Prescribed Burning Notebook

Spring 2011

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EXCERPT FROM: Prescribed Burning as a Management Practice. KSU Res. and Ext. Pub. L-815.

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

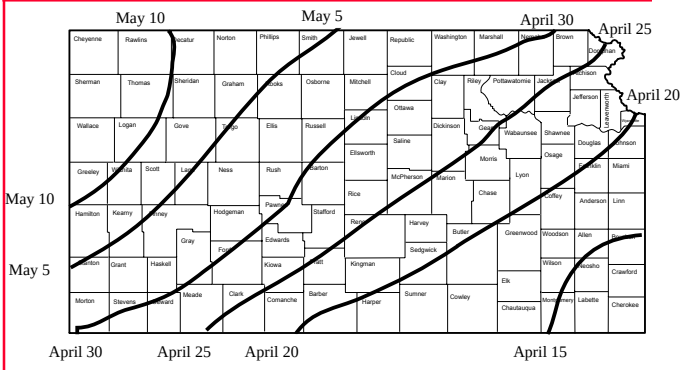


Figure 1. Approximate average vegetative green-up dates in Kansas

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.

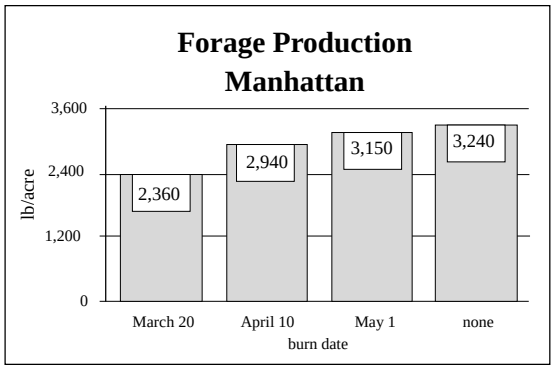


Figure 2. Average forage yield after 17 years of annual burning at the times indicated at Manhattan.

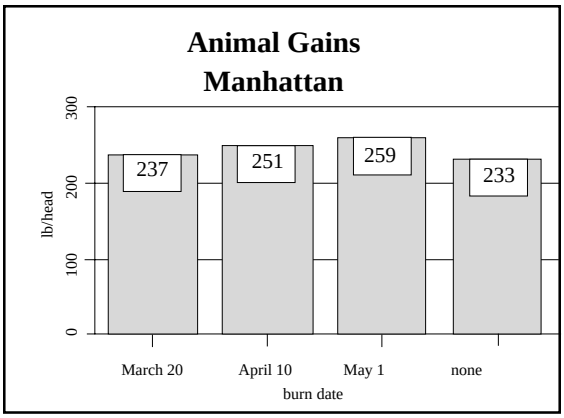


Figure 3. Average season-long stocker gains after 17 years of annual burning at the times indicated at Manhattan.

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.

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.

Prescribed burning is an excellent management practice for grassland.

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

In just another month or so, it will be time to start conducting prescribed burns on cool-season pastures. Temperatures have been mild in southeast Kansas, and soils have good moisture. This could cause some of the cool-season pastures starting to green up earlier than normal.

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 should be burned between February 1 and April 15.

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 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.

Walt Fick, Kansas State University

Burning for Stocker Operations in the Kansas Flint Hills

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 until after a time when fire can occur. 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.

Clenton Owensby, Kansas State University

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.)

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;

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

(2) a description of the open burning including:
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.)

Local Notification and Permits

Many counties in Kansas require permits and notification prior to igniting a prescribed burn. The type and degree of permitting and notification vary widely between counties, and only a few generalities can be made.

Permits are permission to both conduct a prescribed burn in general and to start ignition in particular. Counties may require neither, either, or both. Advance permits are generally obtained from the fire department dispatcher. These can be for a particular 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.

Beginning in 2011, fire officials and emergency managers must also consider the direction of the smoke plume from fires originating in their county. Based on information they receive about smoke plume direction, they may recommend that prescribed burning be postponed until weather conditions change and smoke will be less likely to impact urban areas.

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 any requirements can be completed well ahead of the burn season.

Notification is required by state law unless a local county specifically decides not to require notification. Almost all counties require notification 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 the fire is a prescribed burn, emergency personnel will be dispatched under the assumption that it is a 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.

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.

An additional level of notification may be required by some counties in the form of a formal burn plan with map. This is 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. An attached map shows the burn location and the layout of roads leading to the burn site. This will allow a faster response time in case of an escape, and also provide the dispatcher with contact information for the prescribed burn boss.

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.

Notification and permits are useful for ensuring the safety of county residents and travelers. Follow all local guidelines for local permitting procedures. Remember that if you burn in more than one county, it is highly likely that notification and permit procedures will be different. Work with the local fire department and emergency managers to correctly and promptly convey information about prescribed burning.

Notification and Emergency Information

Landowner/Operator _____

Legals _____

Directions to fire (road names) _____

_____

	Phone Number/ Contact	Circle when Notified *Intent to burn*	*Lighting burn*	*Burn ended*
Dispatcher		notified	notified	notified
Fire Dept.		notified	notified	notified
Neighbors		notified	notified	notified
		notified	notified	notified
		notified	notified	notified
		notified	notified	notified
		notified	notified	notified
		notified	notified	notified
		notified	notified	notified

DON'T HANG UP IF IT'S AN EMERGENCY!

WAIT FOR INSTRUCTIONS OR REQUESTS FOR FURTHER INFORMATION.

Map with burn area identified attached

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, $\pm 5^{\circ}$
-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

When planning a prescribed burn, it is extremely important to have the best, most up-to-date weather information available. 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 spring prescribed burning period where all weather conditions are met (Table 1). In some cases, prescribed burning later in the summer can accomplish some of the same goals and give a longer window of opportunity for burning.

Table 1. Average Number of Acceptable Burning Days

	Tallgrass	Midgrass	Shortgrass
Jan.	**12**[1]	**15**	**14**
Feb.	**14**	**14**	**10**
Mar.	**14**	**13**	**8**
Apr. 1-20	**11**	**9**	**6**[2]

Limiting Factor was **high winds** except:
[1]low temperature
[2]low humidity

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

1. **Humidity.** Humidity generally moves in a cycle through the day. Highest humidity is in the morning, and gradually becomes less during the day. By evening, humidity begins to rise again. This typical cycle can be influenced by fronts, precipitation, or other weather events. For prescribed burning safety, it's best to select a day when humidity is likely to follow the typical cyclical pattern. This allows you to better predict fire behavior.

   Humidity can change very rapidly. Check the humidity on site before beginning fire 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 the resulting changes in fire behavior.

Lower humidity is associated with more rapidly igniting fuels. This means the fire will likely move faster when humidity is lower. Lower humidity is frequently accompanied by higher temperatures, which also will increase the rate at which fuel ignites. The combination of lower humidity and higher temperatures magnifies the effect of both.

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. These 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, and has the potential to start fires across the firebreak. This is a dangerous situation, with the potential for the burn crew to be caught in front of a rapidly moving headfire. 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 can occur after rain or heavy dews, or when prescribed burns are conducted after grass has started growing in the spring. Summer burns, unlike spring 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 vegetation burns much more slowly as internal plant water is converted to steam.

2. **Temperature.** Low temperatures can affect fire behavior by chilling fuel, causing slow ignition and resulting in a slow-moving fire. Low temperatures also delay evaporation of dew in the morning, which can lead to fuels being wetter than anticipated. Burning at low temperatures (around 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, fire behavior becomes more erratic and the fire burns with greater intensity. Equipment can overheat and break down. Avoid burning when temperatures are above 100 degrees. This rarely occurs during spring 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. When temperatures are very cold, it can be difficult to find insulated clothing without synthetic fibers that can melt at fire temperatures. At high temperatures (above 80 degrees), the burn crew can become overheated and dehydrated as the fire increases the ambient temperature. Extra precautions (more rest breaks, plenty of water available) are needed when temperatures are high.

3. **Wind.** Wind determines the overall direction of a fire. At very low wind speeds (below 5 mph), fires burn fairly slowly by often move erratically. It can be difficult to determine which direction the fire is moving. Light winds frequently veer and come from different directions, sometimes opposite to the one under which the fire was planned and ignited. Brief windless periods can cause the fire to be moved more by the fuel distribution than the wind direction. This can lead to a dangerous situation where the fire direction changes unexpectedly and the burn crew can be caught in front of a headfire.

   Southwest winds are most prevalent in the western part of the state, and common everywhere 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. The second most common wind direction is from the south, and the third is from the northwest. Wind direction will almost always change slightly during a burn. Subtle direction changes can be detected by tying a foot or so of flagging tape to vehicle aerials. The tape will show wind direction.

   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 are bent 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 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 higher than prescribed can lead to a prescribed burn becoming an uncontrollable wildfire.

   Wind transports smoke and embers. Embers carried by the wind can start fires ahead of the main fire line, or even across the fire break. As wind speeds increase, the chance of spot fires (fires caused by wind-blown embers) increases. Low humidity in combination with high wind favors the formation of spot fires. Gusty winds, with sudden bursts of increased wind speed, also increase the chances that embers will be carried in unexpected directions and distances and increase the chance of fire whirl formation. It is not recommended that prescribed burning be done during periods of gusty winds.

   Smoke can cause problems at two levels. Smoke that blows across a road can result in low visibility for drivers and has lead to fatal car crashes in Kansas. When planning a prescribed burn, consider the direction the smoke will be traveling and take precautions if it will affect traffic, such as notifying local law enforcement officials and setting out warning signs along the road. Localized smoke problems are greatest when wind speeds 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. Check transport wind direction prior to burning to minimize impact of your fire on urban air quality.

4. **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 for the burn crew. Cloud cover prevents fuels from heating by the sun, causing slower ignition. Clouds can signify precipitation is imminent, or that a weather change is coming.

   Precipitation immediately prior to a burn can cause damp soils, high humidity, and wet fuels. Under these conditions, fuels ignite slowly or not at all, leading to a very patchy, smoky burn. Precipitation during a burn can extinguish the fire. Mud and standing water can hamper movement of fire fighting vehicles. Unexpected puddles can cause vehicles to become stuck, eliminating their usefulness in fighting fire and putting the vehicle at risk for fire damage. Precipitation immediately following a fire can be beneficial in extinguishing smoldering fuels. However, rain in Kansas is frequently accompanied by strong winds, which may reignite embers.

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

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 be aware of weather changes expected or occurring during the burn. Changes in the weather can turn safe 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.

Finding the Weather Information You Need

National Weather Service- Fire Weather Products

The National Weather Service 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 broadcast, read the information provided on the internet at:
http://www.weather.gov/nwr/nwrrcvr.htm

The National Weather Service also provides an extensive array of weather products on the internet. Begin your weather search by entering the url:
http://www.weather.gov/

and follow it with the city from which your forecast originates. You can see which counties in Kansas are associated with the NWS office in each city by looking at the National Weather Service Forecast Offices map.

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

When the page appears, click on the map at the location where you will be conducting your burn. This will take you to a page with a brief discussion of the weather forecast. Scroll down the page to the bottom right hand corner, where you will see a map with a set of clickable links below it. The forecast you will be checking will be specific (for the 3 square mile area or so) to the highlighted area on the map. If you want to move the forecast location so that it more nearly matches your burn location, simply click on the map at your burn location.

Below the map you will see a box entitled "Additional Forecasts and Information". These links will provide you access to the information you need to determine weather conditions at the time of your burn. Some of the most helpful are listed below. Remember that rugged topography can play a part in local wind direction and speed when you burn, and local topography effects won't be included in the forecasts.

Below is a description of two of the most popular weather tools provided for prescribed burning.

1. ***Hourly Weather Graph***
One of the consistently most useful products is the hourly weather graph. This graph provides a wealth of information about wind direction, humidity, temperature, and other factors, and gives an indication of how they will change throughout the day. By printing off the graph and taking it with you to the field the day of the burn, you will have a good idea what weather to expect while you are burning. Be aware that wind shifts may not be at the exact hour for which they are forecast. However, the general pattern of wind shifts should be close to those forecasted.

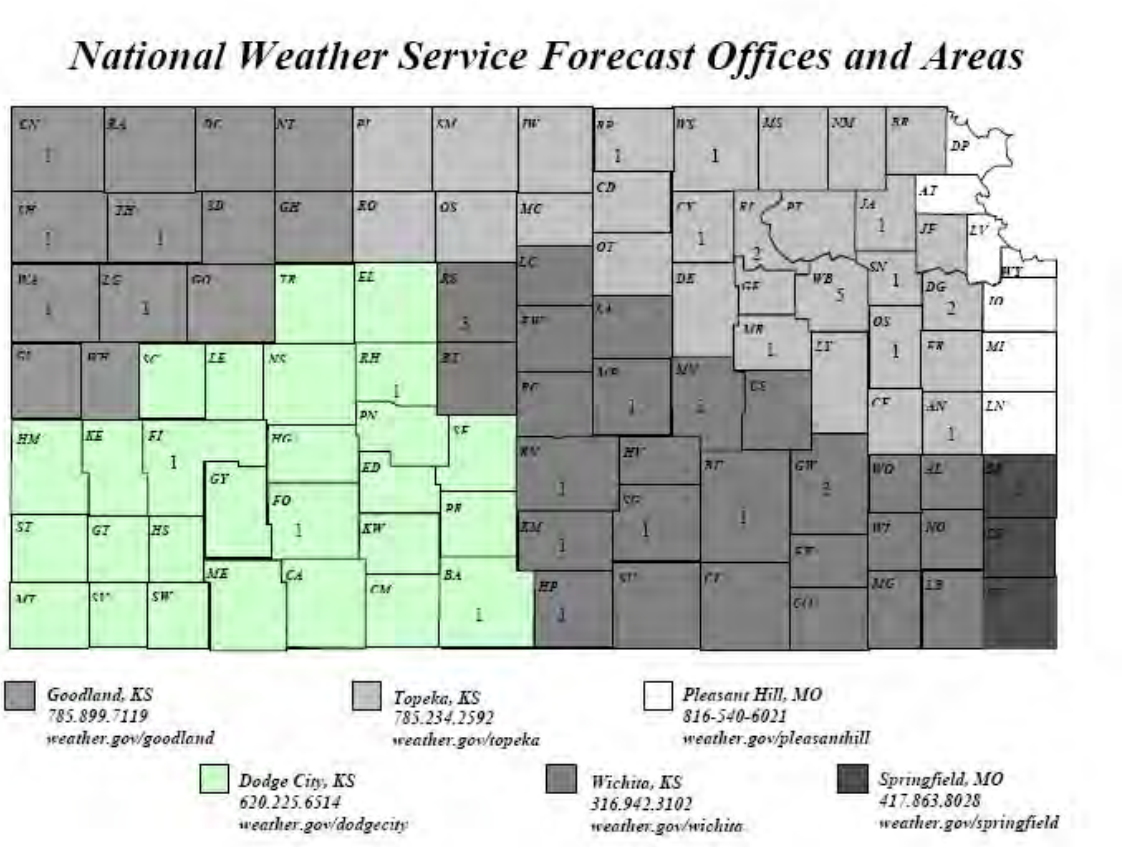
In the gray bar at the top of the page, you will see a selection of boxes that you can check or uncheck, depending on what information you wish to appear on the chart. Checking the transport winds will give you an idea of how rapidly and in what direction smoke will be carried.

Near the bottom of the gray bar, you have the option to select 2 days forward. This will allow you to see the forecast for the near future and determine if an appropriate day for burning will occur in the near future.

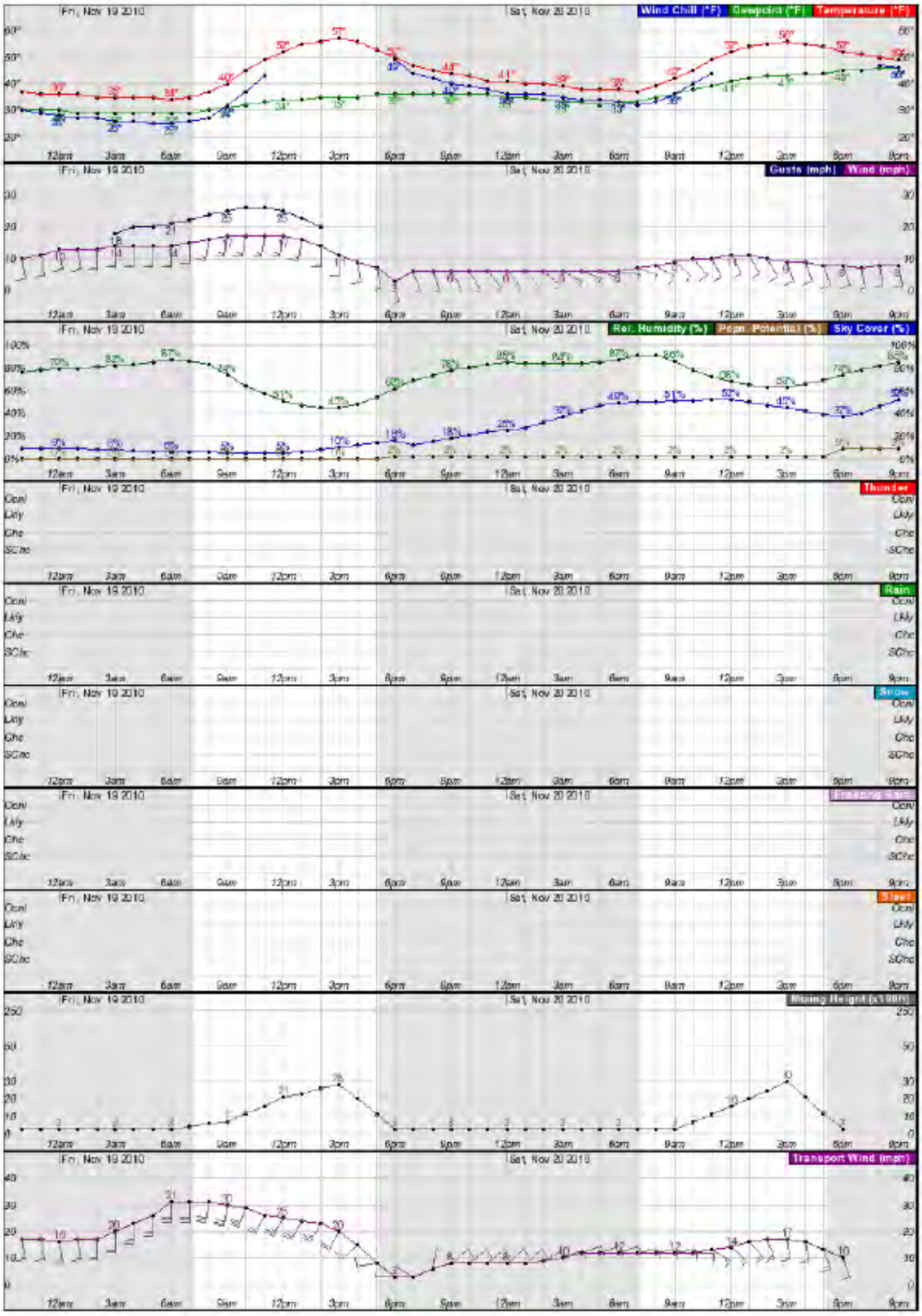
An example of an hourly weather graph follows this page.

2. ***Forecast Discussion***
The Forecast Discussion provides insight into what factors are influencing the weather for the time period beginning at the current date to about a week into the future. Look for thunderstorms, fronts, or other sudden weather changes (abrupt wind direction changes, high wind speeds) that are forecasted immediately after your proposed burn date; you will need to either postpone the burn or use extra vigilance following the burn to make sure smoldering cow patties and other non-extinguished fuels do not reignite and start wildfires.

Local Emergency Officials
Besides the NWS website, you will need to check with you local emergency manager or fire department on the predicted direction of the smoke plume from your fire. Follow their recommendations for conducting your burn to direct smoke away from sensitive areas.



National Weather Service - Hourly Weather Graph Example



National Weather Service Tools

Predicted and current weather information can be obtained from the National Weather Service (NWS) website, including weather watches, warnings, and advisories. Features such as radar and satellite imagery are also available. For more specific information, call the NWS forecaster in your area to discuss your weather information needs.

Weather products offered by the NWS that are helpful when planning and conducting a prescribed burn include:

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

Hourly Weather Graphical Forecasts: hour-by-hour display of predicted weather conditions as a graph for the next 48 hours, or any user selected 48 hours within the 7 day forecast. The user may select various weather elements to display, including fire weather elements such as mixing height and transport winds. (Fire weather elements are available within the first three forecast days.)

Weather Activity Planner: User may select the desired weather conditions, and receive a plot of when those weather conditions will be met in the forecast period.

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

Red Flag Warnings/ Fire Weather Watch: issued when fuels and weather conditions are likely to combine such that extreme fire behavior is possible from fire starts. Used as a guidance tool for wildfire resource planning.

Graphical Fire Weather Forecast: Weather elements available for display in a map / gridded format for the user.

Area Forecast Discussion: A slightly more technical discussion of the weather conditions and forecast for the week, highlighting areas of concern and/or the primary weather hazards in the forecast.

Grassland or Rangeland Fire Danger Index: Used to convey 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.

www.weather.gov

Effects of Windspeed and Humidity at 75^0 F on Rate of Fire Spread, Fire Intensity, and Flame Length

TALLGRASS

Rate of Spread (mi/hr)

Rel. Humidity	5	10	15	20 windspeed (miles/hr)
16%	2	4	7	11
32%	1	3	5	8
48%	1	3	4	6
64%	1	2	4	5

Heat Generated (btu/ft2)

	5	**10**	**15**	**20** windspeed (miles/hr)
16%	835	835	835	835
32%	689	689	689	689
48%	648	648	648	648
64%	610	610	610	610

Fireline Intensity (btu/ft/s)

	5	**10**	**15**	**20** windspeed (miles/hr)
16%	2212	5320	8971	13029
32%	1307	3144	5302	7700
48%	1023	2459	4148	6024
64%	811	1951	3290	4778

Flame Length (ft)

	5	10	15	20 windspeed (miles/hr)
16%	16	23	30	35
32%	12	18	23	28
48%	11	16	21	25
64%	10	15	19	22

Effects of Windspeed and Humidity at 75^0 F on Rate of Fire Spread, Fire Intensity, and Flame Length

SHORTGRASS

Rate of Spread (mi/hr)

	5	10	15	20 windspeed (miles/hr)
16%	1	4	4	4
32%	1	2	2	2
48%	0	0	0	0
64%	0	0	0	0

Heat Generated (btu/ft2)

	5	10	15	20 windspeed (miles/hr)
16%	96	96	96	96
32%	84	84	84	84
48%	0	0	0	0
64%	0	0	0	0

Fireline Intensity (btu/ft/s)

	5	10	15	20 windspeed (miles/hr)
16%	191	607	607	607
32%	127	305	305	305
48%	0	0	0	0
64%	0	0	0	0

Flame Length (ft)

	5	10	15	20 windspeed (miles/hr)
16%	5	9	9	9
32%	4	6	6	6
48%	0	0	0	0
64%	0	0	0	0

Effects of Windspeed and Humidity at 75^0 F on Rate of Fire Spread, Fire Intensity, and Flame Length

REDCEDAR

Rate of Spread (mi/hr)

	5	10	15	20	windspeed (miles/hr)
16%	1	2	3	5	
32%	1	2	3	4	
48%	0	1	1	2	
64%	0	1	1	2	

Heat Generated (btu/ft2)

	5	10	15	20	windspeed (miles/hr)
16%	2651	2651	2651	2651	
32%	2382	2382	2382	2382	
48%	1229	1229	1229	1229	
64%	890	890	890	890	

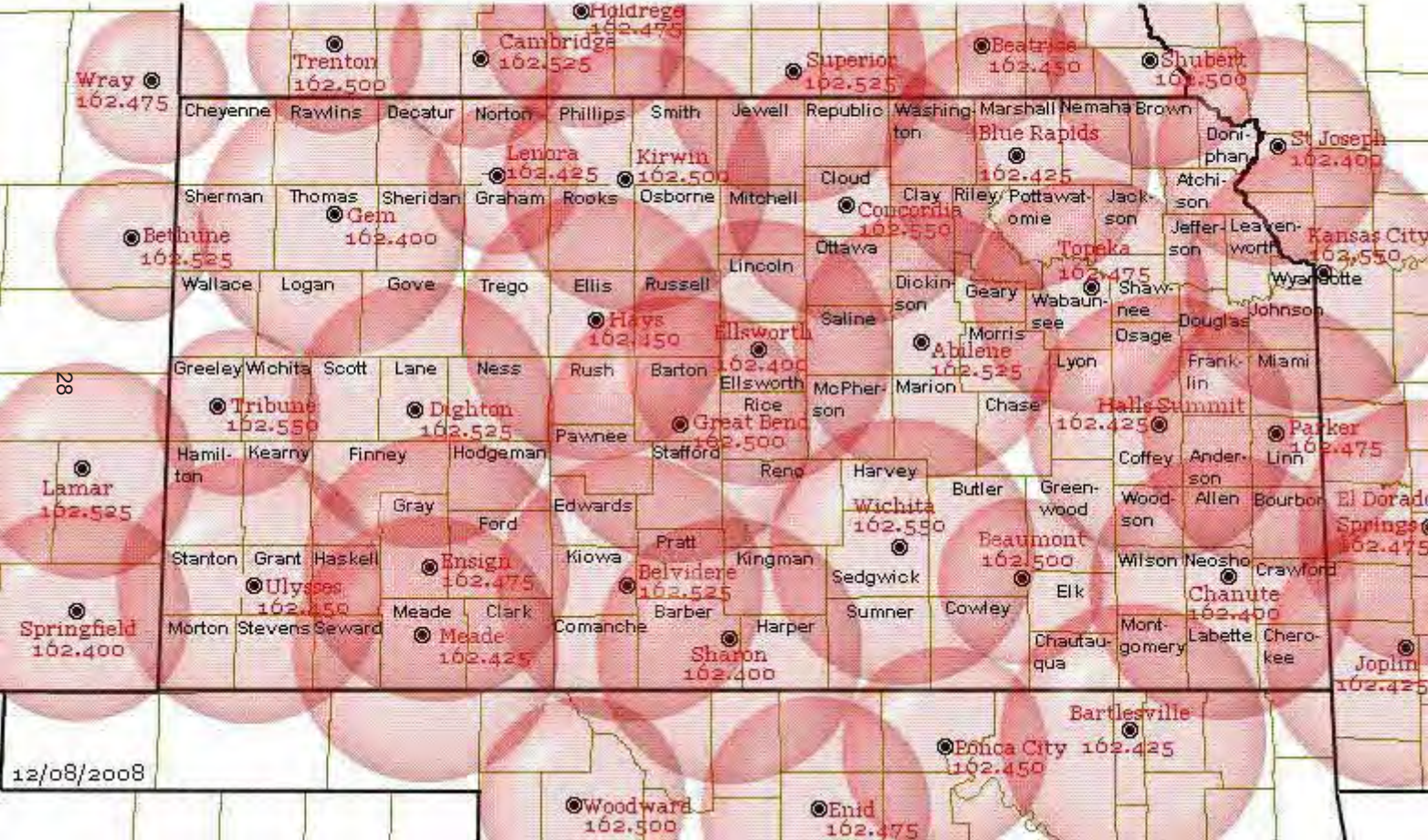
Fireline Intensity (btu/ft/s)

	5	10	15	20	windspeed (miles/hr)
16%	2921	7479	13144	19673	
32%	2298	5884	10340	15476	
48%	596	1527	2683	4016	
64%	305	782	1374	2056	

Flame Length (ft)

	5	10	15	20	windspeed (miles/hr)
16%	18	27	35	43	
32%	16	24	32	38	
48%	9	13	17	21	
64%	6	10	13	15	

Kansas Area NOAA All-Hazards Weather Radio Stations



Prescribed Burning Liability

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. Never assume you're covered!

The best protection is to follow safe prescribed burning practices and avoid escaped fires that damage others' property. Requesting and following an NRCS burn plan may decrease your liability as it proves you were trying to follow safe prescribed burning procedures. However, there is no guarantee that this will reduce liability.

Most agricultural producers carry a general farm and ranch policy. These policies may or may not specify prescribed burning in their coverage. If you don't know if you're covered, 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 your policy. Always mention your intention to do prescribed burning when you apply for a new policy. Failure to disclose your intention may be considered lying on the application.

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

Make sure you understand the limits of your policy. Most general farm and ranch policies only cover activities carried out on your own land. If you help someone else do a prescribed burn, you may not be covered. You are most likely to be covered if: 1)the prescribed burn occurs on your own property; 2) it is consistent with normal farming and ranching practices, and 3) no laws are broken while conducting the burn. This last would include illegal burning during a burn ban. Many farm and ranch policies have an exclusion for activities which pollute. Be sure that smoke from a prescribed burn does not fall into this category.

Burning with others as a volunteer, such as when assisting a neighbor, or when conducting burns jointly with other landowners, falls into a liability gray area. Ask your insurance agent specifically about this type of situation.

If you burn as part of your job or are trained to do prescribed burning, some insurance companies will consider you a professional and will not cover you under a general farm and ranch policy. Question your insurance agent if you are uncertain.

Burn association members and burn contractors are considered professionals and will not be covered under a general farm and ranch policy. If you fall into this category, you will

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. The cost of the policy may be worth the peace of mind.

Insurance is only important if someone or something is damaged. Never assume your current insurance policy provides prescribed burning coverage. It's your responsibility to ask the questions to get the information you need to make good insurance decisions.

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

3. If smoke from a fire which I am conducting or assisting causes an accident, am I covered?

4. If a fire burns down a shed that contains a chemical 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?

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 to make any needed adjustments. 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.

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

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. County regulations may require a higher 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 the 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.

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 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.

Hp: horsepower
Gpm: gallons per minute
Psi: pounds per square inch

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 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 of burn crew members. 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 for extended periods of time. The hold slightly less water than the rigid tanks, and can snag on barb wire and potentially develop holes.

Harnesses are made to fit 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)

Hp: horsepower
Gpm: gallons per minute
Psi: pounds per square inch

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 rig is the standard vehicle used in prescribed burning. Pickups 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 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

Hp: horsepower
Gpm: gallons per minute
Psi: pounds per square inch

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.

Hoses
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 !). Selecting the right hose is a trade-off between these characteristics.

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.

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.

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 to keep them from being run over or melted.

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

Hp: horsepower
Gpm: gallons per minute
Psi: pounds per square inch

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.

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 an auxiliary water source. These can be 1500 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. This will allow for the rapid transfer of water to the fire department sprayer in case of an escaped fire or when extra water is needed to combat a wildfire.

Leaf Blower
A leaf blower can be useful for extinguishing smoldering fires or fires burning in short (less than 1 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.

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.

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.

Hp: horsepower
Gpm: gallons per minute
Psi: pounds per square inch

Oil levels in all vehicles should be checked prior to the burn, and additional oil should be carried in vehicles.

Communication Equipment

Communication equipment is essential to conducting a safe burn. Hand-held radios and walkie-talkies allow communication beyond sight lines. Well in advance of the burn, test communication equipment at the actual burn site to determine if it has adequate transmission at the farthest points on 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.

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.

Cell phones can be useful on a prescribed burn in order to summon help in case of an escaped fire or medical emergency or to check with someone off-site about changing weather conditions. A phone book as well as a list of emergency contacts should also 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.

Ignition Sources and Torches

Ignition Sources

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 relatively light weight compared to propane burners. It is 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.

Hp: horsepower
Gpm: gallons per minute
Psi: pounds per square inch

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 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. Unless a handle is used, a fusee is not practicable for lighting long stretches of fire line as they are relatively short and a continual bending stance would be required to light grass.

Other ignition devices

Propane burners are sometimes used for prescribed burning, but their best application is for burning brush piles and similar concentrated areas of fuel. 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.

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 that are not recommended are pipes or tubes with constricted ends, burning tires dragged with a chain, and burlap bags held on a pitchfork. All are difficult to extinguish easily, and burning tires is not a good idea environmentally.

Hand Tools

Hp: horsepower
Gpm: gallons per minute
Psi: pounds per square inch

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.

A fire broom is 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.

Other items that may be useful to the burn crew include a bucket, hammer, and sharp tile spade. Fence pliers or side cutters are very important and should be carried by every burn crew member to allow them to cut through fence and wire tangles and escape an advancing fire. Additional hand tools may be needed for minor vehicle and equipment repairs.

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 need a special nozzle for application.

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.

Hp: horsepower
Gpm: gallons per minute
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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/

Delaware Sales and Services
http://www.deindustrial.com/3381-0010-17-ADJUSTABLE-PATTERN-SPRAY-GUN-p/3381-0010.htm

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

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

Pre-Burn Briefing

Go over the burn plan and make sure everyone understands it.

a. Purpose of burn: why are we burning?

b. Map:
    i. Explicitly identify burn boundaries
    ii. Point out important hazards
    iii. Identify anticipated fire movement/behavior
    iv. Identify which direction smoke will be travelling
    v. Point out escape zones

c. Crew
    i. Identify the burn boss
    ii. Check to see that crew is dressed appropriately
    iii. Review crew organization and assignments
    iv. Hand out lists with the names of all crew members
    v. Review procedure for an emergency situation: identify who is responsible for calling emergency personnel if the fire escapes.
    vi. Hand out communication devices and test to see that they are working properly
    vii. Hand out bottled water
    viii. Hand out ignition sources/torches

d. Equipment
    i. Identify location of spare parts and supplies
    ii. Identify where each person and piece of equipment will start and its intended travel route
    iii. Identify where auxiliary water supplies are located

Pre-Burn Checklist

Equipment

1 Equipment tested and correctly functioning.
2 Spare parts for critical components on hand.
3 Equipment on site.

Firebreak(s)

1 Prepared according to prescription.
2 Checked to make sure nothing is compromising the firebreak.
(tumbleweed pile, fallen post, too much trash remaining)

Weather

1 Recent forecast in hand (less than 2 hours old).
2 Weather is within prescription criteria.
3 No major weather fronts expected within 24 hours.

Notification (24 hours and 3 hours prior to burn)

1 Dispatcher/Fire Department/Law enforcement has been notified.
2 Neighbors have been notified.

Crew

1 All crew members are present and ready for burn.
2 List of emergency numbers and land legals present in all vehicles.
3 Crew has been fully briefed.

Other

1 Off-site person fully briefed (recommended).
continues to check weather, arranges for additional water deliveries
coordinates rescue efforts in case of emergency.
2 Lookout (recommended)
not actively participating in ignition/suppression activities
monitors overall burn activity
coordinates rescue efforts in case of emergency.

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. Follow-up with repeated inspections until all smoldering embers are completely out.

Post-burn Briefing

1. Did the burn go as planned?

2. What problems were identified during the burn?

    a. Unpredicted fire behavior

    b. Difficulties controlling the fire

    c. Communication failures

    d. Dangerous situations that developed

    e. Things to improve for next time

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 of special concern due to their value, their inaccessibility, or their potential for causing accidents or erratic fire behavior. Each hazard should be identified and a plan developed and implemented to 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 can also be associated with particular types of vegetation or animal activity. Whatever their origin, hazards and precaution areas require special preparation efforts prior to ignition.

Sometimes there are structures near or within the area to be burned that need protection. These includes houses and other buildings, power lines and utility poles, oil and gas pipelines and facilities, corrals, tree plantings, wildlife guzzlers and other watering devices, hay bales, and adjacent crop stubble fields.

Houses, 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 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 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 while the fire is passing beneath them. Burn at right angles to the power lines to minimize the time the fire is under the lines.

Power line poles can readily burn if fire is allowed to linger around the base of the poles. Power companies will 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 far from the downed power line. In short, use caution around power lines.

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. You may need

to break up a large burn into smaller sub-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 trees are redcedar that you want to keep, make the fireguard wider than normal and 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, have extra water on hand as you burn 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 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, burn a black line around them before lighting the main fire. Always check with FSA before 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 contains volatile oils that ignite and can turn the tree into a flaming torch. Before beginning to burn, be sure that the trees closest to the firebreaks are still far enough away that they will not fall or send embers into flammable material across the firebreak.

Sagebrush also contains volatile oils and can burn with intensity.

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. When there are dense stands of dried kochia, the rapidity with which it can burn seems explosive. Kochia is also notorious for creating wind-borne embers and under certain conditions, creating fire whirls. If the kochia patch is located in the middle of the field, 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 edge of the field, 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 grassland adjoining them. Be prepared with extra fire suppression equipment if you are trying to extinguish a fire along a ditch.

Other types of vegetation can be hazards. Grasses that form a heavy thatch, such as the brome often found 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 canyon. A box canyon exists when the topography roughly is configured like the end, bottom, and two sides of a shoe box. Fire increases in speed as it climbs up a slope. Box canyons feature 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. Alert burn crew members to expect rapid fire movement as the fire exits out the top of the canyon.

Culverts 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. Fire can travel through the culvert as embers carried by the wind or as debris and weeds that have washed into the culvert catch on fire. Fire escapes at culverts are common. 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, even if they are not present, can create hazards. Uneven grazing can create patches that burn with varying intensity and slightly change the direction of the fire as it follows an ungrazed patch. Cow chips will smolder long after the rest of the fire is completed, and can later reignite unexpectedly if the wind comes up. Wildlife can also affect fires. Woodrat nests will continue to burn long after the main fire is past. Very rarely a small animal such as a rabbit will catch on fire and run across the fire line, but little can be done to prevent this from occurring.

An additional category of hazards 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.

Immovable 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, old 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. Other travel hazards include bridges that can’t support the weight of the fire

trucks, culverts that extend out into the burn area, junk piles, old tires, old farm equipment (especially 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, can be cleaned up prior to the burn. Creating fire breaks or wet lines around hazard and precaution areas can increase safety during the burn. Assigning extra burn crew and water supplies around these areas reduces the chances of unintentional damage and fire escape.

Where fires are most likely to escape, station a lookout to monitor the situation and report immediately if the fire leaves the prescription area. Plan a route for fire rescue vehicles to 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.

Firebreaks

Firebreaks are created or designated (if using natural features) to contain fires and keep them from spreading beyond the prescribed boundaries. Firebreaks work by restricting the fuel available to a fire. Firebreaks also 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.

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 is 6 feet wide. When volatile fuels such as redcedar or kochia are near the edges of a burn, increase the width of the firebreak. These fuels burn with intensity, increasing the chances of the fire escaping and embers flying across firebreaks. Wider firebreaks should also be used when there are highly flammable fuels on the far side of the firebreak or valuable property such as a house nearby.

The construction of firebreaks on CRP acres is detailed in the program rules. Contract modifications need to be made when installing tilled firebreaks. Check with your local FSA office prior to beginning any firebreak construction on CRP land to ensure staying in compliance with program regulations.

Firebreaks can be either natural or constructed. Constructed firebreaks can be either tilled or non-tilled. The correct firebreak depends on soils, topography, degree of safety desired, and availability of natural features. In some instances, a variety of firebreaks will be 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.

Firebreak construction is especially important in hazardous areas where fires may easily escape. These areas frequently present a challenge to firebreak construction due to difficult terrain or inaccessibility. Many times a different type of firebreak construction will be needed through these areas.

Tilled Firebreaks

Tilled firebreaks 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 until recently, 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 diskings should be very shallow, only about 5 inches deep. Shallow diskings do not harm

the established grass roots, and the grass 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 primarily scrape the surface bare of vegetation. The firebreaks created by the fireplow are about 6 feet in width. Vegetation readily regrows from the roots after the fire.

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

Non-tilled Firebreaks

Non-tilled firebreaks work by reducing the amount of fuel. This slows fire speed and intensity, allowing easier control. Non-tilled firebreaks may be the only practical method of firebreak construction in areas with rugged topography or rocky soil.

Vegetation to be removed from non-tilled firebreaks needs to be carefully raked and moved away from the edge of 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 will increase the fire intensity there and make control much more difficult. Move the material well into the area to be burned.

In some cases, baling the material facilitates material 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, long after the rest of the fire has gone out. This means that the post-burn monitoring will need to be carried out for an extended period, and the chance for wind speeds to pick up and carry embers is also increased.

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. Material removed from CRP firebreaks must be verified that it has been destroyed. Contact your local FSA office for complete details before beginning your firebreak.

Mowing is a common, low-cost method of constructing a firebreak. Mow low to the ground. If appreciable amounts of material are left on the surface, remove as described above. Mowed firebreaks allow easy movement of fire vehicles and are not subject to erosion.

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 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.

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 material 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 carefully burning 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. Monitor these fires until they are extinguished.

Cattle can be used to remove vegetation in a pattern that can be used as a firebreak. 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. A mix of 2,4 D can also be used instead of the molasses mixture. To use this method, begin during the grazing season prior to the spring when the burn is planned. Feeding range cubes within the firebreak will also increase herbage removal by livestock. One disadvantage of this method is that cow chips will be located on the firebreak, which will either need to be removed prior to the fire or flipped into the fire during ignition.

Many firebreaks use existing features as either the firebreak itself or as a staring point for creating 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 provide a firebreak, but be sure traffic will not be a concern. Ditches can present problems for fire vehicles. Paved roads provide a smooth surface on which embers can slide, potentially causing fires on the far side of the road.

Fields with growing cereal crops, such as wheat, can be used as a firebreak. However, hot gasses coming off in advance of the fire can damage the wheat up to 150 feet inside the field. Avoid running a headfire into a wheat field.

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. Carefully monitor these types of firebreaks. 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 prevent fire vehicle movement along the fire edge.

In many cases, paring 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, fence posts, or other flammable material is not crossing the firebreak and compromising its effectiveness.

An additional benefit if 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.

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.

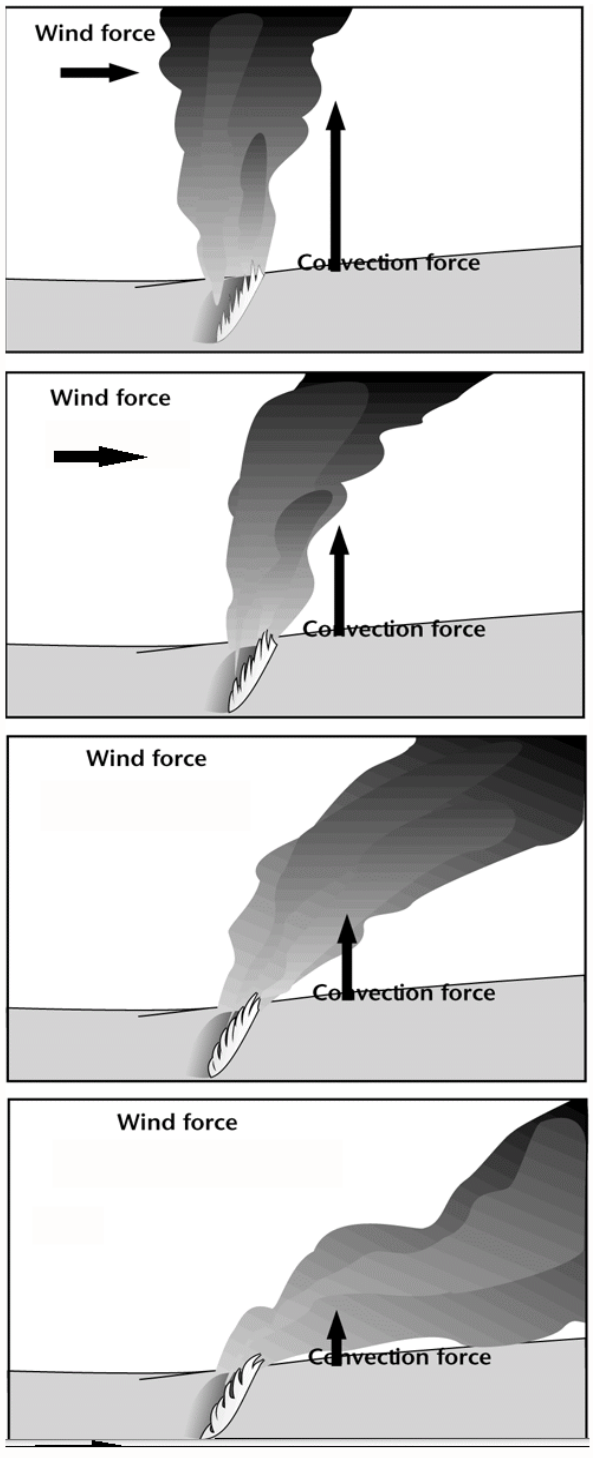


Figure 1 Wind has a major influence o behavior of the smoke column.

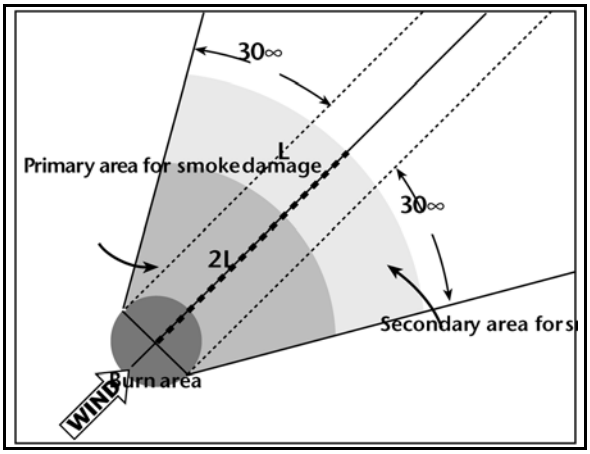


Figure 2 A plot of the smoke dispersion pattern from a prescribed burn

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.

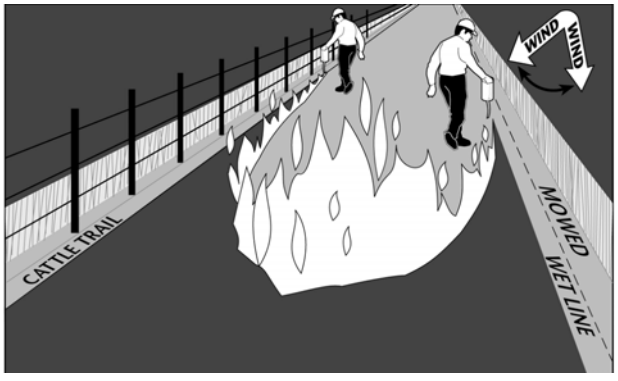


Figure 3 Firebreaks are a key part o prescribed burning. Begin by lighting next to a natural barrier (cattle trail) and moving into the wind. Ensure that the resulting headfire does not cross the downwind barrier.

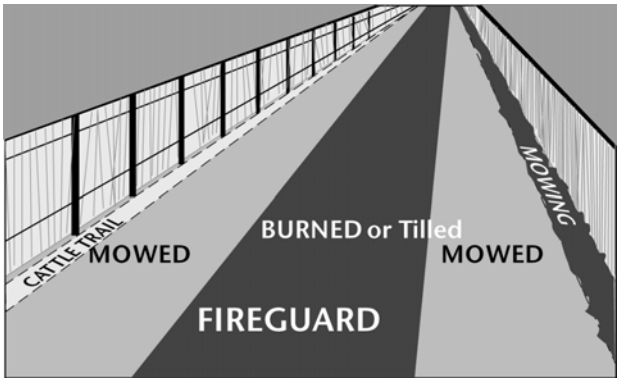


Figure 4 When mowing the edges of the burn area, the minimum width mowed must be a t least six feet, or three times the height of nearby vegetation, whichever is greater. This is necessary to prevent seed stalks or weed stems from falling across

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.

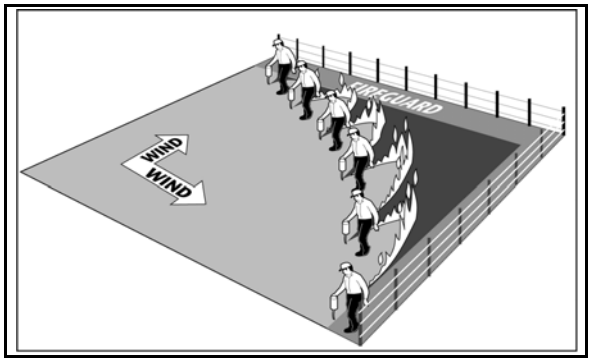


Figure 5 The strip-head fire technique is used to widen firebreaks and to burn areas where control of the size of the fire and/or the amount of smoke is required.

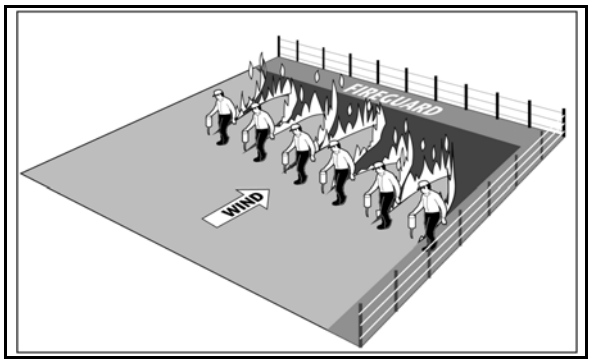


Figure 6 The flank fire technique is used to burn small areas where control of the size of the fire and/or the amount of smoke is required.

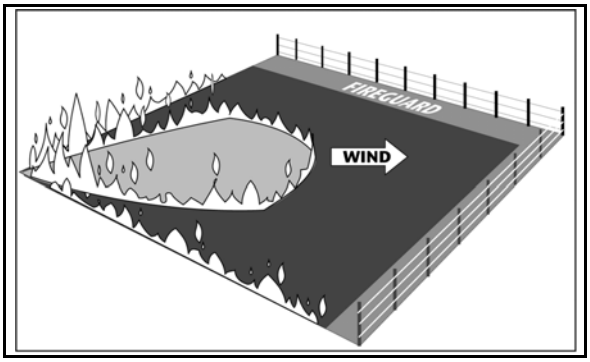


Figure 7 The ring fire technique is used to burn large areas. Once the ring is complete, the fire will burn itself out within the area.

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.

Patch Burning

Patch burn grazing is the use of fire to burn a portion of a management unit along with the use of grazing animals. The burn unit can vary in size from just a few acres to several thousand acres. A single unit many have only a few patches or many patches, depending upon management goals and pasture configuration. Patches are distributed spatially across the landscape, and may also be distributed temporally if burned at different times during the year.

Patches are created by dividing the unit into patches or combinations of patches that are relatively equivalent in size. Patch configurations may utilize natural firebreaks such as streams and roads as division lines. Each patch is burned in some system of rotation, with a fire return interval sufficient to keep woody species from spreading. In systems where fire occurs only during one season (generally spring), adjacent patches are not burnt the same year. In one variation of patch burning, adjacent patches can be burnt at different times during the same year. A common fire return interval in Eastern Kansas would be to burn each patch once every three years. Where conditions are dryer in the western part of the state and brush invasion is slower, longer return intervals could be utilized.

Since units vary widely in size, and the number of patches on any particular unit can also vary, the size and distribution of patches can vary widely. Though likely not practical for a producer, a 90-acre unit could be divided into 9 patches of 10 acres each. In contrast, a 1,000 acre unit could be divided into only 3 patches of 330 acres each. The distribution of patches across the landscape would be vastly different in these two examples of patch burning.

Patch burning is often used as part of a strategy to enhance wildlife habitat by increasing heterogeneity, as the distribution of patches allows for heavily and lightly grazed areas in the same pasture. The spatial extent of the patch needs to be matched to the desired species' needs. Patch burning with grazing provides a wider range of grassland vegetation structure than other burning and grazing regimes, which is important for many wildlife species. For plant species greatly preferred as forage by livestock (decreasers), the reduction of grazing during the years when the patch is not burned allows plants to regain. Riparian areas also benefit from a period free from heavy livestock use.

Patches are not separated by fences, allowing livestock and wildlife access to the entire unit during the grazing period. Patch burning interacts with grazing, as animals will preferentially forage on the most recently burned areas and avoid forage on the areas less recently burned. Patches will display a gradient of use, with recently burned patches being heavily grazed, and less recently burned patches being lightly grazed.

With a three-year fire return interval using a patch-burn grazing system, uniform grazing distribution is achieved over three years. Grazing animals naturally congregate on recently burned areas, rotating grazing pressure throughout the unit as succeeding patches are burnt. Overall grazing distribution tends to be uniform, even in very large pastures, reducing the need for cross fences. Existing cross fences can sometimes be removed

without sacrificing the grazing distribution they provided prior to adoption of patch burning. Fence removal can result in less time spent maintaining fences, and for wildlife, fewer impediments to travel and decreased mortalities from collisions with fences. Removing cross-fences can also result in re-vegetation of eroding trails along fence lines as they no longer serve as travel lanes for livestock. Fewer water developments are needed with patch burning as the lure of high-quality forage will induce livestock to move long distances from water sources. Since livestock congregate on the most recently burned patches, it is easier to check the herd in large pastures.

In times of forage scarcity, such as drought, the less recently burned patches can provide emergency forage. As grazers exhaust the forage on the recently burned patches, they can begin to utilize the abundant but somewhat less nutritious forage on less recently burned patches.

Patch burning concentrates fuel in the lightly-grazed areas due to little livestock use. When burned, patches will have hotter, more intense fires due to the increased fuel load. This may be useful in controlling some undesirable plant species that are damaged by higher temperatures. Patch burning may not be suited to areas where high burn frequency is necessary to decrease a severe woody vegetation problem, but could be used after brush control is achieved. Compared with annual burning of the entire unit, smoke production may be reduced due to fewer acres burned each year, but the reduction in acres could be somewhat offset by the higher fuel loads on the patches to be burned.

In several experimental patch burned pastures, a portion of the patches are burnt during the summer rather than in the spring, providing higher quality forage (sedge ssp.) during the fall and early winter for cow-calf herds. Summer burning extends the burn season and increases the number of suitable days available for burning. However, extending the burn season may not always be desirable from a management standpoint, and may involve burning when livestock are present on other parts of the unit. Repeated summer burning on the same patch may change vegetative species composition.

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

Because a patch burning system is designed with certain patches to be burned each year, 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 burning is a prescribed fire technique that may be useful for achieving some management goals. Standard prescribed burning techniques, such as ring fires and strip fires, can be used when patch burning. Patch burning may result in reduced costs as fewer water developments and cross fences may be needed to achieve good forage utilization. Ecological parameters, such as improved stream water quality, decreased erosion, and improved plant composition may also be enhanced with patch burning. Despite greater management requirements, patch burning can be a good choice when habitat management is the primary prescribed burning goal.

Fire Management Practices
For Air Quality Attainment

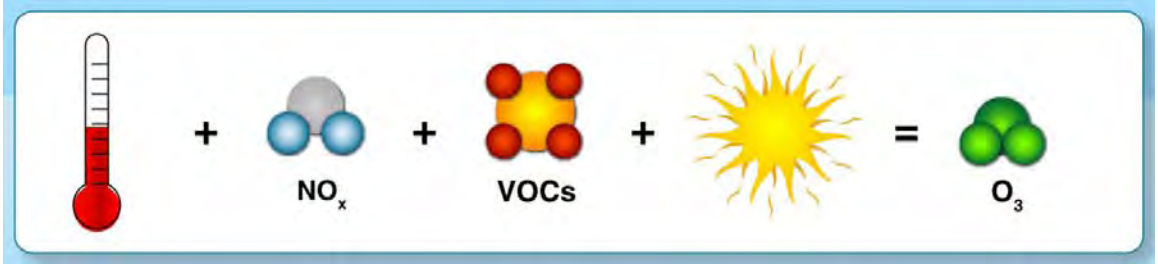
All rangeland fires produce smoke which can be detrimental to air quality for thousands of people as smoke is carried away from the burned area. Smoke does not readily disperse and can be carried like a cloud for long distances. Smoke constituents that are of the most concern are particulate matter,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

Particulate matter is a tiny piece of solid or liquid that is carried and suspended by wind and is denoted by its diameter in microns as PM_{10} and $PM_{2.5}$, with about 70% of the particles produced being of the smaller size. Heavier particles generally precipitate out 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 precipitation and gravitational pull. Smaller particles in particular can cause health problems when they are inhaled, including shortness of breath, coughing, and irregular heart beats.

Ozone precursors consist of nitrogenous gasses (NO_X) and volatile organic compounds (VOC) released by burning fuels that under certain meteorological conditions can form ozone (O_3) downwind from the smoke generation site. Weather conditions that increase the chance of ozone formation are sunshine, high temperatures, temperature inversions, and calm winds. Ozone is the major component of smog, causing coughing, throat irritation, and worsening of asthma, bronchitis and emphysema. Ozone precursors are not cleaned from the air by precipitation but eventually disperse naturally. Ozone precursors from Kansas prescribed fires 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 tree root 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. The formation of haze 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).



Smoke Impacts. Smoke and Air Quality for Land Managers. 2010. NWCG Smoke Committee & University of Idaho. <http://www.cnr.uidaho.edu/smoc/1-2.htm>

Fire Management Practices (FMPs) attempt to reduce the negative effects of smoke that impact air quality, visibility, health, and safety. FMPs reduce smoke-related air quality problems in three ways: by 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 is achieved by conducting prescribed burns when weather patterns are favorable for dispersion and smoke is carried away from sensitive areas which have been identified as part of the prescribed burn planning process. Weather components such as wind speed and direction, mixing height, transport winds, inversions, and atmospheric stability can affect the direction and distance smoke will travel and how close to the ground it will remain. 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 and avoid burning when the plume is directed towards urban areas.

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

Diluting the effects of prescribed burning smoke production depends upon scheduling burning activities so that large quantities of smoke are not produced from the combined emissions from many fires. Burning activities are coordinated across the airshed and spread across a larger time frame to maintain air quality at attainment levels in sensitive areas.

Reducing emissions involves using fuel management to produce less smoke. There are two basic methods of reducing the amount of smoke: reducing the quantity of fuel burned and increasing fuel combustion efficiency.

Less smoke is generated when fewer acres are burned if fuel loads are equivalent. Some livestock management practices generate more fuel per acre, such as patch burning with grazing, deferred grazing rotations, and no grazing. In the case of patch burning, fewer total acres are burnt 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. Fuel loads are decreased by livestock or wildlife grazing, but care should be taken that enough fuel remains at the time of the prescribed burn to carry the fire.

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, continuing to produce smoke. Burning rangeland at intervals that keep woody species from encroaching will aid in smoke management. Extinguish smoldering fuels immediately following the burn. Where appropriate, piling fuels such as dead trees decreases burning time, but may have

negative consequences on the vegetation where they are piled 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. Dryer fuels burn more efficiently. Grasses and forbs burn more cleanly 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.

There are tradeoffs involved when selecting the smoke management FMPs 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. There are few options for managing smoke under wildfire conditions.

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 from the fire. Air quality impacts from the combined smoke from many fires can be reduced by individual producers using practices that mitigate the effects of the smoke from their fire. Cleaner air benefits everyone, both rural and urban.

List of 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 stagnate air conditions that keep smoke from rising.

Lapse Rate: Lapse rate is the rate of decrease in air temperature as elevation increases and 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 towards the ground and negatively impact air quality. The location where the plume sinks may be many miles from the fire location.

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

Atmospheric stability: Atmospheric stability is described as 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.

Mixing height: Mixing height refers to the height above ground level at which vertical mixing of the 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 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 the horizontal movement of smoke. 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.

Adapted from:
National Wildfire Coordinating Group Smoke Committee. Publication year unknown. Smoke management and air quality for land managers. Smoke Lesson 3- Smoke Management (online). Idaho State University.
http://www.cnr.uidaho.edu/smoc/online_refresher.htm
Downloaded 26 Oct. 2010.

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)(3.6-8.9m/s))
- Mixing Height _____(min. 1800ft or 548m)
- Soil Moisture _____(saturated, moist, dry)
- Fuel Moisture _____(moist, dry)
- HYSPLIT Model Results _____ 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.)

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.

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.

Ness County

Prescribed Burn Abstract

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:

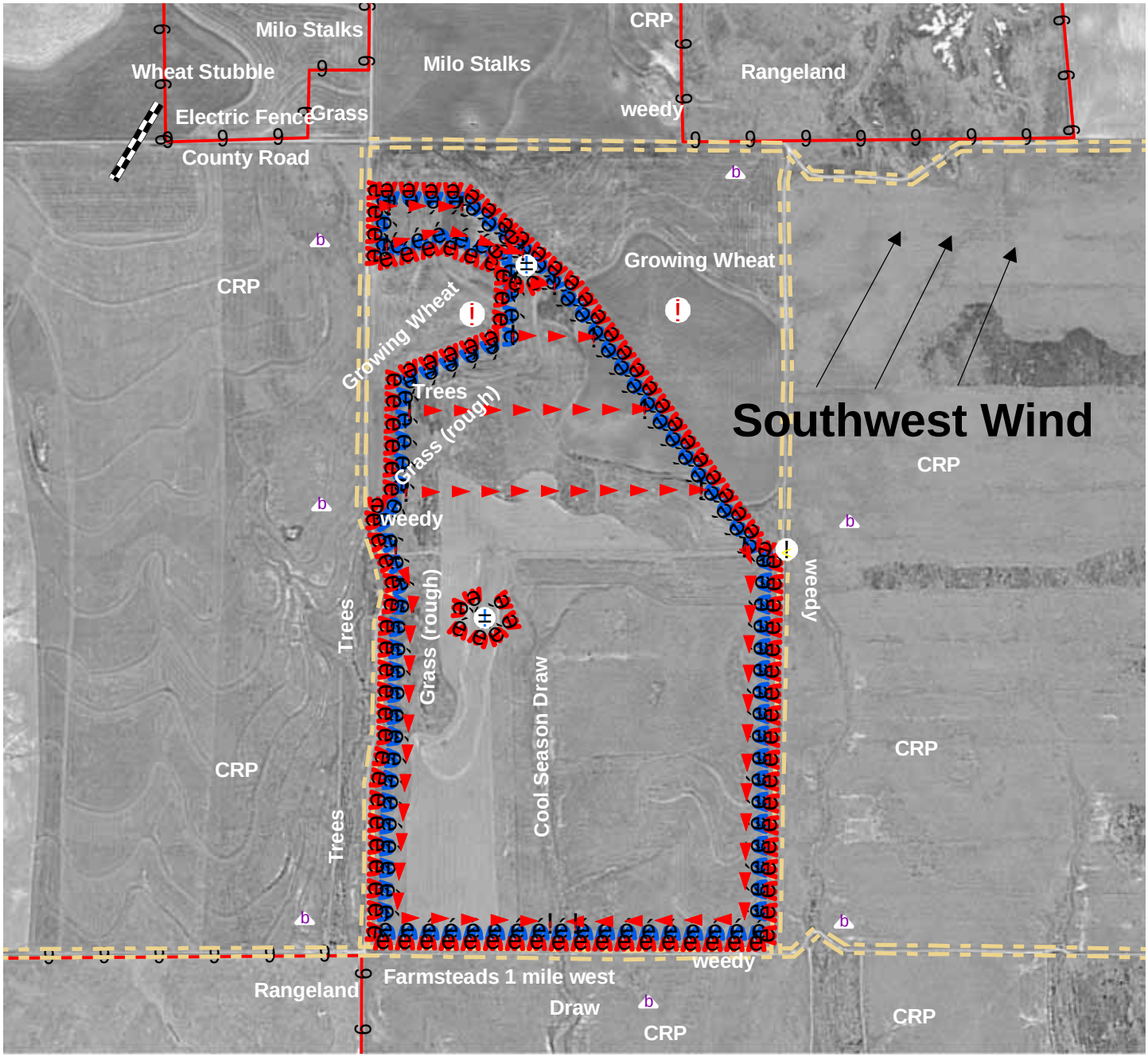
Field Office: Ness City Field Office

Agency: USDA-NRCS

Assisted By: Ness County

State and County: KS, NESS

Land Units: Tract:



Legend

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

1:12,000

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

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

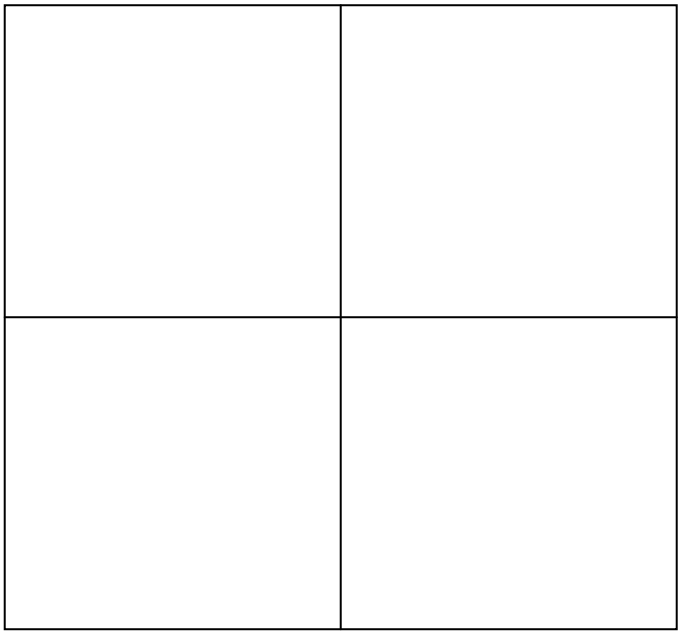
**Auxiliary fire suppression unit: (Show location of unit on burn plan map and describe.) (Use arrow key to advance to next line.)

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.



N

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:

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"

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.: 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	☐
		Yes	☐	No	☐
		Yes	☐	No	☐
		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

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

PRESCRIBED BURNING PLAN MAP

Date: 4/14/2010

Customer(s): Example

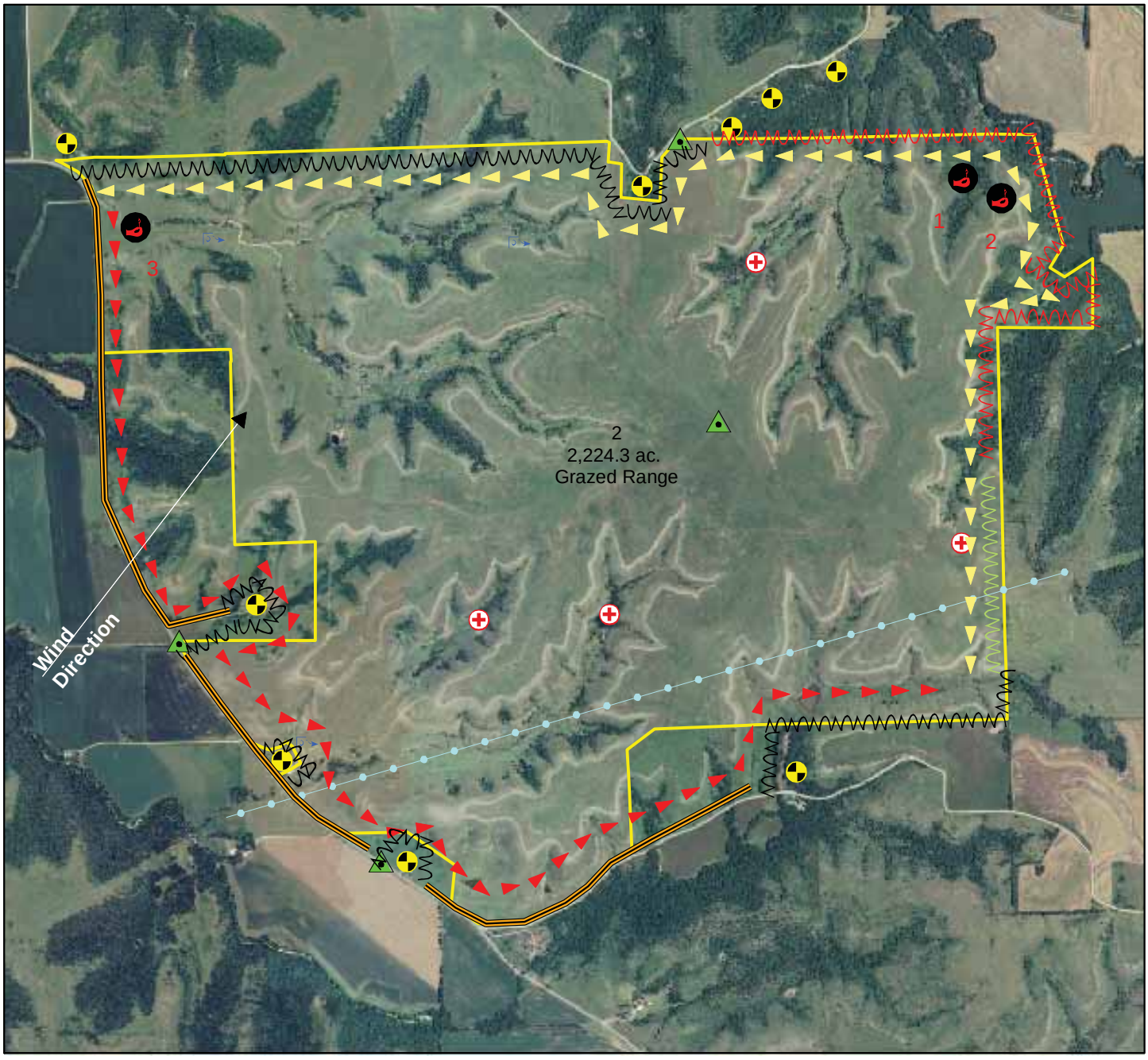
District: GEARY COUNTY CONSERVATION DISTRICT

Field Office: JUNCTION CITY SERVICE CENTER

Agency: USDA-NRCS

Assisted By:

State and County: KS, RILEY



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

Patch Burn Plan

RX BURN OBJECTIVES/ORGANIZATION	RX BURN Name: Date: 03/15/2010 Time: 0900-1200	Producer:	2010 Permit #

Description of the Burn Area:

- Russell County
- Approximate acres to be burned: 160

Emergency Direction to Burn Area:

- From Russell:

Special Fire/Smoke Hazards:

- See aerial MAP for roads, highways, houses, buildings, oil/gas wells, power lines, fences, and gates.

Adjoining Landowners & Cooperators:

- North, East, & Northeast:
- South, Northwest, West:
- GLM Oil Production Co. (785) 483-2123

Weather Forecast: …….EXAMPLE……

- □ Time Frame: Ignition 0900 to 1200
- □ Temperature Range: 35-43 degrees
- □ RH Range: 38%-29%
- □ Wind Speed: 10-11 Gusts to 15 M.P.H.
- □ Wind Direction: North northeast

Weather Forecast for night operations and next day: See attached Spot weather forecast

!!!!CALL CONTROLLED BURN LINE BEFORE ATTEMPTING TO BURN!!!! (785) 483-2121

RX BURN Organization: **Permit #**

Burn Boss:

Team 1- XX, *West Crew leader & interior lighter*

- □ –Water Truck w/ 200gal sprayer
- □ – ATV w/ 15gal sprayer

Team 2- XX, *South Ignition Crew leader*

- □ – Crew Member 1
- □ – Crew Member 2, *igniter*
- □ – Water Truck w/ 200gal sprayer

Team 3-XX, *Holding Crew leader*

- □ – JD Gator 4x2 w/ 50gal sprayer

General Objectives:

Resource objectives:

- Reduce/weaken the stand and density of accumulated ground litter.
- Improve forage quality and quantity for wildlife and livestock.
- Control eastern red cedar, increase warm-season grass production and nutritive value, and improve animal performance.
- Increase vegetation diversity and structure by stimulating new growth of early successional plant species and establishment of forbs.
- Promote flower, seed, and fruit production, thus increasing available nuts and fruits for wildlife attracting greater densities and diversity of insects.
- Enhance habitat for Prairie chicken, Pheasant, Bobwhite quail, and other grassland nesting birds by providing critical nesting and escape cover while discouraging excessive woody encroachment.

Prescribed fire objectives:

- Remove 90%-100% of the current years vegetation grow along with any decadent litter accumulation.
- Decrease buildup of biomass duff layer by 75% in one year.
- Keep fire with in project area/burn block perimeter.

Medical Emergency Procedures

Brief Description: In case of injury needing immediate medical attention, XXX Manager will contact Russell County Sheriff's Office (911) for dispatching of nearest ambulance. The nature of injury will need to be conveyed from burn site through dispatchers to ambulance crew to insure proper response.

Ambulances

Name	**Address**	**Phone Number**	**Paramedics**	
			Yes	**No**
Russell County EMS	210 E 4th St. Russell, KS 67665	911 785-483-2151	**Y**	

Hospitals

Name	**Location**	**Phone Number**	**Travel Time**
Russell Regional	Russell	785-4833131	30 minutes by ground
Central Kansas	Great Bend	620-792-2511	60 minutes by ground
Hays Medical	Hays	800-248-0073	75 minutes by ground

Supplies to the Field

WATER	Drip Torch w/ extra fuel pre-mixed
Burn kits	Fire Flapper
Fire Shovel	McCloud
Pulaski	Fire Broom

BRIEFING

I. **Burn Organization**
- A. Organizational Chart/Personnel Assignments
- B. Equipment Assignments
- C. Other Resources

II. Burn Objectives

III. Description of Burn Area
- A. Review Map of Burn/Topographical Features/Acreage
- B. Values at Risk
- C. Problem Areas
- D. Fuel Type (Both Inside and Outside the Burn Unit)
- E. Roads/Access
- F. Water Sources
- G. Natural/Manmade Barriers

IV. Expected Weather
- A. Wind Direction and Speed
- B. Relative Humidity
- C. Temperature
- D. Fuel Moisture
- E. Atmospheric Stability
- F. Predicted Changes

V. Predicted Fire Behavior
- A. Flame Lengths

VI. Communications
- A. Procedures
- B. Frequencies/Channels
    1. Burn Crew
    3. Cooperators
    4. Others

VII. Firing Sequence
- A. Test Burn
- B. Ignition Equipment (Type, Number, Etc.)
- C. Pattern and Sequence of Firing (Map)

VIII. Contingency Plan
- A. Assignments/Organizational Chart
- B. Strategy
- C. Tactics

X. Safety
- A. Inspect Personal Protective Equipment
- B. Lookouts, Escape Routes and Safety Zones
- C. Hazards (Footing, Natural, Man made, Smoke [visibility], Etc.)
- D. Potential Problems

UNIT LOG

Personnel/Equipment Assignments	Individual Assigned

ACTIVITY LOG

Time	Major Events

Pre- established (8ft. mow-lines) around all borders

Sequence of Firing:

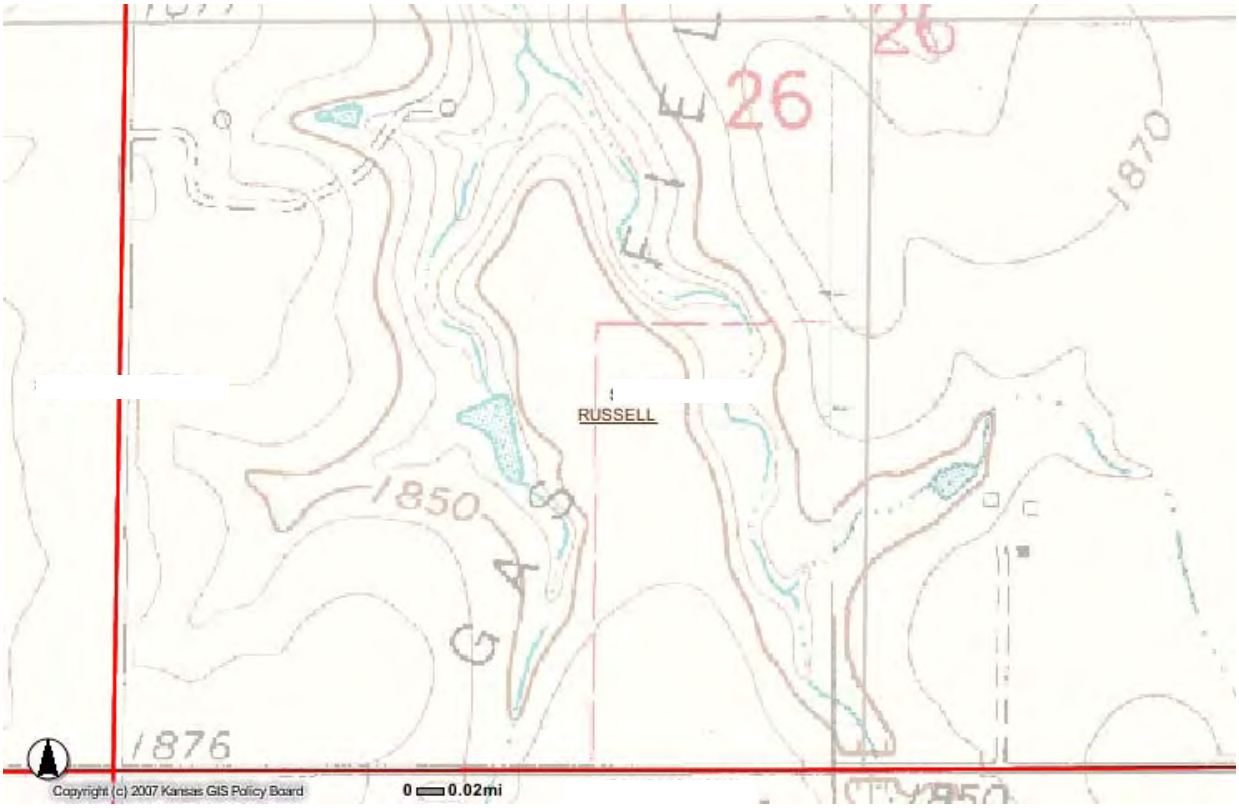
- Acceptable wind directions East, NE (190°-260°)
- Test Burn SW corner
- Two separate ignition teams will work away from **CP1** with Team 1 lighting along the West fence line inside mow line and Team 2 lighting along the South fence line
- Ignition teams will be lead by individuals with water to apply wet line along the fence line to create first line of containment while also wetting any hedge post and telephone poles that may be near the fire line
- After reaching **CP's 2 & 3**, ignition teams may send interior lighters down access roads lighting along the road (T1 ignite from the middle of the unit "**CP4**" out towards the perimeter) (T2 will ignite from the perimeter towards the middle "**CP5**")
- Ignition teams will finish lighting along perimeter to **CP's 6 & 7** tying in the back fire to the existing black
- Lighting continues along black line towards final **CP8** at the northeast corner
- Patrol area perimeter and interior piles to confirm fire is OUT

Key Points:

- Igniter only move as fast as the fire is being put out by Holding Crews
- Holding Crew only use water when needed, allow for persons with flappers to extinguish majority of smoldering ash (save water in case of escape)
- Interior lights must watch for known hazards and escape routes

At Risk Values:

- Limestone School House SE corner, *interior*
- Wooden hedge post and telephone poles along West fence line, *interior*
- Oil wells (3) & tank battery, salt water disposal tank, *interior*
- Homesteads (2) South “XXX HQ” & East “Neightbor”, *exterior*
-



Sec. 34 Patch Burning Plans

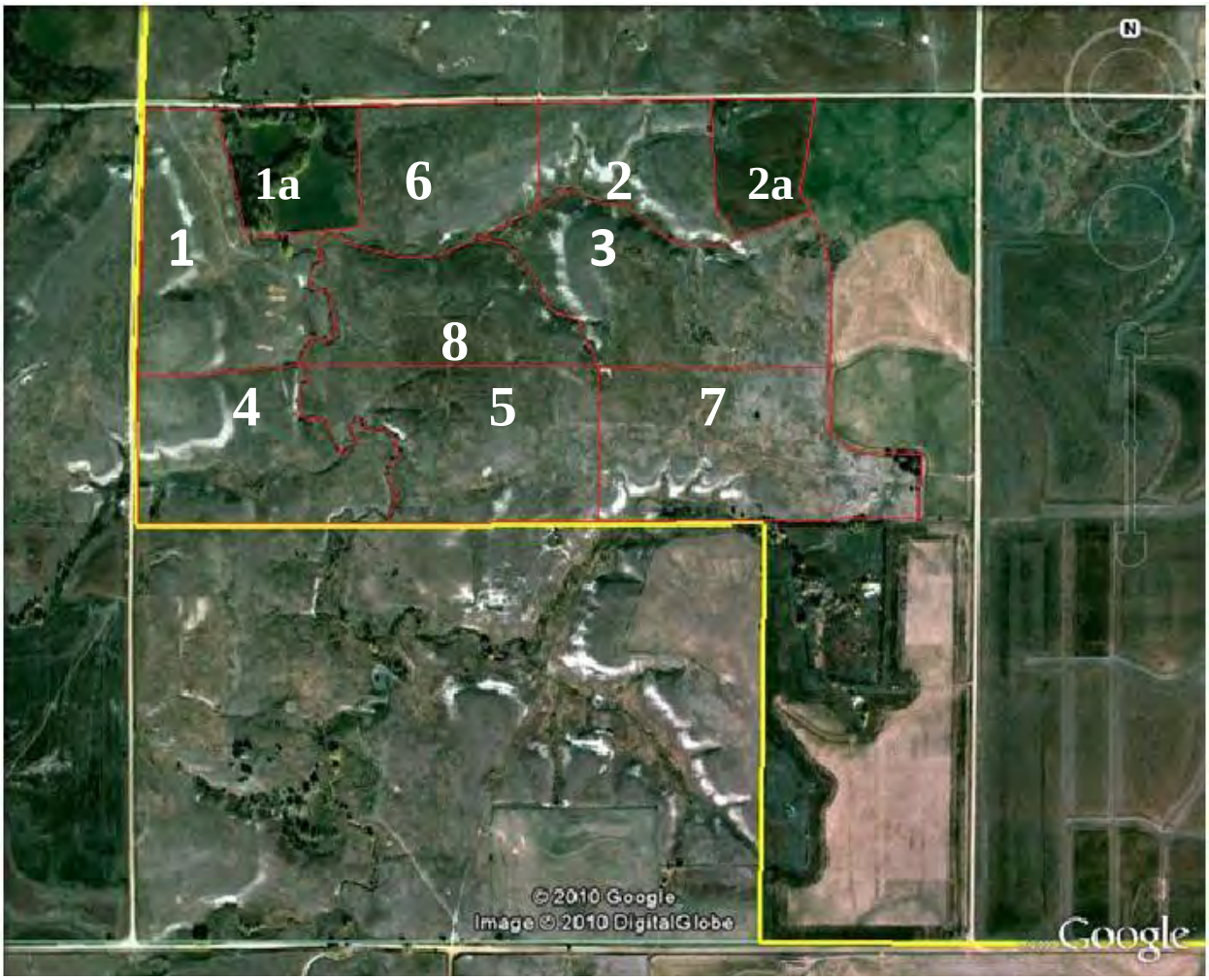
Odd Numbers = Spring Burn
Even Numbers = Summer Burn

BURN Schedule

1. Spring 2010	31.9 acres
2. Summer 2010	20.2 acres
3. Spring 2011	38.3 acres
4. Summer 2011	30.7 acres
5. Spring 2012	35.1 acres
6. Summer 2012	22.6 acres
7. Spring 2013	35.6 acres
8. Summer 2013	27.1 acres
	241.5 acres

Comments:

- Burn **1a** (14.4 acres) during Spring 2010 Burn on **Block 1**
- Burn **2a** (10.6 acres) during Summer 2010 Burn on **Block 2** **(**2a** only after July 15th)*



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
- they are 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. 4) Amend. 2, paragraphs 238 & 239. 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. 4) KS Amend. 13, KS Page 10-13. Publicly available through the Kansas Farm Service Agency.

Prepared by Michael Martin, FSA, Ellsworth, KS Feb. 2010

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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CONVERTING EXPIRED CRP TO CCRP

a.k.a. – Farm the Best, CRP the Rest!

In order to get the most acres into CCRP, you should consider all the available practices and where they might fit into your field:

Grassed Waterways – CP8A – natural draws can be enrolled as waterways, shaping can be cost-shared if needed

Grass Terraces – CP15B – existing terraces can be enrolled, they need to be functioning correctly with adequate height and no breaks

Contour Grass Strips – CP15A – fields that are not terraced can enroll strips of grass on the contour, generally where terraces would be

Field Borders – CP33 – the entire field border can be enrolled for a maximum width of 120 feet or up to 50% of the field, whichever comes first

Kansas Upland Game Birds (SAFE) – CP38 – any field 5 acres or less can be enrolled entirely; other fields can be enrolled up to 20% of the field

In summary, any field 5 acres or less can be enrolled entirely (CP38).

Just by combining CP33 and CP38, 56% of a 40-acre field can be enrolled and 38% of a 160-acre field can be enrolled. This is dependent on the shape of the field – the longer your field perimeter is, the easier it is to get a maximum percentage of the field enrolled.

By adding in other practices, it is not uncommon to enroll up to 65% of the original field.

Farm the Best – CRP the Rest!

Written by Steve Wingerson, NRCS, Smith Center, KS

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.

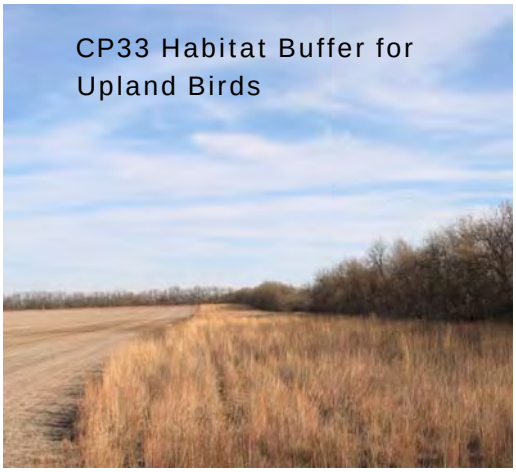
Most land enrolled in the CRP was highly erodible and difficult to farm. Returning such land to crop production requires meeting highly erodible land conservation compliance rules to retain eligibility for U.S Department of Agriculture (USDA) commodity or conservation programs. Landowners should consider “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.

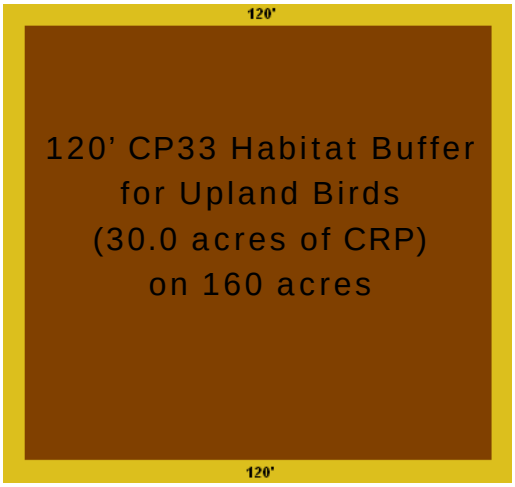
Options for Re-enrolling Parts of the Field in Continuous Conservation Reserve Program (CCRP)


CP21 – Filter Strip Adjacent to Stream

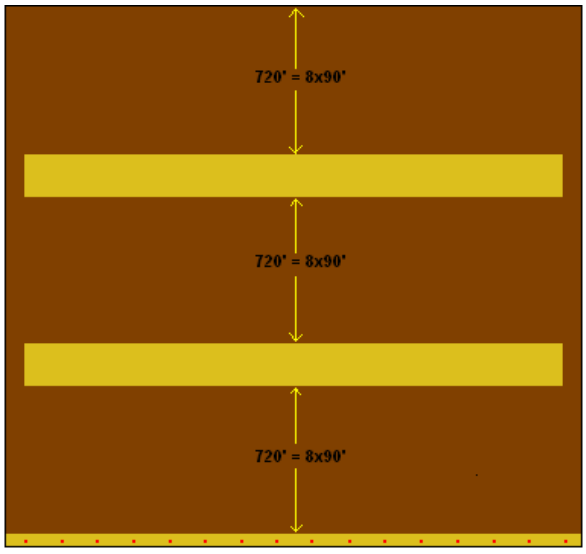
Careful planning before breaking out CRP grassland will help maintain critical habitat for wildlife and provide other environmental benefits. Areas around streams and other water bodies can be protected with CP21, Filter Strips. Wetlands within cropland may be eligible for protection and restoration 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.

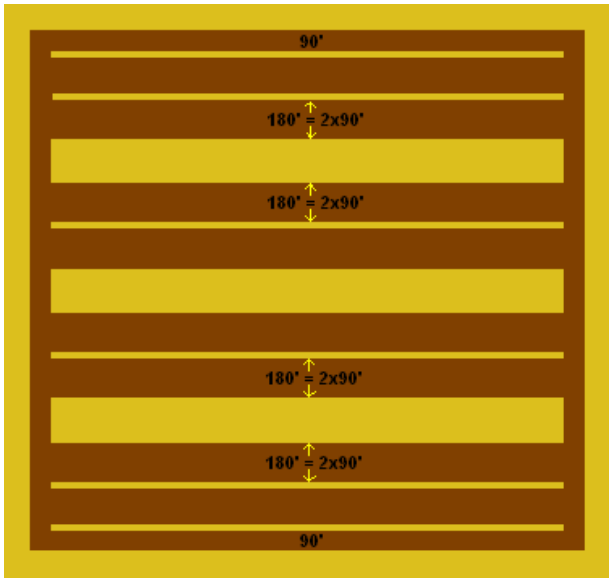





Waterway straightened to facilitate farming with "Flexible Buffer" CP38E State Acres for Wildlife Enhancement (SAFE)



(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

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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.

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-- Sandy Johnson, Northwest Area Livestock Specialist
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eupdate Feb 12, 2010

K-STATE Kansas State University Research and Extension

FORAGE FACTS

Publication Series

GRAZING AND HAYING CONSERVATION RESERVE PROGRAM LAND

INTRODUCTION

Conservation Reserve Program (CRP) Land contracts began expiring October 1, 1997, and interest in managing these lands for grazing and haying has increased. Based on research in Kansas and surrounding states, converting CRP land to cropland can be expensive. The potential to graze or hay the land can be an alternative when managed properly.

BACKGROUND

CRP grass stands, both native and cool-season, were established and allowed to grow for 8 to 10 years, often without any management (mowing or burning). As a result, the stands have limited ground cover, large amounts of standing dead material and possibly litter layers. Large spacing between grass plants is common, resulting in poor plant vigor and low forage production. These characteristics prevent the grass plants from growing and developing normally. Research and experience have shown the need to develop the production potential while utilizing the plants. The primary needs of the stand are to remove standing dead growth, recycle the plant nutrients in the material and increase plant density. Initial stocking rates must be low in order to develop the grass plant's ability to produce forage and be grazed.

RESEARCH RESULTS

When CRP stands of mixed native species come out of the contract period, they are not in condition for full grazing pressure. Based on Kansas research and demonstrations from 1993 to 1996 and research in surrounding states, there is a need to bring the stands into full production through a management strategy covering 2 to 4 years. CRP stands need to be managed to reach their full productive potential. Several alternatives are possible based on the long-term goals for the land.

Research and experience have shown that developing the full forage potential of the stand is necessary in order to obtain optimum animal performance or hay production. Under the research program, stocking rates were reduced in succeeding years when heavy grazing occurred the first season. By reducing the stocking rate the first year or two, greater long-term production is realized.

The considerations necessary to develop the full potential of CRP grass stands is based on the need to condition the plants to use. After 5 or more years of little or no harvest (removal of old growth by any means), the plants are at a low vigor state and probably have a limited root system. The first requirement is to develop the vigor and root system of the existing plants and to enhance the number of species and plants.

Native Grass Stands. The following guidelines should be considered:

1. The stand should be mowed during March or April or prescribed burned in April to:
   a. Remove standing dead material (for burning, and excessive surface mulch).
   b. Recycle plant nutrients tied up in old growth.
   c. Allow sunlight to reach plant crowns.

2. Management and use the first year should be to improve the vigor and productivity of the stand.
    a. If possible, hay the stand the first year (early July preferred).
    b. If grazing, use a light stocking rate (see suggested rates in Table 1). Stock to leave an average of 3 to 4 inches of stubble for tall grass stands and 2 to 3 inches of stubble for mid-grass stands at the end of grazing season.
    c. Use half-season grazing if possible (double stocking from May 1 to July 15).
3. Management after the first year.
    a. Do not burn unless heavy growth remains. Annual prescribed burning should be avoided until the stand is completely developed (2 to 4 years). Always burn only in spring when soil moisture will ensure good plant growth following the burn. Dry spring burns should be avoided.
    b. Adjust stocking rate according to stand development. Stocking rates after the first year should be based on the amount of forage left from the previous season. A sustainable stocking rate may require 2 to 4 years to reach.

Cool-season Grass Stands. The following guidelines should be considered:

1. Unless local CRP guidelines prohibit, the following steps are suggested:
    a. Take soil tests in July or August.
    b. Apply all required phosphorus and lime, plus 30 pounds of nitrogen per acre, in late August to early September **if** good soil moisture is available. (If soil moisture is lacking or local CRP guidelines prohibit, apply all fertilizer in late November or early December. Do not apply fertilizer to frozen soil.)
    c. In late November or early December, apply an additional 30 pounds of nitrogen. Do not apply fertilizer to frozen soil.
    d. If soil moisture is adequate for growth in late February to early March, a prescribed burn can be used to remove accumulated dead plant material.
    e. If grazing, use a light stocking rate (approximately 65 percent of stocking on comparable pastures). Stock to leave an average of 4 to 5 inches of stubble at the end of grazing season.
    f. Prescribed burning should be used only as needed to reduce heavy accumulations of dead materials.
    g. Adjust stocking rate according to stand development. Stocking rates after the first year should be based on the amount of forage left from the previous season. A sustainable stocking rate may require up to 4 years to reach.

Table 1. Suggested stocking rates based on remaining top soil for native CRP stands. ***Rates are in pounds of live animal per acre at start of season.***

Amount of top soil remaining	east	central	west
	stocking rate (pounds / acre)		
no top soil loss	100	80	60
little top soil left	90	70	50
subsoil only	80	60	40

MANAGEMENT FOR HAY PRODUCTION

Cool-season grasses (brome and fescue). Management should follow the same criteria as non-CRP stands. (See Smooth Brome and Tall Fescue fact sheets in FORAGE FACTS notebook.)

Native grass mixtures. See Native Hay Meadow Management fact sheet in FORAGE FACTS notebook.

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Kansas State University Agricultural Experiment Station and Cooperative Extension Service

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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.

There are four main factors to consider.

1. 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 a third of the N and S will volatilize. 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 5000 lbs of wheat straw
N	27.0
P_2O_5	7.5
K_2O	37.5
S	5.0

2. 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.

3. 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.

4. 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 a 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, Environmental Soil Science and Soil and Water Management Specialist, Kansas State University

Technical and Financial Support Available for Prescribed Burning

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 includes spray units, drip torches, and fire swatters, with additional tools available on a county by county basis. 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

Farm Service Agency

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

Kansas Dept. of Wildlife and Parks

All KDWP biologist can provide information, recommendations, and data such as aerial photography but KDWP Biologist will not be providing private landowners with specific burn plans or prescriptions. Some private land biologist have training to help assist on prescribed burns but will not be in charge of the burn on private land.

Some of the equipment listed in the attachment is available for loan and other equipment will only be used by KDWP biologist helping with a burn. I received more information from the Biologist/Tech. on other entities equipment that is available but I didn't include it in this document. If the landowner would call their local KDWP biologist, they can help them find equipment from conservation districts, PF chapter, QF chapters, or other conservation groups' equipment available in their county.

-Chris Berens

National Weather Service

The National Weather Service provides forecast and warning products and services that are used by the general public, the aviation community, and local governments. Some fire weather related products include Fire Weather Forecasts, Spot Forecasts, Fire Weather Watches and Red Flag Warnings. Hazardous Weather Outlooks can also contain fire weather information. The Rangeland Fire Danger Index and Grassland Fire Danger Index is also produced for the eastern part of Kansas.

This information can be received in a variety of ways including the internet, Noaa All Hazards Radio, and by telephone. National Weather Service offices are staffed 24 hours a day, 7 days a week.

-Mary-Beth Schreck

National Wild Turkey Federation
The NWTF purchases prescribed burn equipment for agencies that can check the equipment out to landowners for their use in conducting prescribed burns.

-Brandon Houck

Natural Resources Conservation Service
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

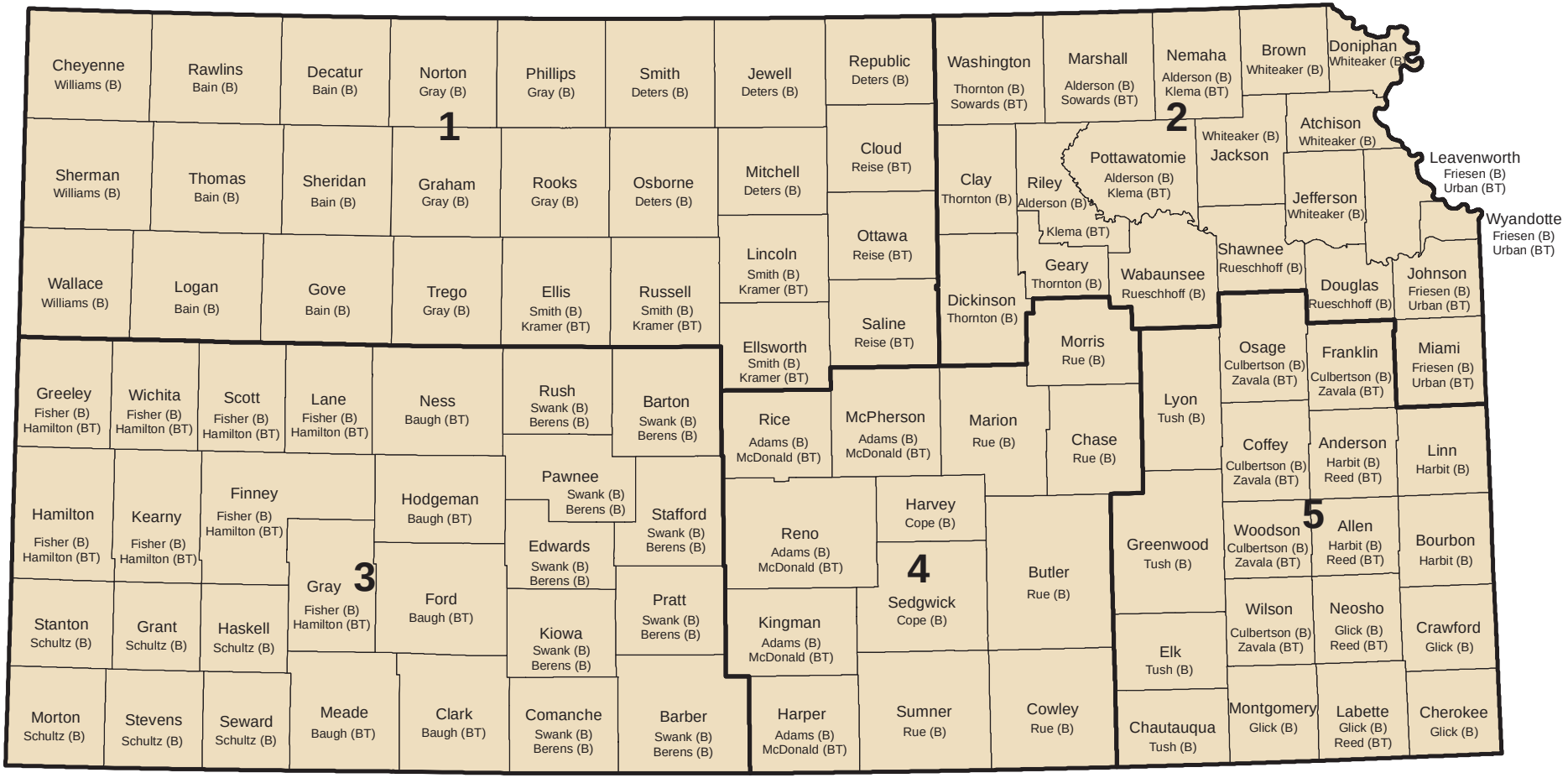
Pheasants Forever & Quail Forever
Pheasants Forever Farm Bill Biologists are private lands wildlife biologists that work in a partnership with NRCS and KDWP in several locations across Kansas. These biologists work directly with landowners and can provide technical assistance on elements of the development of burn plans. While they can't approve a burn plan, they can help the landowner to ensure that the burn plan is completed and executed properly.

In addition, Farm Bill Biologists work directly with NRCS staff in developing necessary applications and contracts to 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 54 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.

-Jordan Martincich

Wildlife Biologists & Bio-Technicians

Kansas Department of Wildlife & Parks



KDWP Regional Offices

Region 1	Region 2	Region 3	Region 4	Region 5
1426 Hwy 183 Alt.	300 SW Wanamaker Rd.	1001 W McArtor	6232 E 29th St. N	1500 W 7th
Hays, KS 67601	Topeka, KS 66606	Dodge City, KS 67801	Wichita, KS 67220	Chanute, KS 66720
(785) 628-8614	(785) 273-6740	(620) 227-8609	(316) 683-8069	(620) 431-0380

Rev. Feb. 2010

KDWP Wildlife Biologist and Bio-Technicians Burn Equipment

Name	Phone	Counties Coverage	200 gal. skid sprayer	Drip Torch	Fire Swatter	Backpack Sprayer	Fire Rake	Atv Sprayer	ATV Disk
Adams, Steve	620-663-3501	HP, KM, MP, RN, RC	1		2		2	1	
Alderson, Corey	785-539-7941	MS, NM, PT,RL							
Bain, Matt	785-462-3367	DC, GO, LG, RA, SD, TH	1	3	4			1	
Baugh, Aaron	620-227-8609	CA, FO,HG, ME, NS		1					
Berens, Chris	620-672-0771	BA, BT, CM, ED, KW, PN, RH, SF							
Cope, Charlie	316-683-8069	HV, SG			2		1		
Culbertson, Bob	620-343-7276	CF, FR, OS, WO, WL	1						
Deters, Aaron	785-545-3345	JW, MC, OB, RP, SM	1	2					
Fisher, Daryl	620-276-8886	FI, GY, GL, HM, KE, LE, SC, WH							
Friesen, Andy	913-422-1314	JO, LV, MI, WY		3	7	1		2	1
Glick, Tom	620-231-3173	CK, CR, LB, MG, NO							
Gray, Marc	785-425-6775	GH, NT, PL, RO, TR	1	2					
Hamilton, Justin	620-276-8886	FI, GY, GL, HM, KE, LE, SC, WH							
Harbit, Justin	620-223-9671	AL, AN, BB, LN		2					
Klema, Blake	785-539-7941	NM, PT, RL							
Kramer, Lucas	785-658-2465	EL, EW, LC, RS	2	2					
McDonald, Kyle	316-772-2704	HP, KM, MP, RN, RC	1		2		2	1	
Reed, Allen	620-431-0381	AL, AN, NO, LB							
Reise, Pat	785-392-3393	CD, OT, SA							
Rue, Jeff	316-322-7513	BU, CS, CL, MN, MR, SU							
Rueschhoff, Brad	785-273-6740	DG, SN, WB		1	2				
Schultz, Kraig	620-450-8287	GT, HS, MT, SW, ST, SV							
Smith, Matt	785-658-2465	EL, EW, LC, RS	2	2					
Sowards, Wes	785-363-7316	MS, WS							
Swank, Charlie	620-793-3066	BA, BT, CM, ED, KW, PN, RH, SF	1	2					
Thornton, Clint	785-461-5095	CY, DK, GE, WS							
Tush, Richard	620-583-6783	CQ, EK, GW, LY							
Urban, Tim	913-422-1314	JO, LV, MI, WY		3	7	1		2	1
Whitaker, Randy	785-935-2552	AT, BR, DP, JA, JF		2					
Williams, Josh	785-462-7993	CN, SH, WA	1	3	4			1	
Zavala, Amy	620-637-2748	CF, FR, OS, WO, WL	1						

Please contact the KDWP Biologist in your county for more information on the equipment listed next to their name above.

Contacting Local and Regional Agencies

A wealth of information and assistance is provided by federal, state, and local agencies. For more information about prescribed burning, contact the following:

Conservation District (CD)
Farm Service Agency (FSA)
Natural Resources Conservation Service (NRCS)
Use the following website to locate your local NRCS, FSA, and the local conservation district.
http://offices.sc.egov.usda.gov/employeeDirectory/app?state=ks
Click on "click here" under Service Centers (about halfway down the page).
Click on the appropriate county on the map when it comes up.
Click on the tab "Complete Office Listing" (near the upper right hand corner of the page).

Kansas Dept. of Wildlife and Parks (KDWP)
Use the documents following this page to locate your local biologist. Note that the prescribed burning equipment each biologist has is also listed.

National Weather Service (NWS)
Use the following website to locate your local forecast center.
http://www.crh.noaa.gov/ict/office/mission.php
Click on the appropriate county when the map comes up.
At the bottom of the page near the left hand side, you will find the area forecast office. Use the telephone number provided to request additional forecast information.

National Wild Turkey Federation
http://www.nwtf.org/in_your_state/lists.php?STATE=KS

Pheasants Forever (PF)
Use the following website to locate your area Pheasants Forever representative.
http://www.pheasantsforever.org/page/1/FindaChapter.jsp?state=KS

Kansas Forest Service (KFS)
Use the following website to locate your regional forester.
http://www.kansasforests.org/staff/community/index.shtml
Click on the appropriate county when the map comes up.

Kansas State University Extension (KSU)
Use the following website to locate your local K-State Extension office.
http://www.ksre.k-state.edu/DesktopDefault.aspx
Click on the map in the upper right hand corner marked "Click for Local Contact Information".
Click on the appropriate county when the map comes up.
Click on the words "About Us" in the left hand bar.
Click on the words "Meet the staff" to identify the Natural Resources agent.

Prescribed Fire Associations

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Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
http://osufacts.okstate.edu

A Prescribed Fire Association is a group of landowners and other concerned citizens that form a partnership to conduct prescribed burns. Prescribed burning is the key land management tool used to restore and maintain native plant communities to their former diversity and productivity for livestock production and wildlife habitat. Native prairies, shrublands, and forests supply the majority of livestock forage and 99.9% of the wildlife habitat in Oklahoma. Without fire, native plant communities become dysfunctional and unproductive. Research has clearly shown that there is no substitute for fire. Oklahoma's ecosystems are fire dependent and not burning is poor land management.

Why do not more people use prescribed fire to manage their land? First, fire was not part of the European culture that has come to dominate the Oklahoma landscape for more than 100 years. Fire exclusion and fire suppression had been engrained in our society for years and popularized by the very successful Smokey the Bear ad campaign. The results of which has been a rapid decline in the quality of our natural resources, along with costing taxpayers millions of dollars each year to fight wildfires and the many other negative consequences of fuel build up.

There are four excuses that are often used when people are asked, "Why don't you use prescribed fire?" The first and foremost is liability. Liability should be a concern but not to the point of inaction. There is little evidence in case law that properly conducted prescribed fires have resulted in significant sums of money being exchanged as a result of damages. Much of the perception of risk is generated by media coverage of wildfires, which have nothing to do with prescribed fire. The second excuse is, "I do not have enough training or experience." The third excuse is "I don't have enough people to help me." The fourth excuse is "I don't have enough equipment." All of these answers will result in not burning and not taking care of your land. Eventually you will be out of business regardless of your interests.

Forming a prescribed fire association deals directly with the four reasons of why some people do not use prescribed fire. You still have to have insurance for liability, but you manage risk by having the proper training, experienced help, and proper equipment provided by the association. You attend prescribed fire workshops, but you also help other association members conduct burns. This hands-on assistance allows you to gain experience and confidence with prescribed fire. You do not have to hire labor, because you now have neighbors helping neighbors. Association members pool their equipment so that no one person has to buy all the equipment. One person may have a drip torch, another person a slip-on cattle sprayer, while another member has a four-wheeler, and yet another has a tractor and disk for preparing firebreaks. All of this equipment and labor allows you to safely conduct prescribed burns.

Starting a Prescribed Fire Association

First, call a meeting of interested citizens. Make sure to involve key members of the community, landowners, lessees, federal and state land management agencies, and local fire departments. You must then pick a leader. The association has to be a grass roots organization that is locally led. Government organizations are only there to provide technical assistance and guidance. If no one from the community steps forward to lead and encourage others the association will not be successful.

When forming an association there should be a set of goals and objectives to help guide the way. These goals listed below are adapted from the Edwards Plateau Prescribed Burning Association, Inc (EPPBA) located in Sonora, Texas.

- Share Equipment
- Share Labor
- Train Our Membership
- Foster good relations between neighbors and within the community in regards to the use of prescribed fire.

Other associations have also adopted similar goals and objectives. These goals outline what an association should do. Teach and train the landowners/managers how to use prescribed fire safely and properly, as well as educate those in the community about the positive aspects of prescribed burning. The last part is the most important. To have a viable prescribed fire program you must gain the support of the community. Listed below are guidelines that have been compiled from associations that are active as of 2005.

Guidelines for Prescribe Fire Associations

- Elect officers (President, Vice-President, and Secretary/ Treasurer) and a Board of Directors (one or two from each county if multiple counties are involved) - landowners/ lessees' only – agency/university personnel can only provide technical assistance.
- Dues-$25.00/year (used to buy equipment).
- Fire Training School (annual) - Safety, equipment use, techniques.
- Fire Plans - prepared by landholder with help from agency or extension.
- Liability - landholder assumes liability for fire and must show proof of insurance before burn.
- Firebreaks - landholder responsible for preparing firebreaks and they must be adequate.
- Personnel on Burn - have a minimum number that must be present on each burn.
- Equipment - have an inventory of what is available.
- Burn Participation - members must assist with a certain number of burns, before their land is burned.

Associations should be incorporated. Incorporation is simple, and all the association needs to do is get a copy of SOS form 009 Certificate of Incorporation (Not for Profit) from the web at http://www.sos.state.ok.us/forms/FM0008.PDF or contact the Oklahoma Secretary of State for a copy. Follow the procedures and submit the forms with a filing fee back to the secretary of state's office. Incorporation also allows the association to gain non-profit status 501(c)(3). The non-profit status precludes the association from paying taxes. It also makes dues, donations, gifts, and contributions tax-deductible. The association becomes eligible for grants from public agencies and private foundations that donate to non-profit corporations. The association also becomes eligible for a bulk-mailing permit. For information about obtaining non-profit 501(c)(3) status obtain the Internal Revenue Service (IRS) form 1023 from the IRS website or at a local IRS office.

Some associations use rural fire department equipment for conducting prescribed burns. For example, the Edwards Plateau Prescribed Burning Association has been allowed to use a fire truck belonging to the Sonora Volunteer Fire Department. The fire department rented the truck to association members for a year, and then they sold the fire truck for a $1.00 to the Edwards Plateau Soil and Water Conservation District so it would be available to the association members anytime they burned. The Big Pasture Prescribed Burning Association uses trucks and personnel from several different volunteer fire departments when it burns depending on location. Some volunteer fire departments require a donation or rental fee for these services. Joining forces with a volunteer fire department is a benefit to both parties. It gives the burn association added equipment, personnel, and safety, while it gives the VFD some training time, added income, and community service. In addition, both parties have a positive impact on our natural resources and community safety.

Another benefit of a prescribed fire association is its ability to have strength in numbers and influence politics. When members of the community band together with the same goals, while safely applying fire to the landscape, many community members will lend their support. They will also enjoy the benefits of prescribed fire in their area including reduction of wildland fuels for wildfire protection, enhanced native wildlife and plant habitat, enhanced livestock habitat, improved water quality and quantity, and elimination of eastern redcedar. An equally important aspect of forming an association is public education, especially for youth that will provide benefits for future generations.

At this time (2005) there are seven prescribed burning associations in Oklahoma, with six in Texas, one in Colorado, and one association in California that has existed since 1956.

Prescribed Burning Associations in Oklahoma

Big Pasture Prescribed Burning Association, Inc.

Formed in 2001 and covers Comanche, Cotton, Kiowa, Jefferson, Stephens, and Tillman counties.

Northwest Range Fire Management Association, Inc.

Formed in 2002 and covers Dewey and southern Woodward counties.

North Central Range Improvement Association

Formed in 2004 and is located in Noble County.

Cross Timbers Prescribed Burning Association

Formed in 2004 and is located in Lincoln County.

Arbuckle Restoration Association

Formed 2004 and covers Carter, Johnston, and Murray counties.

Salt Creek Burn Association

Formed 2005 and covers southern Pottawatomie and southern Seminole counties.

Cimarron Range Preservation Association

Formed in 2005 and covers Woods, Alfalfa, and northern Woodward counties.

For information about membership in these associations contact the Oklahoma Cooperative extension office or USDA-NRCS office in the respective county.

Other articles about prescribed burning associations

Burn Baby Burn! The Oklahoma Cowman. February 2003.
Ring of Fire. The Cattleman. February 2003.
Management By Fire. Beef. August 1999.

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Kansas Prescribed Burning Associations

Red Hills Prescribed Burning Association
Contact: Brian Alexander
19178 Southwest Highway 160
Sun City, KS
620.247.6443
banzaiwrx@gmail.com
http://www.rhpba.com/

Russell County Prescribed Burn Cooperative
Contact: Gary Blundon
17953 Fairfield Road
Russell, KS 67665
yody@ruraltel.net

Jewell County Prescribed Burn Cooperative
Contact: Chad Simmelink
315 N Road
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csimm@ruraltel.net

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785.794.2419
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Roger Rightmeier
2135 Highway 36
Mankato, KS 66956
785.378.3097

Cloud County Prescribed Burn Cooperative
Contact: Jeff Buckley
1940 N 220 Road
Concordia, KS 66901
785.243.7891
buckley@twinvalley.net

Agency Contacts:

Dwayne Rice, NRCS (Russell, Jewell, Cloud)
112 E. Court St.
Lincoln, KS 67455
785.524.4855
Dwayne.rice@ks.usda.gov

Andy Phelps (Russell)
555 South Fossil
Russell, KS 67665
785.483.5618
andy.phelps@ks.usda.gov

Source: Kansas Grazing Lands Coalition <http://www.kglc.org/>

Prescribed Fire Contractors

These individuals or companies* are available for hire as prescribed fire contractors.

Art Aeschliman
Syracuse, KS 67878
Phone: (620) 384-4518

American Fire Rescue, LLC
1807 E. 26th, Suite B
Hays, KS 67601
Phone: (785) 628-1141 – ask for Shawna
Bruce Timmons: (785) 259-6269
Ken Kippes: (785) 650-2333
Jerry Sonntag: (785) 635-5986
Email: amerikanfirerescue@yahoo.com

Badger Creek Wildfire
Wayne Brown
14173 County Road 314
Poplar, MT 59255
Phone: (406) 774-3034
Web: http://www.badgercreekwildfire.com

Banner Farm and Home Fencing
Bart Hettenbach
P.O. Box 87
Woodbine, KS 67592
Phone: (785) 479-1261
Email: bannerfence@yahoo.com

Gene Brehm
10044 SE 40th St.
Pratt, KS 67124
Home: (620) 672-6729

CD Custom Burning
Chris Wesley
Sun City, KS 66531
Cell: (620) 388-4445
Home: (620) 248-3201

**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.*

Chloeta Fire, LLC
Mark D. Masters, CEO
6608 N Western Ave, Ste 294
Oklahoma City, OK 73116-7326
Phone: (877) 245-6382
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Email: mmasters@chloetafire.com
http://www.chloetafire.com

Delaney Farm Service Inc.
Deone Delaney
PO Box 5
Utica, KS 67584
Phone: (785) 391-2304
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Wildlife Management Services of North Central Kansas
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Clifton, KS 66937
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Steve Paulsen
621 W. Broadway
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Home: (620) 234-5193
Mobile: (620) 546-4682

Quality Forest Management, LLC
733 Stanton Ave
Monroe City, MO 63456
Phone: (573) 248-7713
Email: treemanwilson@msn.com

Ranchland Development
Roland Spencer
Winfield, KS
Phone: (800) 324-0042
Web: http://www.ranchlanddevelopment.com

Rangeland Fire Specialists, LLC
John Weir, Owner
29680 County Road 40
Orlando, OK 73073
Phone: (405) 780-0036

Safe Burn
Mike Hirschmann
419 2nd Street
Baldwin City, KS 66006
Phone: 785-979-2954

Robert Swonger
Bloom, KS 67865
Phone: (620) 255-5352

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Timmermann Wildland Fire Services, LLC.
Contact: John Timmermann
610 S Harris St
Harrisburg, MO 65256
Phone: (573) 875-5726
Fax: (573) 817-0189

Up in Smoke Inc.
Jeff Scott
Route 1, Stafford, KS 67578
Phone: (620) 234-5508
Cell: (620) 546-6304

Source: Kansas Forest Service
https://www.kansasforests.org/pubs/fire/Prescribed_Fire_Consultants_and_Contractors.pdf

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Compiled by Carol Blocksome, Ph.D.

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