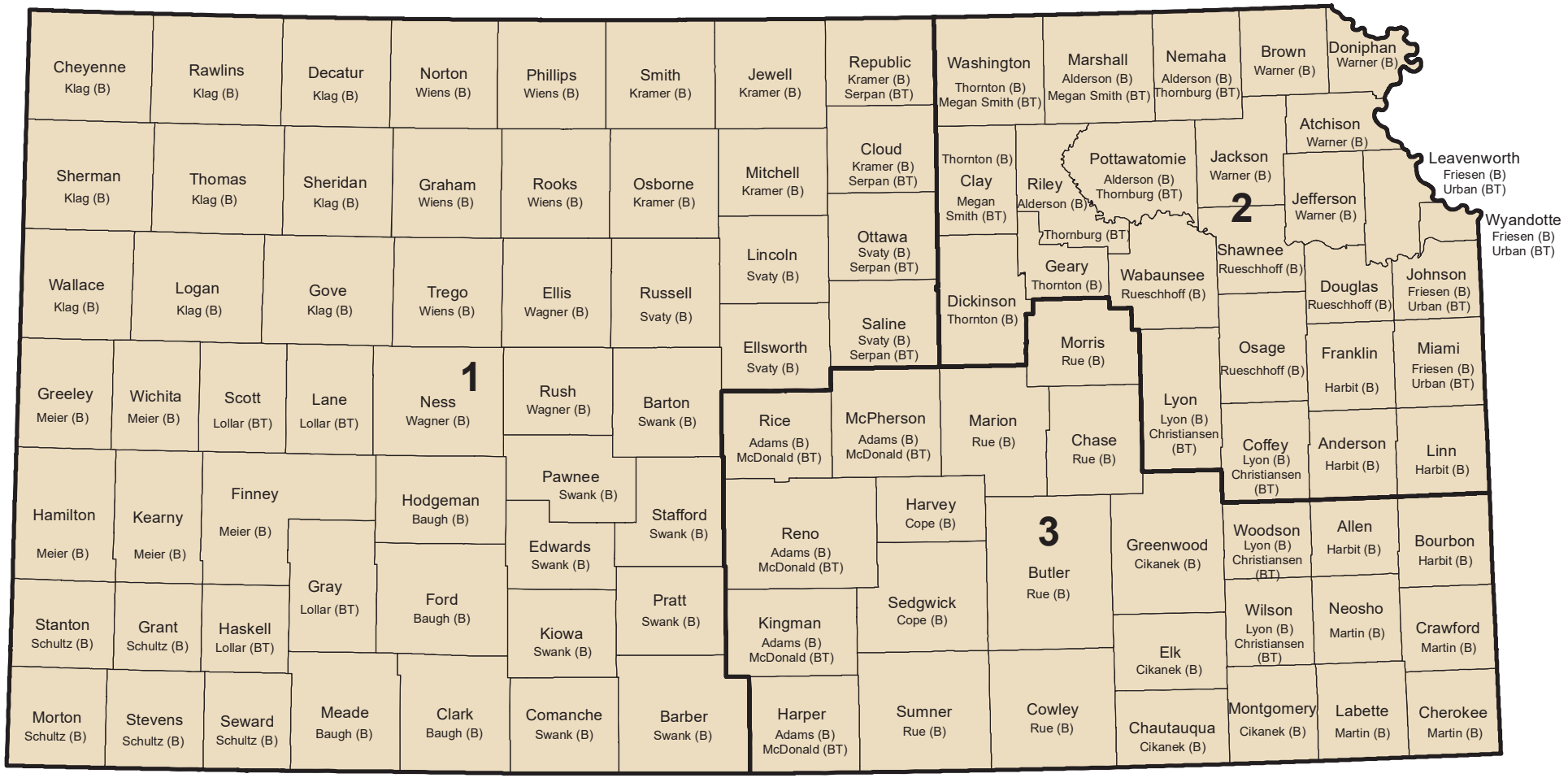
Rangeland Management Specialist Coverage Areas

- Toni Flax
- Ted Houser
- Dusty Schwandt
- Doug Spencer
- Dustin Tacha
- James Ungerer
- Dane Varney
- Vacant

N W E S

Wildlife Biologists (B) & Bio-Technicians (BT)

Kansas Department of Wildlife, Parks & Tourism



Regional Offices

Kansas Department of Wildlife, Parks and Tourism

Region 1
Sup: Matt Smith
1426 Hwy 183 Alt.
Hays, KS 67601
(785) 628-8614

Region 2
Sup: Aaron Deters
300 SW Wanamaker Rd.
Topeka, KS 66606
(785) 273-6740

Region 3
Sup: Craig Curtis
6232 E 29th St. N
Wichita, KS 67220
(316) 683-8069

Rev. Jan 2017

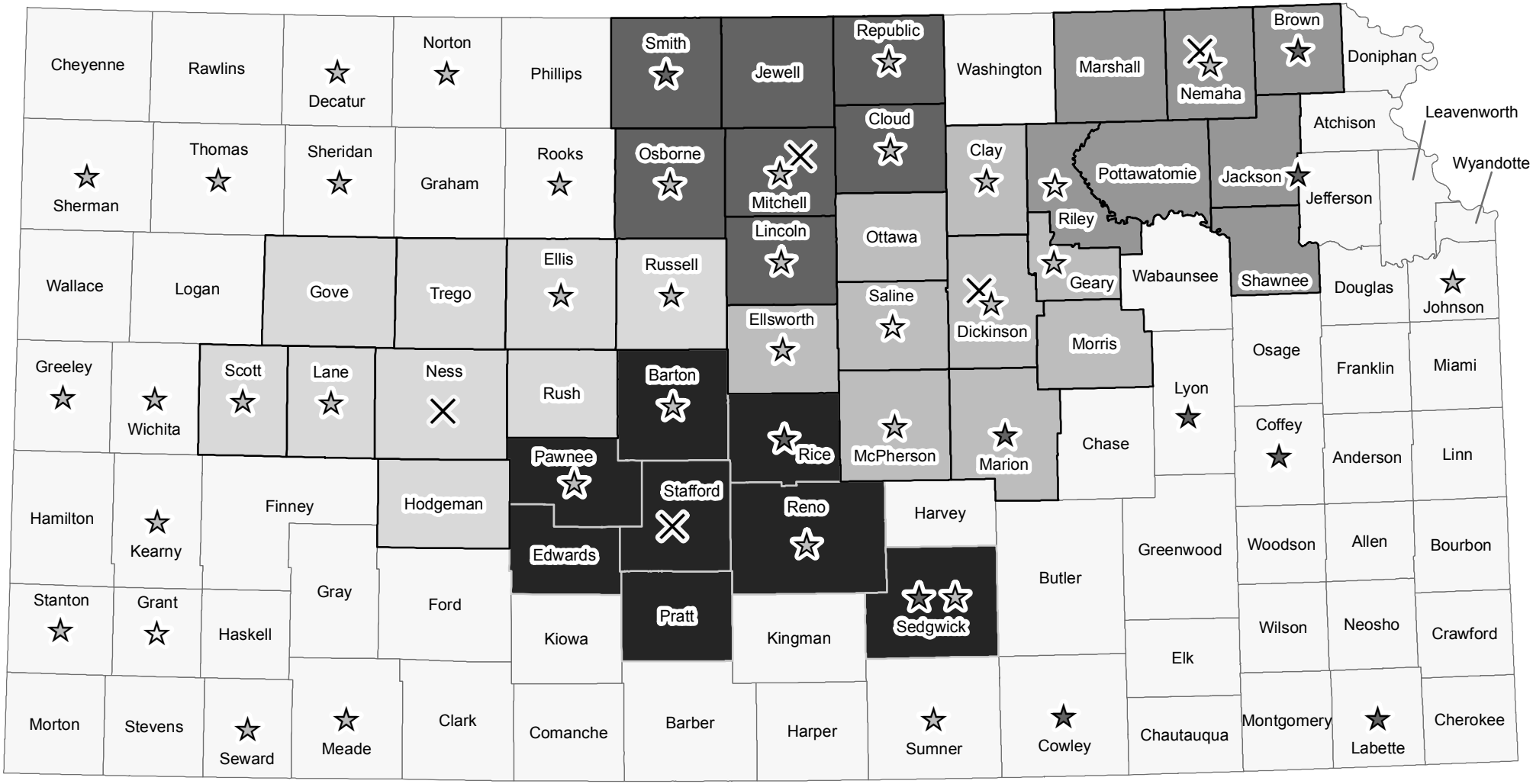
Wildlife Section: Supervisors, Biologists, and Bio-Technicians

Kansas Department of Wildlife, Parks & Tourism

LastName	FirstName	Address	City	State	Zip	Phone	E-Mail
Adams	Steve	2803 North Lorraine Street, Suite J	Hutchinson	KS	67502	316-772-2702	steven.adams@ks.gov
Alderson	Corey	3705 Miller Parkway, Suite B	Manhattan	KS	66503	785-776-5182	corey.alderson@ks.gov
Baugh	Aaron	1001 W. McArtor Rd.	Dodge City	KS	67801	620-227-8609	aaron.baugh@ks.gov
Christiansen	Jacob	738 Fegan Rd.	Toronto	KS	66777	620-637-2748	jacob.christiansen@ks.gov
Cikanek	Vickie	1739 80th St.	Climax	KS	67137	620-583-5049	vickie.cikanek@ks.gov
Cope	Charles	6232 E. 29th St. North	Wichita	KS	67220	316-683-8069	charles.cope@ks.gov
Curtis	Craig	6232 E. 29th St. North	Wichita	KS	67220	316-683-8069	craig.curtis@ks.gov
Deters	Aaron	300 SW Wanamaker Rd.	Topeka	KS	66606	785-273-6740	aaron.deters@ks.gov
Friesen	Andy	8304 Hedge Lane Terrace	Shawnee	KS	66227	913-422-1314	andy.friesen@ks.gov
Harbit	Justin	1515 S. Judson	Fort Scott	KS	66701	620-450-8138	justin.harbit@ks.gov
Klag	Kevin	1880 S. Range Ave., Ste. 2	Colby	KS	67701	785-462-7993	kevin.klag@ks.gov
Kramer	Lucas	2131 180th Road	Glen Elder	KS	67446	620-450-7203	lucas.kramer@ks.gov
Lollar	Ab	785 S Hwy 83	Garden City	KS	67846	620-276-8886	abram.lollar@ks.gov
Lyon	Alex	3020 W 18th Ave, STE B	Emporia	KS	66801	620-450-7202	alexander.lyon@ks.gov
Martin	Logan	507 E. 560th Ave.	Pittsburg	KS	66762	620-231-3173	logan.martin@ks.gov
McDonald	Kyle	3502 Lakeview Rd.	Hutchinson	KS	67502	316-772-2704	kyle.mcdonald@ks.gov
Meier	Kurtis	785 S Hwy 83	Garden City	KS	67846	620-276-8886	kurtis.meier@ks.gov
Rue	Jeff	5095 NE 20th	El Dorado	KS	67042	316-772-2706	jeff.rue@ks.gov
Rueschhoff	Brad	300 SW Wanamaker Rd.	Topeka	KS	66606	785-273-6740	brad.rueschhoff@ks.gov
Schultz	Kraig	P.O. Box 1502	Elkhart	KS	67950	620-450-8287	kraig.schultz@ks.gov
Serpan	Brian	#3 State Park Rd.	Sylvan Grove	KS	67481	620-794-6138	brian.serpan@ks.gov
Smith	Matt	PO Box 338	Hays	KS	67601	785-628-8614	matt.smith@ks.gov
Smith	Megan	801 Main St.	Blue Rapids	KS	66411	785-221-3273	megan.smith@ks.gov
Svaty	James	#3 State Park Rd.	Sylvan Grove	KS	67481	785-658-2465	james.svaty@ks.gov
Swank	Charlie	56 NE 40 Rd.	Great Bend	KS	67530	620-793-3066	charlie.swank@ks.gov
Thornburg	Alex	5800A River Pond Road	Manhattan	KS	66502	785-539-7941	alex.thornburg@ks.gov
Thornton	Clint	P.O. Box 293	Wakefield	KS	67487	785-259-2474	clint.thornton@ks.gov
Urban	Tim	8304 Hedge Lane Terrace	Shawnee	KS	66227	913-422-1314	tim.urban@ks.gov
Wagner	Jason	PO Box 338	Hays	KS	67601	785-628-8614	jason.wagner@ks.gov
Warner	Tyler	7760 174th Street	Valley Falls	KS	66088	785-945-6615	tyler.warner@ks.gov
Wiens	Eric	1140 Ten Rd.	Stockton	KS	67669	785-425-6775	eric.wiens@ks.gov

KANSAS PHEASANTS FOREVER AND QUAIL FOREVER

CHAPTER & FARM BILL WILDLIFE BIOLOGIST LOCATIONS



Active Chapters

- ★ QF
- ☆ PF
- ☆ Both

Biologist Areas

- ✕ Biologist Office Locations
- Anna Walkowiak (402)450-9299
- Allie Rath (319)330-6015
- Holly Shutt (785)294-2004
- Tyson Seirer (785)534-0266
- Central KS Biologist*

PHEASANTS forever The Habitat Organization

QUAIL forever The Habitat Organization

N

* Position currently vacant. Contact Sr. Farm Bill Biologist Holly Shutt for assistance.

Kansas Prescribed Burn Associations

Gypsum Hills PBA Contact: Tom Carr, Chairman 314 N. Main St. Medicine Lodge, Ks 67104 620.501.2552 trcarr@illinois.edu	Cherokee Strip PBA Contact: Bill Barby, Chairman B and B Ranch Ashland, Ks 67127 620.873.9700 bill_barby@yahoo.com
Alan Sleeper PBA Contact: Steve Nielsen, Chairman 2220 7th Rd. Alden, Ks 67512 620.534.2831 Steven.sn69@gmail.com	Cloud County PBA Contact: Jeff Buckley 1940 North 220 Road Concordia, KS 66901 785.243.7891
West Ark PBA Contact : Mark Sexson 620-275-6090 msexson@wbsnet.org	Russell County PBA Contact: Gary Blundon 17953 Fairfield Road Russell, KS 67665 yody@ruraltel.net
Phillips County PBA Contact local conservation district office	Jewell Count PBA Contact: Tom Marr 785.648.0063 tkm.marr@gmail.com
Sandhills PBA Contact: John McCurry 620-727-5197 mccurryangus@outlook.com	Tri-County PBA Contact: Todd Harman 620-663-7957 Todd.Harrman@adm.com
Rt. 36 Contact local conservation district office	Ninnescah Valley PBA Contact: Russel Blew 620-921-5949 redcow500@hotmail.com

Kansas Prescribed Fire Council Coordinators

Jason Hartman 785.532.3316 hartmanj@ksu.edu	Jess Crockford 620.664.4882 Jess.crockford@ks.usda.gov	Roger Tacha 785.672.0401 plainsman1@outlook.com

SOUTHERN Fire Exchange
Uniting Fire Science and Natural Resource Management
JOINT FIRE SCIENCE PROGRAM

SFE Fact Sheet 2016-2

The Value of Forming a Prescribed Burn Association

John Diaz, Jennifer E. Fawcett and John R. Weir

Introduction

Prescribed burning is the application of fire to the landscape to meet multiple land management objectives.[1] It is one land management practice that can be used to restore the natural balance of ecosystems in a safe and calculated way, while also reducing wildfire risk. While most plant communities in the South are dependent on fire to maintain plants and native wildlife, many lands do not receive as much fire as they need.

In the South, the majority of forest land is privately owned. This means that the ability to manage fire-dependent and fire-adapted ecosystems is contingent upon the private landowner's capacity to use prescribed fire on their lands. Many landowners already use prescribed fire for accomplishing their management goals, but most do not. To some, burning is viewed as a risky and daunting task, which hinders their willingness to utilize prescribed fire. However, evidence shows that with the help of neighbors and other landowners, prescribed burning is easier, safer, and more economical than when trying to burn on one's own.[2, 3, 4]

Members of the Roger Mills County PBA in western Oklahoma get ready for a prescribed burn. Photo: John Weir.

The development of Prescribed Burn Associations (PBAs) is becoming an increasingly popular approach to increase private landowner's ability to utilize prescribed fire.

What Is a Prescribed Burn Association?

A PBA is a group of local landowners and other concerned citizens that form a partnership to conduct prescribed burns.[3] PBAs have successfully increased prescribed fire use by landowners and land managers, mainly by making it easier and safer to use prescribed fire.[4] The goal of a PBA is to promote the safe and responsible use of fire in the region through increasing landowner access to education, training, technical support, funding, equipment for burning, and hands-on experience to achieve multiple management objectives.[3] Each PBA is operated by private landowners and other local volunteers.[3] Examples of PBA-led activities can include conducting training and workshop events, working to improve prescribed burn laws, tracking prescribed burn activity in the region, and purchasing burn equipment for use by PBA members.[3]

PBAs can be formed at various levels, such as local, county, or multi-county, depending on the need. A state-level PBA, such as the Prescribed Burn Alliance of Texas (www.pbatexas.org) or Oklahoma Prescribed Burn Association (www.ok-pba.org), can also be formed to support existing local, county, or multi-county PBAs and to help develop new PBAs within the state. These larger-scale PBAs can assist local organizations by providing additional resources, promoting the establishment of local PBAs, and advocating in state legislatures and regulatory agencies. Such state-level fire coalitions and prescribed fire councils were a driving force in passing "Right-to-Burn Acts" that established prescribed burning as essential to maintaining and restoring ecological integrity.[5]

In 2015, there were 62 known PBAs in eight states, along with two statewide burn associations (Oklahoma and Texas) and one regional alliance.[4] This represents an increase from the 50 PBAs that were in existence as of 2012. In 2016, a new PBA was developed in North Carolina (North Carolina Sandhills Prescribed Burn Association) increasing the current figure to 63.[6]

For more information and an interactive map of existing PBAs, please visit www.gpfirescience.org/fire-organizations-agencies.

Members of the North Carolina Sandhills PBA shared resources and equipment to conduct a prescribed burn on a landowner's property. Photo: Brady Beck Photography.

Barriers to Burning and How PBAs Can Help

According to surveys, landowners have listed several reasons they do not burn.[7, 8, 9] These surveys identified the following major barriers, which are described in more detail below:

- Liability concerns
- Lack of capacity
- Lack of training and/or experience
- Resource concerns (including limited access to equipment)
- Weather (including narrow burn windows and limited burn days)

Prescribed Burn Associations can help members to

- Obtain insurance and effectively manage risk by addressing the other needs,
- Increase available peer support to burn,
- Gain experience through assisting with burns,
- Take advantage of narrow burn windows by deploying quickly and having multiple groups burning at once, and
- Pool equipment to increase resource availability.

Liability

The fear of liability is arguably the most significant concern related to prescribed burning among landowners. By increasing capacity, experience, and equipment through a PBA, liability risk will subsequently be reduced. Planning burns with multiple landowners, where neighbors assist one another, reduces liability as well because if a landowner burns only their property, the biggest concern is keeping the fire on their property. If multiple landowners plan their burns together, they allow fire to pass freely from one property to another without the worry or fear of liability. This also can make burning more economical due to using natural or man-made firebreaks that may exist on a neighboring property, along with burning larger blocks at once, thus reducing costs, time, and number of burn days needed.

PBAs exhibit relative success in mitigating issues of liability in relation to the occurrence of spotfires (a fire started by flying sparks or embers at a distance from the main fire) and escaped burns. A study by Weir et al. found that spotfires occurred on prescribed burns conducted by PBAs at the identical rate (1 of 5 burns) relative to experienced crews within the same region.[4] They also found that only 1.5% of a total of 1,094 fires conducted by PBAs escaped, with no reported insurance claims against any of the PBAs or members. This demonstrates that PBAs can manage spotfires and mitigate the potential for escaped burns.

Also, in some cases, PBAs can provide prescribed fire liability insurance at an affordable rate to landowners through a group discount. Potential damages caused by escaped fires, suppression costs, injury to people assisting with the burn, or problems caused by smoke are usually covered with insurance. A minimal annual fee and additional charge may incur for each burn the landowner would like to have insured.

Capacity

A significant challenge for prescribed fire implementation both at a national and regional level is lack of capacity. Research shows that there is a lack of trained prescribed fire managers, training opportunities, private contractors, and partnerships that has resulted in a major bottleneck for the appropriate application of prescribed fire.[10] PBAs provide a successful method for building prescribed fire capacity through the development of a collaborative network of landowners, government agencies, conservation groups, and other interested individuals and organizations that come together with the common goals of expanding the use of prescribed fire in a specific geographic region.

Training and Experience

Knowledgeable landowners who are well equipped with an informed crew are less concerned about liability because they know how to effectively plan and manage prescribed fire.[11] Successful PBAs can also assist in confronting negative local attitudes and reactions to burning. For example, one Texas PBA was able to successfully rebut accusations of property damage and received an apology in the local paper from the accuser.[5] Weir et al. surveyed 50 PBAs located in five Great Plains states about their formation, burn history, fire planning, member experience, external assistance, and other information.[4] The majority of respondents reported that their members had a mix of training or experience prior to joining the PBA, with 75% reporting that some members did not have prior training or experience and 88% reporting that some members did have prior training or experience. This shows that PBAs provide an opportunity for peer-to-peer learning as both experienced and non-experienced burners can work side-by-side to gain valuable experience in the implementation of prescribed fire.

Resources

In the same survey of PBAs, members indicated that drip torches, radios, slip-on pump units and ATV sprayers, ATVs, weather instruments/kits, utility vehicles, flappers/swatters and fire rakes were commonly used on burns.[4] Gloves, flame retardant shirts and pants, and goggles/safety glasses were reported as the personal protective equipment most frequently worn on burns. Members identify the value of pooling their equipment so no one person has to buy all of the equipment needed to burn. Some PBAs partner with their local fire department to rent or use equipment for conducting burns, as well as having the local fire department present with additional manpower and equipment for burns.[3]

In addition to equipment, PBAs can receive funding through grants or donations. The aforementioned survey found that all responding PBAs received funding in the form of private donations, nongovernmental organization grants and donations, along with state and federal grants ranging from $500 to $250,000.[4] The funds have been used for needs such as equipment and training activities.

Weather

Narrowing burn windows as a result of weather or limiting burning to a single season of the year also presents a very significant challenge when coupled with the aforementioned impediments related to capacity. Experience has shown that PBAs are more efficient in accomplishing prescribed burns than landowners burning on their own because they can organize the required labor and support quickly within the often narrow window of desired weather conditions.[4] Also several PBAs have enough members and equipment available to conduct multiple burns in a single day.

Summary

The total value of forming a PBA is not only realized by one individual, but by many. The services resulting from an active PBA benefit neighbors, as well as the community through healthy forests and rangelands, reduced wildfire impacts, and the multitude of other benefits that prescribed burning provides. A video, produced by the North Carolina Sandhills Prescribed Burn Association, depicts the value of this PBA to its members: https://youtu.be/HaHt6ZLYd3o. More information about forming a PBA is available at http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-2819/F-2880web.pdf.

References

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Authors

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For more information, visit www.southernfireexchange.org or email contactus@southernfireexchange.org.

The Southern Fire Exchange is funded through the Joint Fire Science Program, in agreement with the United States Forest Service, Southern Research Station. This institution is an equal opportunity provider.

In almost all cases the public's use of fire as a management tool is met with varying degrees of skepticism at first. It doesn't appear that most are interested in the ecology of "why fire". Although, in all cases a brief explanation of the value and the objectives that can be achieve has been discussed as an opening and introduction.

The Commissioners and the Chiefs seem to take a greater interest in the discussions that relate to the training that is offered to the PBAs, the organization (man power), equipment, and the burn plan development process. The Chiefs understand the weather and fuel condition as it relates to the plan and usually have questions relating to that, training and equipment. Safety is emphasized throughout the discussion. Everyone's skepticism seems to lessen the more they come to understand the complete process. Obviously, everyone has had some bad experiences that they can relate. But, as the Commissioners and the Chiefs come to understand that this is not a random or haphazard operation, they begin to buy into the overall concept of "neighbor helping neighbor" with adequate training and equipment. The objective or goal that the Chiefs pick up on and relate to is the reduction in fire hazard particularly in counties with heavy cedar infestation in the rural/urban areas.

We have had Fire Chiefs that became openly supportive of the concept of PBAs as the result of meeting with them and discussing the positive aspects. The success in winning these groups over is contingent upon focusing the discussion around safety, training, equipment and personnel. The message that needs to be conveyed is that this is not a halfhearted effort that puts matches in the hands of just anyone but an organized, well thought out process supported by agencies and groups providing training, equipment and expertise. The Chiefs also come to understand that prescribed burning can reduce their problem fires by reducing fuel load and that the PBAs could become an asset that could provide some back support in controlling wildfires.

Jess Crockford

Key Steps to Consider when Forming an Association

With the recent publicity regarding controlled burning and wildlife management associations, some people have expressed interest in forming an association, but don't quite know where or how to begin. There are many ways to form an association, but however formed, there are some important steps to consider.

To be successful, an association should be a locally led, grass roots effort. Government and non-government agencies can assist by serving as advisors, providing technical assistance and removing bureaucratic road blocks, but without local leaders and local involvement, an association will fail, period. Creating and maintaining a locally led association is absolutely the single most important aspect to consider.

There are two basic options to organize an association and both will work. The first option is to organize loosely with or without officers and the second is to formally elect officers and develop bylaws and other pertinent information. If the association wants to become a nonprofit corporation such as a 501(c)(3), formal organization is required. A 501(c)(3) status makes an association eligible to apply for grants and receive tax deductible charitable donations.

Getting started seems to be a common concern, but there are many ways to begin forming an association. The following considerations are beneficial:

- Visit neighbors and/or other landowners in the local area to determine level of interest.
- Contact people involved with other similar associations.
- Organize an informal meeting and meal to discuss interest and potential. Include key landowners or individuals in the community and people with experience in other associations.
- Generate rough ideas for goals and objectives. Don't get hung up here. There are many possible goals and objectives. Seek everyone's input and realize goals and as the association matures.
- Ask for commitment from key landowners or influential members of the community.
- Organize a more formal meeting and meal to discuss geographical boundaries and preference of informal or formal structure. Note: formal structure can be developed later if needed.
- Identify several key people to share responsibilities Successful associations have several people involved with coordinating and scheduling.

Be sure to plan meetings and fun events at least once every year and consider incorporating education into these events. Resources such as university, government and private agencies are available to help with educational events. A critical role for local leaders is to be sure these events happen and all members of the association are kept informed.

There are many benefits of forming an association. Major ones include sharing of equipment and labor, management of natural resources such as wildlife habitat and populations over a larger area, and accomplishing or influencing other activities as a result of a group of people working together. It's not easy and requires time, but these benefits are worth it.

Russell Stevens
rlstevens@noble.org

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Jess Crockford

Guidance for Contracting a Prescribed Burn

The Nature Conservancy
Protecting nature. Preserving life.™

Choosing a Contractor

The Conservancy has adopted a tiered approach for evaluating training and qualifications standards when choosing a contractor to serve as a burn boss on Conservancy land. The best alternative is to hire a person whose qualifications meet those of the National Wildfire Coordinating Group for Type 2 Burn Boss. If such a person is not available in your area, or if the cost is prohibitive based on available funds, document your search effort or funding limitations and go to the next-best alternative. An individual who is qualified by a state-regulated prescribed fire burn boss certification process or qualified as a burn boss by a respected state agency would be acceptable under this alternative. If a person with this level of qualification is not found, document the search effort again and go to the third alternative. At this level, you will need to review the training and experience record of the individual and make an informed decision as to his/her suitability.

In any of the above scenarios, the Fire Manager for the state must approve the person contracted to conduct a prescribed burn.

Checklist

This checklist provides guidance for developing a contract with an agency or company to conduct a prescribed burn on TNC property. There is a standard template for contracting a burn, available on the Conservancy fire/legal intranet pages. However, every burn is different, and so every contract must be developed in conjunction with your Conservancy Attorney. The items below are not all requirements, but points for discussion with your attorney and your potential contractor.

Burn Boss and Crew Qualifications

- ❑ The burn boss is qualified as an RxB2, or his/her agency equivalent, and is a certified burn boss according to state regulations or laws where they exist.
- ❑ The burn boss has led burns of similar complexity.
- ❑ The burn boss has led burns in the same fuel type.
- ❑ The burn boss will be on site during the burn.
- ❑ All members of the burn crew have been trained (S130-S190, or prescribed fire crew member training or equivalent).
- ❑ Crew members are trained and experienced in the use of the equipment needed to conduct the burn.
- ❑ All crew members and the burn boss have passed a physical fitness test.

Planning and Equipment

- ❑ The Contractor has developed a written plan for the prescribed burn.
- ❑ The Conservancy Fire Manager provides comments on the plan and approves it.
- ❑ A wildland fire engine or other water-delivery system will be on site during the burn.
- ❑ All prescribed fire crew members and fire observers will wear personal protective gear.

Insurance, Administration, Legal

- ❑ The contractor has at least $1 million of liability insurance.
- ❑ The contractor has worker's compensation insurance for the crew members.
- ❑ The contractor has insurance that covers accidents or injuries resulting from smoke.
- ❑ The contractor has supplied proof of above insurance policies and the policy has been reviewed by a TNC attorney.
- ❑ The contractor will indemnify and defend TNC against all claims arising from the burn.
- ❑ A contract has been approved by TNC legal counsel and signed by all parties involved.
- ❑ The contract specifies burn objectives and/or specific desired outcomes.
- ❑ All required permits and authorizations for the burn will be obtained by the contractor.
- ❑ Either party can withdraw from the contract on written notification.

Last Reviewed January 1, 2009
Posted to *Fire Management Manual* January 1, 2009

PRESCIBED FIRE CONTRACTORS

These individuals or companies* are available for hire as prescribed fire contractors.

Bitter Creek Range Management
Robert Larson
3212 NW Forest City Road
Medicine Lodge, KS 67104
620-886-9822 Office
620-886-0776 Cell

Global Frontline Solutions
Archie Stone
PO Box 1032
Fritch, TX 79036
806-274-8371
frontlinesolutions@windstream.net

Ranchland Development, Inc.
Roland Spencer
PO Box 613
Winfield, KS 67156
620-221-2200 Work
785-483-0329 Cell
800-324-0042 Toll-free

Delaney Farm Service Inc.
Deone Delaney
PO Box 5
Utica, KS 67584
785-391-2304 Work
785-731-7000 Cell
ddelaney@gbta.net

Grimm's Gardens
Kurt or Ted Grimm
2991 Goldfinch Rd
Hiawatha, KS 66434
785-547-5209 or 785-548-6791
kurt@grimmsgardens.com
ted@grimmsgardens.com
www.grimmsgardens.com

Fire 4 Hire
Nathan Brunner, Leonard Jirak
325 Lincoln Street
Tampa, KS 67483
785-366-3682 (Nathan)
620-203-8081 (Leonard)
Deere9700@hotmail.com

Grassland Management, LLC
Martin Lohrke
17088 SW 100th Street
Nashville, KS 67112
620-246-5367

Rangeland Fire Specialists, LLC
John Weir
29680 County Road 40
Orlando, OK 73073
405-780-0036

Robert Swonger
Bloom, KS 67865
620-255-5352

CHLOETA FIRE, LLC
Mark Masters
13101 S. Penn Avenue
Oklahoma City, OK 73170
877-245-6382 ext. 3614
mmasters@chloetafire.com
www.chloetafire.com

Crossroads Prescribed Burning
2333 C. Detroit St.
Abilene, KS 67410
785 -479-7111
7852107679

**This contact information is provided as a courtesy and service, and while every effort has been made to verify accuracy of information, it may change without our knowledge. Listings do not constitute endorsement of these providers, and do not imply that they are the only source of help.*

PRESCRIBED FIRE CONSULTANTS

These individuals are available to provide free *or* for-hire consulting services, with specific expertise in prescribed fire. They can assist with writing burn plans and other aspects of preparing to conduct a safe and effective burn, but will not actually perform the burning.

Dr. Walt Fick
Extension Specialist in rangeland and pasture management
Throckmorton Hall, KSU Manhattan, KS 66506
Phone: (785) 532-7223
Email: whfick@ksu.edu

Dr. Robert Nicholson
Certified Rangeland Management Consultant

Ray Guse
Smoked Goose Consulting
6 Farver Lane
Tonasket, WA 98855
Phone: 509-322-5542
Website: www.smokedgooseconsulting.com

USDA Natural Resource Conservation Service (NRCS)
Assistance in writing burn plans and related activities.
Contact your county NRCS service center, or visit http://www.ks.nrcs.usda.gov for further information or to be put in contact with a specialist.

App: *RxBurnTracker*

John R. Weir, Research Associate
Natural Resource Ecology and Management

R. Seth Coffey, Graduate Research Assistant
Natural Resource Ecology and Management

It has been said, "Those who cannot remember the past are condemned to repeat it." This is also true with land management practices because change on the landscape occurs slowly overtime. Having some way to maintain a photographic record of this change will assist land managers in making decisions about previous and future management options. A new application, or app, called *RxBurnTracker* for smart phones and tablets has been developed. It allows land managers a quick and simple way to monitor and document burn units before, during and after prescribed fires. The main goal of *RxBurnTracker* is to help land managers determine how effective their prescribed burn was compared to management goals. *RxBurnTracker* also allows land managers to track the progress of individual burn units relative to the number of prescribed fires that have been conducted on that site. *RxBurnTracker* can even be used with other management practices, such as mechanical or chemical applications to see effectiveness or vegetative progression through time.

RxBurnTracker is available free for both Android™ and Apple™ devices at their respective app stores. This app uses the photograph capabilities of the users phone or tablet to capture and record images. After initial photos have been taken, the unique ghost image capabilities of the app allow the previous image of that site to be aligned with the current image of the particular spot for precise reference. The app also allows the user to record burn information, such as burn date, temperature, relative humidity, wind speed and direction for each time the unit is burned.

***RxBurnTracker* is available free for both Android and Apple devices at their respective app stores. This app uses the photograph capabilities of the users phone or tablet to capture and record images.**

Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
http://osufacts.okstate.edu

How to Use the App

RxBurnTracker is user friendly and easy to operate. The home screen of *RxBurnTracker* opens to Burn Units (Figure 1). To begin documenting burns, click the "+" symbol, which will allow the user to add and name a new burn unit. Once the burn unit is named, tap the screen or "+" symbol to add a photograph or burn data. If "Photo" is selected, tap "add location" and type the name or description of the new photo point, selecting "Done" when finished. The new photo label will have a check mark by it, select "Go" to allow the user to take the desired photograph. The app will prompt the user to "Use Photo" or "Retake." This will take the user back to the burn unit where more photo points can be added by selecting the "+" and following the previous steps. Once the unit is burned,

Figure 1. *RxBurnTracker* home page. The main goal of *RxBurnTracker* is to help land managers determine how effective their prescribed burn was compared to their management goals. *RxBurnTracker* also allows land managers to track the progress of individual burn units relative to the number of prescribed fires that have been conducted on that site.

the user can add the burn data by selecting the burn unit, selecting "+," then "Burn Data," to add the burn information, then select "Done." When the user is ready to begin adding post-burn photos, select the desired burn unit, then "+," then "Photo," select "Start New," select the name of the desired photo point, it will have a check mark when selected, then "Go." This will take the user to the camera. A transparent or ghost image of the previous photo from that particular point will appear on the screen. Transparency of the ghost image can be adjusted by sliding the white button located in the lower right of the screen. The ghost image feature allows the user to line up the current photo with the previous photo (Figure 2). This feature ensures that the new image is taken in the same place and position as before, so a consistent photographic record can be maintained (Figure 3). *RxBurnTracker* automatically puts all photos and burn data in chronological order beginning with the newest first. At any point, the user can go back to a burn unit and add new photos or new photo points as time progresses.

RxBurnTracker is a tool land managers can use to observe and document the regrowth of vegetation following a prescribed fire. *RxBurnTracker* is a simple way for land managers to see short-term progress within their long-term prescribed fire management goals. This app is also a great way for land managers to know where they are relative to their management goals and, more importantly, to show them where they have been.

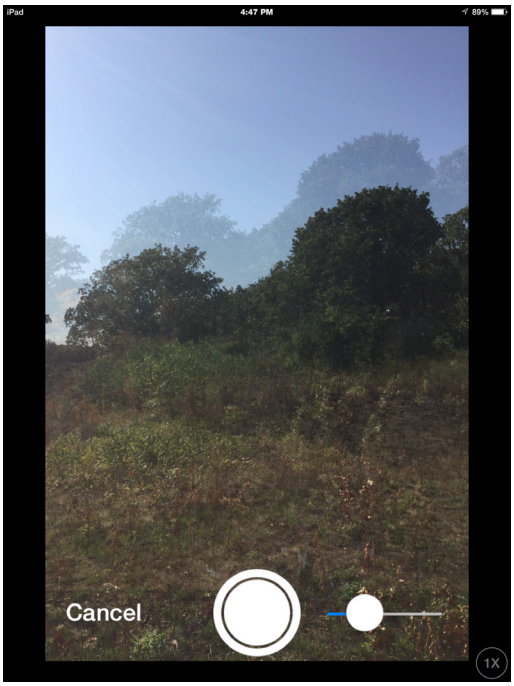

Figure 2. The ghost image feature allows the user to line up the current photo with the previous photo. This feature ensures that the new image is taken in the same place and position as before, so a consistent photographic record can be maintained.

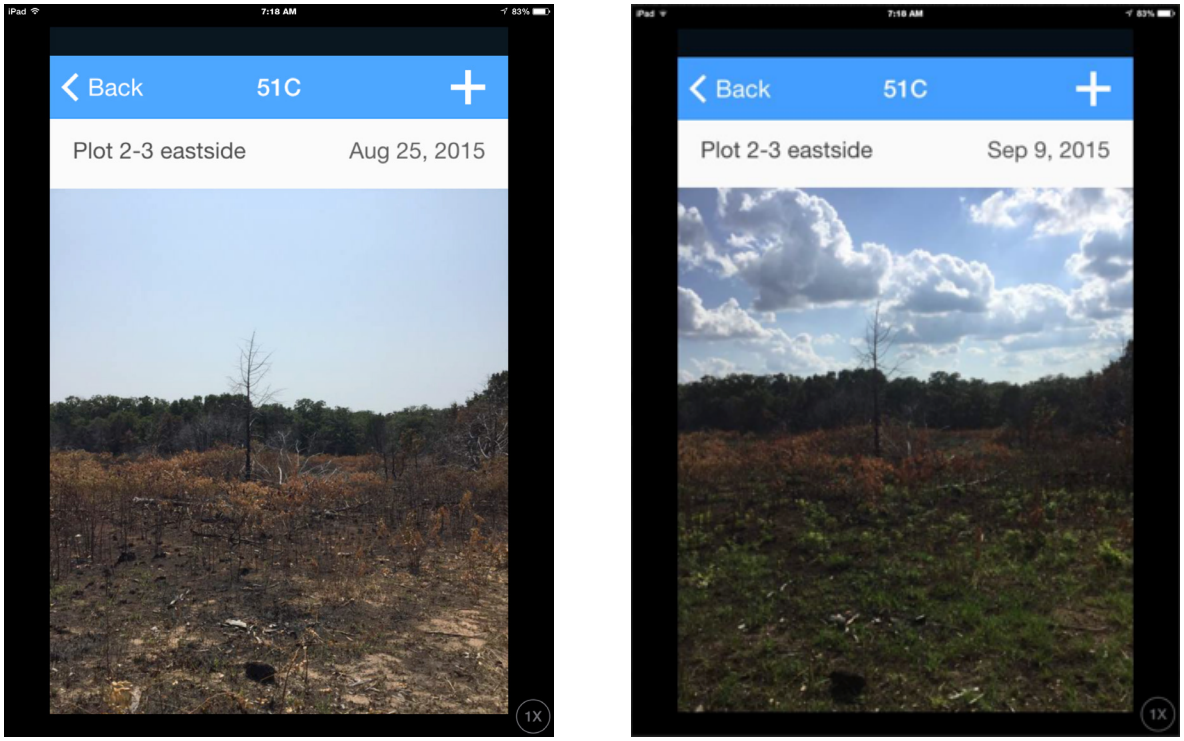

Figure 3. *RxBurnTracker* allows users to maintain a consistent photographic record of before and after prescribed burn treatments. These pictures were taken 15 days apart to show regrowth following a growing season burn.

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Additional Resources

NRCS Agricultural Air Quality Conservation Measures Section 7 Fire and Smoke
http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1049502.pdf

USGS The Use of Fire as a Tool for Controlling Invasive Plants
http://www.firescience.gov/projects/06-S-01/project/06-S-01_final_report.pdf

Interagency Standards for Wildland Fire Module Operations
http://www.nwcg.gov/general/memos/nwcg-001-2013a.pdf

Fire Behavior Field Guide
http://ocw.usu.edu/forest__range__and_wildlife_sciences/wildland_fire_management_and_planning/Field_Guide.html

Fire Ecology Monitoring Protocol for the Heartland Inventory and Monitoring Network
http://irmafiles.nps.gov/reference/holding/423856

Weed and Brush Control for Pasture and Rangeland
http://www.ksre.ksu.edu/bookstore/pubs/SRP1117.pdf

Grassland Management with Prescribed Fire
http://www.nfs.unl.edu/documents/fireprotection/Ext%20EC148.pdf

Interagency Ground Ignition Guide
http://www.nwcg.gov/pms/pubs/443/pms443.pdf

Expiring Contract Options for CRP
http://www.fsa.usda.gov/Internet/FSA_File/crp_takeout.pdf

Decision Considerations for Expiring CRP
http://www.ksre.ksu.edu/bookstore/pubs/mf2827.pdf

Grazing and Haying Conservation Reserve Program Land
http://www.asi.k-state.edu/doc/forage/fora35.pdf

Basic Smoke Management Practices
http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046311.pdf

Firebreak Management
http://blogs.missouristate.edu/gpfirescience/files/2014/08/FirebreakManagement.pdf

Burn Plan for Prescribed Burning
http://www.forestry.ok.gov/Websites/forestry/images/NREM-2893,_Burn_Plan_for_Rx_Fire.pdf

Burn Plan Form (electronic)
http://osufacts.okstate.edu/docushare/dsweb/Get/Document-9065/Producer_burn_plan.pdf

Partners for Workshops

Local Fire Departments and Emergency Management Personnel

Meal and Burn Workbook Sponsors (varies by workshop)

Kansas Forest Service

Kansas Department of Wildlife, Parks and Tourism

National Weather Service

Kansas Conservation Districts

Kansas Natural Resources and Conservation Service

Kansas State University Research and Extension

Pheasants Forever

The Wildlife Society — Kansas Chapter

Great Plains Fire Science Exchange

Farm Service Agency

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