NATURAL RESOURCES CONSERVATION SERVICE

GENERAL SPECIFICATION

PRESCRIBED BURNING

(Ac.)

CODE 338

GENERAL SPECIFICATIONS

Procedures, technical details, and other information relevant to and for providing additional guidance in carrying out selected components of the Conservation Practice Standard 338, Prescribed Burning are listed below. This material supplements the requirements and considerations listed in the Conservation Practice Standard for Prescribed Burning.

Deviations

Deviations from the standards and/or specifications shall be approved by the State Resource Conservationist (SRC).

Laws

This practice will be applied in accordance with all federal, state, tribal and local laws, regulations and ordinances. Refer to Section I – Laws of the electronic Field Office Technical Guide (eFOTG). Contact the local fire department or check Oklahoma Forestry Services website http://www.forestry.ok.gov/burn-ban-information to determine current county burn policy.

The Oklahoma Department of Agriculture Food and Forestry (ODAFF) – Oklahoma Forestry Services (OFS) has approval authority for burning activities within the Organized Forest Fire Protection Area as identified and filed in eFOTG, Section I – Maps. A notification to the Department of intent to burn is required within this area http://www.forestry.ok.gov/Websites/forestry/Images/burnlaw.pdf. For forestland in the Organized Forest Fire Protection Area, contact the local office of the ODAFF (OFS) for planning and site specific recommendations.

Oklahoma has two types of burn bans that can be issued in a county. One is the “Governor Declared” burn ban and the other is the “County Commissioner Declared” burn ban. Typically, prescribed burning should not be conducted during a Governor Declared burn ban, as these are issued when extreme conditions exist. At times exemptions are allowed to these burn bans if conditions are favorable. During County Commissioner Declared burn bans, similar conditions may exist, but may not be as extreme or persist throughout the ban period. To meet some objectives of a burn (e.g., to control undesirable plants) a prescribed fire may need to be conducted during a burn ban. However, to burn under a County Commissioner Declared burn ban, one must obtain an exemption from the local County Commissioners in order to conduct a burn without penalty. In most situations this would involve meeting certain requirements imposed by the County Commissioners including demonstrating precautions necessary to contain the burn.

Landowners are required to provide a burn notification as referenced in OK Forestry Code Title 2, Section 16-28.2, Subsection D – Prescribed Burning Notification Plan to local rural fire departments as referenced in the NRCS Burn Plan.

Firebreaks

Landowners must fully understand they are responsible for confining prescribed burns to lands contained in the burn plan. All prescribed burns shall include appropriate firebreaks to conduct a safe burn, accomplish the objectives of the burn and contain the burn to the designated area. Refer to the Oklahoma NRCS Firebreak (394) conservation practice standard for types, dimensions and designs of firebreaks specific to the prescribed burn being planned. Involving adjacent landowners in a larger scale burn to take advantage of natural or existing firebreaks may be more feasible than constructing firebreaks along property boundaries.

Fire intensity can be estimated by flame height, both of which are influenced strongly by fuel mass (fuel load). Mowing or shredding to reduce the height as much as possible will reduce intensity of the fire. Where tall fuels and heavy fuel loads are a concern, mow or shred a strip around the edge of the burn area inside the mineral soil firebreak. Be aware that recently mowed or shredded thatch may burn for long periods of time, which requires more water and slows burn progress. Mowing multiple times during the year is preferable to a single mowing immediately prior to the burn because it allows time for the thatch to decompose or disperse. The width of this strip will directly depend on fuel loads and may range from 20 to 100 feet wide. The width allows equipment and personnel to move along the firebreak with lower fire intensity. Once the fire reaches the taller unmowed fuels, fire intensity is often so high that working close is difficult due to the heat. Crews can work safer and easier in the mowed strips.

Follow the manufacturer's label for rates and application techniques when using foam or fire retardant (most prescribed burns do not involve fire retardant).

Identify areas in the burn unit that may need to be excluded from the burn or plan appropriate precautionary measures to protect sensitive wildlife habitat, headquarters, buildings, oil and gas sites, windbreaks, snags, desirable trees, highly erodible areas, archeological/cultural resource sites, threatened and endangered plants and animals, or other areas which would be unsafe or undesirable to burn.

Weather

Knowledge of the weather is a key component to successful prescribed burning, and is important for proper smoke management. Always monitor weather for several days prior to a scheduled burn. Before igniting a prescribed burn, acquire the latest weather forecast for the day of the burn. A 24-hour weather outlook is required prior to conducting a prescribed burn. If the burn area contains smoldering woody debris, logs or cow chips, monitoring weather forecasts for several days after the burn will be required to reduce the risk of escape and potential smoke impacts.

Although exceptions exist, burning is often extremely risky when one or more of the following conditions exist: (1) air temperature exceeds 100˚ F, (2) wind velocity, including gusts, exceeds 20 mph, (3) relative humidity is less than 20%, or (4) with variable or no-wind conditions. Some burn objectives may require one or more of these conditions, thus when burning occurs with any of these conditions, extreme caution should be exercised. The level of risk is largely dependent on the fuel moisture, combined with fuel type and fuel amount.

Burning is not recommended within 12 hours of a predicted wind shift or frontal passage for grass type burns. It is not generally recommended to burn areas with woody litter or debris if the forecast is predicting a gust front, a wind shift or strong winds within a 2 day period following a burn. Woody materials commonly burn for more than 2 days, so some burning woody fuels near a firebreak may have to be extinguished or moved prior to a gust front or wind shift. Fire weather forecasts from the National Weather Service may be obtained at http://www.srh.noaa.gov/oun/?n=fireweather. Current weather conditions and future weather forecasts may be obtained from the OK-Fire website on the Oklahoma Mesonet at http://okfire.mesonet.org/.

Weather and corresponding fire behavior should be monitored at regular intervals before, during and after the burn. On-site fire weather monitoring is mandatory from just before ignition until mop-up is

complete. Wind speed, wind direction, relative humidity, and air temperature should be monitored and recorded with the time of observation every 30-45 minutes throughout the prescribed fire.

It is a good practice to print the forecasts used the day of the burn and attach them to the burn plan. Data is available on the Oklahoma Mesonet website for past weather conditions, if needed, at (http://www.mesonet.org/index.php/weather/category/past_data_files).

Topography

Topographic features on the landscape (e.g. mountains, canyons, steep hills, deep gullies) have a dramatic effect on wind speed, wind direction and ultimately rate-of-spread (the larger the feature – the greater the effect). Fires can speed up, slow down, change from a backfire to a headfire, and create hazardous conditions for the crew and increased risk of fire escape. Special precautions should be planned and addressed when burning in these areas to account for erratic fire behavior, increased escape risk, and extreme danger to the fire crew.

Smoke Management

Smoke management issues shall be addressed in the burn plan and smoke plume trajectory included on a map or sketch. All prescribed burning should be conducted in accordance with the air pollution control regulations contained in the Oklahoma Department of Environmental Quality statutes (http://www.deq.state.ok.us/rules/100.pdf).

Smoke management practices, strategies and techniques to consider for reducing or altering emissions or preventing excessive pollution include emission reduction, dilution and avoidance. Emission reduction involves fuel management practices, strategies and fire prescriptions to reduce available fuel loadings or improve combustion efficiency, along with firing and mop-up techniques to reduce emissions. Backing fires consume fuel more efficiently than head or flank fires, and produce roughly one-third of the smoke of a head fire. Scheduling fires when larger fuels, such as logs or stumps, are too wet to burn also reduces emissions. Carbon release will be minimized by considering the timing of the burn as well as burn intensity (e.g. low-intensity burning will minimize carbon release). Dilution involves reducing smoke concentrations by diluting smoke through a greater volume of air, either by scheduling fires to enhance convection or dispersion by burning during good dispersion conditions or burning at slower rates (burning smaller strips or smaller areas). Mid-day burns will typically have better ventilation rates than early morning or late evening burns. Avoidance involves scheduling the burn to ensure that the smoke plume trajectory moves away from sensitive areas as well as avoiding burns on days where a temperature inversion or a stagnant high-pressure system is in place.

Atmospheric stability is the degree to which vertical motion in the atmosphere is enhanced or suppressed. An unstable atmosphere (often characterized by clear skies and cumulus clouds) enhances vertical motion, thus increasing mixing (smoke rising to higher altitudes) and dispersion of the smoke. A stable atmosphere (characterized by overcast skies and stratus clouds) suppresses vertical motion, thereby limiting dispersion of the smoke (smoke stays close to the ground). When smoke management is critical, burning should occur when conditions are good for rapid dispersion of smoke. The atmosphere should be somewhat unstable so the smoke will rise and dissipate, but not so unstable as to be problematic in controlling the burn.

Prescribed fires usually should not be set during periods when the National Weather Service issues an Air Stagnation Advisory, an Ozone Alert, unhealthy or hazardous Air Quality Index, fire weather Category Day 1 or 2, or the Oklahoma Mesonet forecasts moderately poor or worse dispersion conditions. Typically, smoke will “lie” close to the ground causing poor air quality and visibility during these periods. For current information and forecasts on air quality and dispersion refer to http://www.airnow.gov/ or http://okfire.mesonet.org/.

Nighttime burning is usually not recommended because visibility and smoke dispersion are usually worse at night. Typically, winds lessen or calm completely at night, temperature declines, relative

humidity increases, causing residual smoke to stay near the ground. Smoke will tend to flow downhill, down-slope or down-drainage and settle in low areas contributing to heavy smoke fog, which creates hazardous road conditions and can “smoke out” a town. Should a large acreage burn extend into the evening and night, consider the following recommendations: (1) burn in light fuels, (2) use backing fires, (3) burn when humidity is less than 80%, (4) burn when surface wind speed is greater than 4 miles per hour, and (5) monitor downhill and low areas for smoke concentrations. Residual smoke associated with the smoldering of larger slash or woody fuels can cause serious visibility problems, especially at night.

Heavy, thick, carbon-laden smoke can cause dangerous discharges (arcing) from overhead electrical transmission lines under certain conditions. Avoidance, dilution and emission reduction are the key management techniques to enhance safety where power lines exist. Extreme caution should be exercised when burning around these lines. Divide the burn unit so the power line right-of-way is not included in the burn, or use alternative firing methods and techniques (backing fire) to reduce the smoke emissions into the lines. Extreme care and caution must be exercised when using water in units with power lines. Water conducts electricity very easily and can be hazardous to crew members using devices that spray water. Another concern is that the potential exists for power lines to be downed during a prescribed fire due to vehicles colliding with the poles or poles being burned. Once a line is down, serious hazards exist from electrocution or serious shock injury (either from the line itself or potentially from a fence if the line falls on a fence wire). The potential for spot fires to start from the downed lines arcing is also increased. Proper planning prior to the burn must address or alleviate these hazards. All utilities should be identified on the burn plan map so that crew members are aware of the location of potential hazards. Telephone lines in addition to oilfield locations, along with oil and gas pipelines should be identified, as there could be unknown leaks at the locations or along the lines. The intent is to prevent damage to the utility and avoid personal injury.

The distance downwind influenced by smoke depends on many factors such as fuel load, fuel type, transport winds, fuel moisture, slope, burn area, firing techniques used (head fire, back fire, etc.), brush piles or other heavy fuels being burned and the atmospheric mixing conditions. Category Day is determined by the ventilation rate of the atmosphere which takes into account the afternoon mixing height of the atmosphere and the transport wind speed. This determines how high and how well the smoke mixes with the atmosphere and is transported aloft. The Category Day may be obtained from the National Weather Service fire weather forecast website at http://www.srh.noaa.gov/oun/?n=fireweather. Keep in mind that liability related to a prescribed burn includes the smoke produced from that burn. Burns conducted adjacent to areas of concern or near smoke sensitive areas must be burned when the wind direction is steady and persistent in a favorable direction throughout the entire burn including the mop-up phase.

Further smoke management planning information and knowledge enhancement may be attained by referring to http://www.forestry.ok.gov/rxfire-smoke-mgmt, http://www.forestry.ok.gov/Websites/forestry/images/E-1008_Smoke_Management.pdf and http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046311.pdf.

Firewhirls

Firewhirls can be caused by burning under “low-wind” or “no-wind” conditions, burning headfires into backfires, burning flank fires into backfires when the two converge at acute angles to each other, and burning in canyons and hilly or mountainous terrain. The burn plan should take these features into consideration, and avoid using firing techniques that encourage firewhirl formation. When the potential exists for firewhirls, provide the necessary safeguards in vulnerable locations (additional spotters, extra pumper truck, etc.), and ensure sufficient blacklines exist in those areas. Proper planning should minimize or eliminate zones where fires converge near burn area boundaries.

Wildlife Considerations

When wildlife habitat improvement is an objective, refer to the appropriate Habitat Appraisal Guides or the Oklahoma NRCS Upland Wildlife Habitat Management (645) conservation practice standard for the desired plant community for the management species desired. Prescribed burning is highly recommended for wildlife habitat management by manipulating or managing vegetation for the benefit of the wildlife species. Fires that create a mosaic of burned and unburned areas tend to maximize the heterogeneity of the area, which promotes optimum habitat for a variety of species. Selecting the proper size, frequency, and timing of burns are the most crucial factors in the successful use of fire in wildlife habitat improvement. Where burning may disturb nesting and feeding cover, adjust the timing to address this wildlife consideration or adjust the plan to reduce the area disturbed. Fall and winter burns generally favor the forb component in mixed stands, and help improve vegetation structure and habitat diversity. Burning in the spring and fall of the same year greatly reduces stands of cool-season grasses.

Consider patch burn grazing as an alternative for improving wildlife habitat and livestock grazing distribution. Patch burn grazing is the application of prescribed fire and livestock grazing used to create a shifting mosaic of fire and grazing across a landscape. The burn pattern varies seasonally and/or annually to increase the diversity and structure of vegetation in a way to benefit wildlife and maintain livestock production. Refer to Oklahoma NRCS Technical Note Range OK-16, “Patch Burn Grazing Information Sheet”.

Brush Piles and Volatile Fuels

Brush pile burning poses long-term hazards and increased potential for fire to escape. Brush piles emit firebrands (live glowing embers) constantly while burning. This poses a threat of escape when they are located near the perimeter of the prescribed burn unit or when they are still actively burning (includes smoldering) when a storm or front approaches with strong winds. Brush piles should be disposed of (burned prior to the prescribed burn, ground up or hauled off-site), moved well into the burn area, or protected with adequate firebreaks and not burned with the prescribed burn. If dozing or cutting brush is required while preparing firebreaks, and piling is absolutely necessary, keep the piles as small as possible and away from the perimeter. It is preferred that they are excluded from the burn unit or scattered throughout the burn unit rather than being piled, when practical. For the purposes of planning a prescribed burn that involves brush piles, consider the brush piles as volatile fuels. Refer to the Oklahoma NRCS Firebreak (394) conservation practice standard for specific requirements.

Dead and downed trees should be moved well into the burn unit away from the perimeter. Standing dead snags that are near the perimeter should be pushed down or cut down and moved well into the burn unit.

When burning volatile fuels such as cedar, greenbrier, weeping lovegrass, blooming plum thickets, blackberries, etc.; wider firebreaks will be planned according to the Oklahoma NRCS Firebreak (394) conservation practice standard.

Notifications

As a matter of courtesy and to limit liability, it is the landowner’s responsibility to notify all adjoining neighbors, fire departments, sheriff departments, 911 dispatch centers, public safety officials, utility companies and/or oil companies when their equipment is present in the burn area, etc., prior to the burn. Neighbors include all adjoining landowners, and other neighbors in the downwind airshed of the burn that may be impacted from the smoke trajectory (typically the first ¼ to ½ mile is the most critical, but may need to be extended if known conditions exist with residents in the downwind area). Check with your local county officials as sometimes the 911 dispatch system may be operated by the sheriff’s department, and sometimes they are separate and each will need to be notified. Notify utility or oil company personnel well before the intended date of the prescribed burn to allow them to implement contingency plans that minimize hazards to people and resources in and near the burn area. As a minimum, they need to be aware that a prescribed burn will be occurring.

Planning and Management Considerations

For specific purposes and conditions for burning, see Table 2, Criteria for Burning.

The pre-burn vegetation cover must be considered when planning a burn, as it is one of the main components affecting fire behavior. Deferment from grazing may be necessary on certain areas in order to provide an adequate amount of fine herbaceous fuels to carry the fire and meet specific management objectives. Refer to the site-specific Ecological Site Descriptions for the proposed burn unit for an estimate of production potentials for rangelands in various states or conditions. In many situations involving light fuel loads, continuity is more important for a continuous fire front than fuel loading.

The burned area must be incorporated into a system of management that allows the desired response of the plant community. Refer to the Oklahoma NRCS Prescribed Grazing (528) and Forage Harvest Management (511) conservation practice standards and specifications. Timing and frequency of burning are the most critical elements for obtaining the desired results. The kinds and amounts of the various plants in an area are changed by these key elements of fire.

When patch burn grazing is not being implemented and a portion of a pasture is burned, typically grazing management would be based on the burned area within the context of the long-range management plan. Burning will alter grazing patterns by drawing livestock to the burned area, but it can be used as a management tool to help mediate erosion on heavy use areas, or maintain wildlife habitat.

Although historical burns likely occurred at all times during the year, be cognizant of wind erosion concerns on sandy soils during periods subjected to severe wind erosion. Erosion on other soil types usually is related to slope and topography of the landscape. Typically following a burn sufficient plant materials remain to prevent excessive erosion, as long as adequate soil surface moisture is present. Timing of burning should be commensurate with soil and site conditions to maintain site productivity and minimize effects on soil erosion and soil properties. After a rain, once fuel is dry enough to carry a fire, the soil is generally moist enough to protect much of the litter and plant crowns from burning or being damaged. The soil rooting zone should have enough moisture to support recovery of the desired plant species following the burn.

Burning in the summer or fall or during dry conditions has been observed to cause crown damage to bunchgrasses, however this may be an objective for the burn.

Sometimes unwanted pest plants increase following burning (e.g. sericea lespedeza). Remedial action should be considered to prevent an increase in unwanted invasive plants. Likely an integrated approach will be required involving fire, herbicides and grazing. Refer to the Oklahoma NRCS Integrated Pest Management (595) and Prescribed Grazing (528) conservation practice standards and general specifications for management options of pest plants.

Prescribed fire is only one alternative in an overall resource management plan. The decision to burn should consider and be compatible with the long-term objectives of the resources and be directed toward specific management objectives of the client. In most instances, a long-term regime of prescribed burning will be needed to achieve objectives rather than a single burn.

The National Weather Service will issue “Red Flag Alert” days when potentially hazardous conditions exist that may allow fires to escape easily. These are not a “burn ban”, but are intended to alert people of potential problems should the fire escape. It simply means that burning may be more risky than normal due to the weather conditions (e.g. high winds, low relative humidity, high air temperature, dry fuels, and overall dry conditions to create intense or aggressive fire behavior).

If down-wind spotfires from volatile fuels are a concern, conduct the burn with lower air temperature and higher relative humidity. This is where the 60:40 rule of thumb comes into play. The 60:40 rule is simply burning when the temperature is below 60˚F and relative humidity above 40% as these

conditions tend to offer some built-in safety. This rule is a good starting point for safety when dealing with volatile fuels, but depending on fuel loads and other parameters of the burn, the temperature and relative humidity may be adjusted further. Also, these conditions are a good starting point for beginning burners. (See **Figure 1** - Distance of Spotfires Relative to Temperature; **Figure 2**, - Percent Probability of Spotfire Occurrence; and **Table 1** - Spotfire Risk and Planning Strategy, for further details on the risk of spotfires in relation to the 60:40 rule).

Plans and Specifications

As mentioned in the standard, written specifications will be prepared by certified individuals and be prepared and recorded for each site using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

Prescribed burn plans shall be developed using the Oklahoma Conservation Practice Job Sheet 338 01, “Prescribed Burning” for the Prescribed Burning Management Plan. All burn plans shall include all of the necessary details, instructions and descriptions that provides the specific information to safely conduct the prescribed burn. All necessary permits must be obtained and a burn plan developed before implementation of the practice.

Prescribed fire is very complex and should only be used by properly trained individuals. All Natural Resources Conservation Service (NRCS) employees must have the proper certification, authority and training to plan and/or to participate in any prescribed burning activities. Refer to General Manual, Title 190, Ecological Sciences, Part 413.

The first consideration in planning for a prescribed burn is always **SAFETY.** With safety at the forefront, planning for a prescribed burn often begins a year or more prior to the burn taking place. The importance of planning cannot be over-emphasized! Detailed planning is required for conducting all prescribed burns. The incomplete assessment of any factor can cause personnel safety issues, natural resource damage, or pose serious liability questions should the fire escape or its smoke cause damage.

The NRCS employee(s) designing and approving the burn and the client shall sign the burn plan. With their signature, the NRCS client acknowledges acceptance of full liability resulting from the implementation of recommendations made by NRCS.

Operation and Maintenance

The kinds and expected variability of site factors (e.g. fuel conditions, moisture content, weather conditions, human and vehicular traffic that may be impeded by heat or smoke, liability, and safety and health precautions) shall be monitored during the operation of this practice. Sufficient fire suppression equipment and personnel shall be available commensurate with the expected behavior of these factors during the time of the burn to prevent an escaped fire or other safety, health or liability incident.

The client (landowner or their designee) must be on-site throughout the prescribed burn period and is responsible for any damages caused as a direct result of the prescribed burn whether it is from the fire or from the smoke generated by the fire. NRCS personnel <u>will not</u> serve as the client’s designee.

All burn crew members will wear flame resistant clothing (cotton, wool, Nomex), leather gloves, hat or cap, and leather boots (preferably high top, lace-up leather boots). Polyester or nylon clothing, tennis shoes, sneakers, sandals, shorts or other inappropriate burn clothing <u>shall not</u> be worn. Protective eyewear such as safety glasses or goggles is desirable. For crew members in smoky areas, a dust mask, aspirator, or a breathing apparatus may be desirable. Adequate fluids should be consumed during the prescribed burn to avoid dehydration.

Prescribed burning can be physically strenuous, stressful and demanding. All crew members should be in good physical condition to enable them to perform all necessary assigned tasks. People with known health issues must not participate in any activity that could aggravate that known condition.

Should a medical emergency occur some people would have to be pulled away from the fire to provide emergency assistance; this reduction in personnel could result in an escaped fire.

Summertime prescribed burns (growing season burns) can produce working conditions which many times may exceed the typical working conditions of a dormant season prescribed burn. Working conditions resulting from higher temperatures, or sometimes higher relative humidities, and wearing fire resistant clothing shall be discussed with the clients and crew members conducting burn activities under these growing season conditions. The fireboss should consider crew safety at all times during growing season burn conditions. An alternative to consider is to have extra crew members present. With extras, crew members can work for a while, then swap out and let the others work while giving each other some resting and cool-down time. Keep swapping out crew members until the burn is complete to provide those resting periods. Also to reduce the amount of heat stress on crew members have everyone ride on some type of vehicle whenever possible. Proper hydration is a key to crew safety when conducting summer burns.

The fireboss will be the sole leader and coordinator of all prescribed burning activities. If the fireboss is not satisfied with the firebreak preparation, fire prescription, personnel, weather conditions, or any other aspects of safety, then the burn shall be postponed. The fireboss shall be able to answer “go” to all questions on the “go/no-go checklist” prior to igniting the test fire. The burn shall not be ignited until all precautions have been taken and all personnel on site are briefed on the burn plan and their responsibilities during the burn. All personnel should know what is happening, when it is happening, and have clear and concise instructions on the procedures for conducting the burn. Everyone should also know the proper operation of the equipment, know the contingency plan should the fire escape, and know where the safe areas or safe zones are located. All crew members should have a map of the burn unit with them.

All necessary tools, equipment, and manpower necessary to conduct and contain the fire to the area planned for the prescribed burn will be on-site prior to ignition. All prescribed fire equipment will be tested for functionality prior to the burn. Typically all motors (pumps, ATV’s, pumper trucks, tractors, etc.) will be left running throughout the entirety of the burn.

Maintenance shall include “mop-up” or monitoring of the burn site and adjacent areas until ash, debris and other consumed material is at ambient air temperature. Smoldering materials such as cow chips, logs, dead trees (snags), stumps, fence posts, piles, etc. may smolder for several days after the burn if left untreated. Mop-up actions may include drenching with water or fire retardant, smothering with a covering of soil or sand, and/or breaking the fuels apart to speed up combustion and letting them burn out or aid in extinguishing the burning materials Mop-up procedures will continue until all “hot spots” have been extinguished as outlined in the burn plan. Be especially careful with burning materials near the perimeter of the burn unit by moving burning or smoldering materials a safe distance inside the burn unit, but also exercise caution of leaving burning or smoldering materials anywhere if a forecast calls for a frontal passage with strong gusty winds within several days following the burn. Elevated burning materials (snags, brush piles, tall stumps, etc.) throw embers farther than burning materials lying on the ground.

Once the resource objectives are met, a management program on grazing lands consisting of a grazing plan that helps maintain the desired plant community should be implemented. An integration of multiple methods such as targeted grazing, mechanical, biological and chemical treatments should be evaluated to achieve long-term maintenance of the resource goals. In general terms, a burning interval of every 3-5 years will keep most re-sprouting woody plants in check but more frequent fire may be necessary to open up established woody communities.

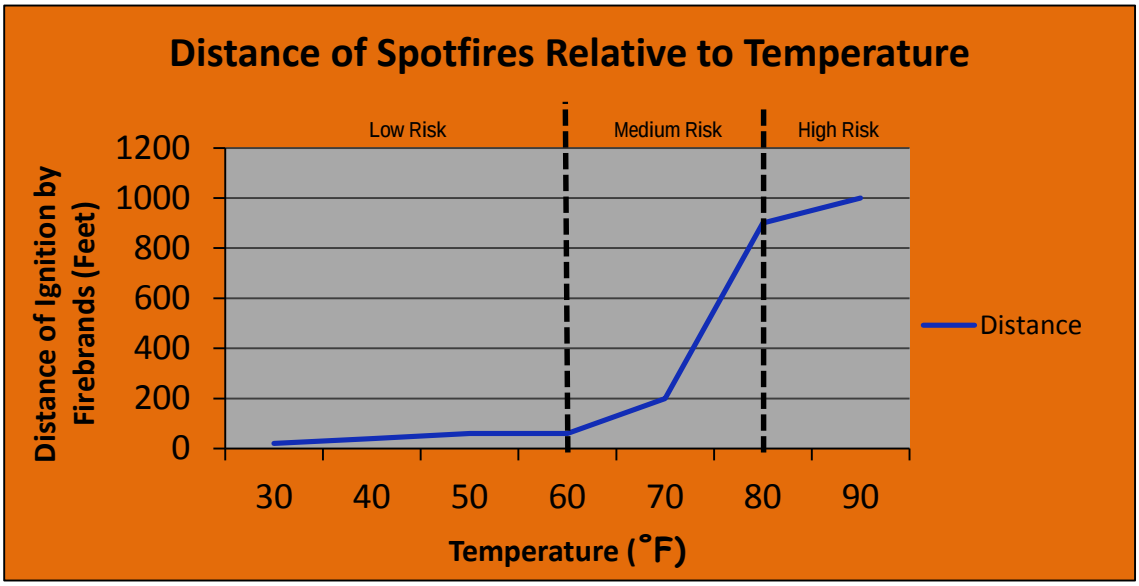

Figure 1. The maximum distance of spot fires from prescribed fires in relation to air temperature. Spotfires that started when temperatures were below 60 degrees F were primarily by flaming firebrands. (From Bunting and Wright 1974)
(Risk factors have been added to the chart to offer guidelines as to the risk associated with temperature.)

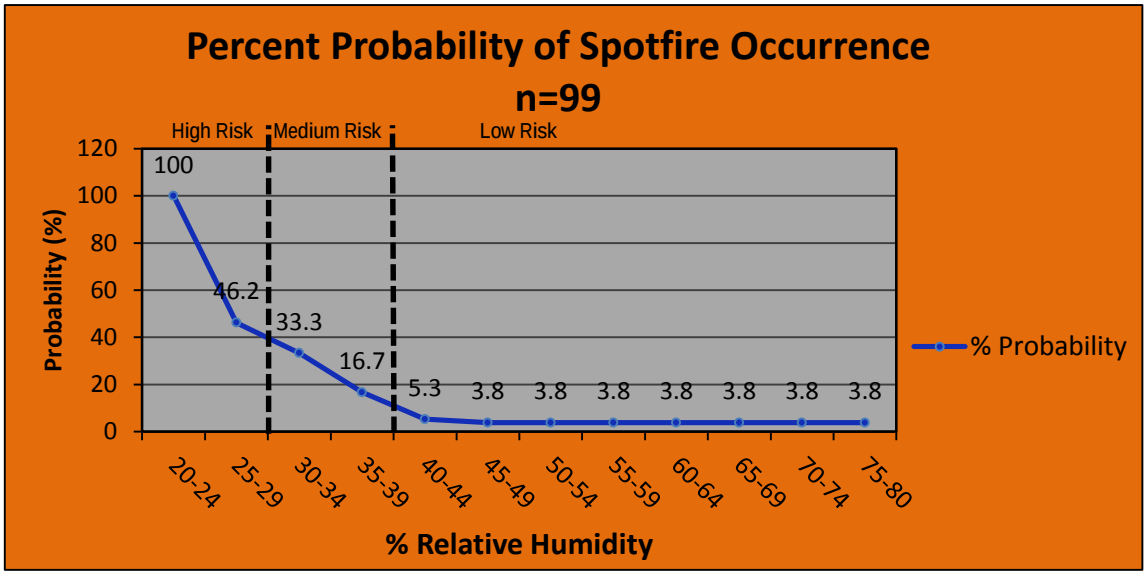

Figure 2. Spotfires were caused by fire brands from crowning cedar trees, fire brands from 60 ft. pine trees crowning, fire creeping across mowed lines, and oak leaves blown over the firebreak. Spot fires were related primarily to a critical level of relative humidity. (From Weir, 1999)
(Risk factors have been added to the chart to offer guidelines as to the risk associated with humidity.

TABLE 1. - SPOTFIRE RISK AND PLANNING STRATEGY

Spotfire Risk	Burning Conditions	Planning Considerations and Guidelines
Low Risk	*Air Temperature: < 60º F* *Relative Humidity: >40%* *(60:40 Rule)*	*The probability of spotfire occurrence is <5% chance. Spotfires will typically be at distances <100 feet from the prescribed fire (depending on the wind velocity). The minimum total width of the downwind firebreak should be 100 ft. for burns that are planned under these conditions. If the burn cannot be applied under these conditions (actual conditions on day of burn different than planned), additional width should be incorporated in the firebreak, additional crew members should be present and located as spotters at vulnerable locations, and additional equipment should be on hand to manage the increased potential for spotfires. The burning of brush piles should be safe if they are located well within the burn area.*
Medium Risk	*Air Temperature: 60-80º F* *Relative Humidity: 30-40%*	*The probability of spotfire occurrence is ~25% chance. Spotfires can be started by flaming firebrands and easily carried downwind up to 750 feet (depending on the wind velocity). The minimum total width of the downwind firebreak should be 500 feet for volatile fuel burns that are planned under these conditions. If the burn cannot be applied under these conditions (actual conditions on day of burn different than planned), additional width should be incorporated in the firebreak, the presence of additional crew members is suggested so that extra spotters can be located at vulnerable locations, and additional equipment should be on hand to manage the increased potential for spotfires. Utilize the strip-head-firing technique to burn smaller areas to increase blackened areas for safety. The burning of brush piles has greater risk and the probability of spotfires increase over longer distances. Use extreme caution if brush piles are involved.*
High Risk	*Air Temperature: >80º F* *Relative Humidity: <30%*	*The probability of spotfire occurrence is ~50% chance when the relative humidity is between 25-29%. When the relative humidity is <25%, there is a 100% chance that spotfires will occur. Spotfires are significantly more common and firebrands can travel at distances up to and exceeding 1000 feet downwind. The minimum total width of the downwind firebreak should be 500 feet for burns that are planned under these conditions. If the burn cannot be applied under these conditions (actual conditions on day of burn different than planned), additional width should be incorporated in the firebreak, the presence of additional crew members is essential so that extra spotters can be located at vulnerable locations, and additional equipment must be on hand to manage the increased number of spotfires. It is critical that smaller areas are burned utilizing the strip-head-firing technique to increase the size of the blackened areas for safety. A consideration is to burn the entire area with strip-head-fires or a backfire. Another consideration would be to pre-burn areas downwind prior to actually burning the unit under these conditions. If none of this is possible postpone the burn and wait for safer conditions. The burning of brush piles will be exceptionally risky and is not recommended under these conditions.*

Burns with higher temperature and lower relative humidity should be implemented by experienced firebosses and fire crews. The concern is how large the spotfire gets before it can be stopped. This will depend upon fuel load, wind speed, crew size, crew experience, dependability of equipment, and how soon the spotfire is discovered. The primary question that the fireboss should ask before lighting the fire is “Can the fire crew control this fire if it escapes?”

TABLE 2 - CRITERIA FOR BURNING

These prescriptions are general and cover a wide geographic area. Prescribed burn plans shall be developed based upon site-specific conditions, goals and objectives. Resource management objectives determine the timing and intensity of the fire. Depending on the objectives, a "hotter" or "cooler" fire may be needed. The prescription should be planned for the proper season, type (headfire, backfire, etc.), frequency, temperature, wind speed, and relative humidity to give the desired results. The following table gives general information for prescriptions. All of these general prescriptions are designed to meet one or more of the purposes for prescribed burning: control undesirable vegetation; prepare sites for harvesting, planting or seeding; control plant disease; reduce fuel hazards that lead to wildfire; improve wildlife habitat; improve plant productivity, health and vigor; remove slash and debris; enhance seed and seedling production; facilitate distribution of grazing and browsing animals; restore and maintain ecological processes and ecological site integrity; and protect air quality from wildfire smoke impacts. For various purposes involving forestland or woodland sites in the Organized Forest Fire Protection Area, development and/or approval of fire plans should be done in direct consultation with the local office of the ODAFF-OFS. (Refer to map in eFOTG – Section 1 – Maps)

Vegetation Type and Specific Purpose	Season	Wind Speed (mph)		Relative Humidity (%)		Air Temperature (ºF)		Fine Fuel (lbs/ac) 2/	Frequency of Burning
		Optimum	Maximum Range	Optimum	Maximum Range	Optimum	Maximum Range		
Installation of Blacklines for all purposes and vegetation types 1/	Anytime	4-8	4-15	40-60	30-80	40-60	35-95		
Annual Herbaceous Plants Set-back (Grasses or Forbs; Cool-season or Warm-season)	After plants germinate, but before area is too green to burn; or after plants are dry, but before seed matures.	6-12	4-20	30-50	20-80	60-80	35-110	2000+	As needed.
Annual Threeawn During Greenup (w/20% or more desirable grasses) 4/, 8/	After germination and before area is too green to burn	6-12	4-20	30-50	20-80	60-80	35-110	2000+	Annually for 3-5 years or until desired results are achieved.
Annual Threeawn Before Seed-Drop (w/20% or more desirable grasses) 5/, 8/	After plants are dry, but before seed shatters in late summer or early fall.	6-12	4-20	30-50	20-80	60-80	35-110	2000+	Annually for 3-5 years or until desired results are achieved.

Vegetation Type and Specific Purpose	Season	Wind Speed (mph)		Relative Humidity (%)		Air Temperature (ºF)		Fine Fuel (lbs/ac) 2/	Frequency of Burning
		Optimum	Maximum Range	Optimum	Maximum Range	Optimum	Maximum Range		
Broomsedge Bluestem (w/20% or more desirable grasses) 6/, 7/, 8/, 17/	8/15 to 11/15	6-12	4-20	20-30	20-80	80-90	35-110	2000+	Annually for 3-5 years or until desired results are achieved. Dry fuel and topsoil are preferred.
Broomsedge Bluestem (w/20% or more desirable grasses) 8/	During green-up, but before area is too green to burn	6-12	4-20	30-50	20-80	60-80	35-110	2000+	Annually for 3-5 years or until desired results are achieved.
Cool-Season Grass Stimulation 3/	Late summer to early fall during dormancy	6-12	4-20	30-50	20-80	40-60	35-110	2000+	As needed.
Cool-Season Grass Set-back in Warm Season Vegetation	Late winter to early spring	6-12	4-20	30-50	20-80	40-60	35-110	2000+	As needed
Eastern Redcedar or Ashe Juniper (<6' tall) 11/, 12/, 15/	Anytime	6-12	4-20	30-50	20-80	60-80	35-110	2500+	Every 3-5 years or as needed.
Eastern Redcedar or Ashe Juniper (>6' tall) 11/, 12/, 15/	Anytime	10-15	4-20	20-40	20-80	60-80	35-110	3000+	Every 3-5 years or as needed.
Eastern Redcedar or Ashe Juniper (Downed and dead); ideally >3 weeks after cutting or pushing, but before leaves fall off)	Anytime	6-12	4-20	60-80	50-90	40-70	35-80	2000+	Typically a one-time application following mechanical brush management. Burning with lower temperatures and higher humidities will lower the risk of spotfires.
Improve Woody Browse and Structure	Mid Nov. to 3 weeks prior to green-up of browse is optimal, but can be burned anytime	6-12	4-20	30-50	20-80	60-80	35-110	2000+	Approximately every 3-4 years or as needed to allow the resprouting woody plants to increase.
Increase Forbs	Winter, prior to spring green-up or late summer into early fall	6-12	4-20	30-50	20-80	60-80	35-110	2000+	Approximately every 1-3 years depending upon need.

Vegetation Type and Specific Purpose	Season	Wind Speed (mph)		Relative Humidity (%)		Air Temperature (ºF)		Fine Fuel (lbs/ac) 2/	Frequency of Burning
		Optimum	Maximum Range	Optimum	Maximum Range	Optimum	Maximum Range		
Loblolly Pine - Thin, Increase Survival, Suppress Hardwoods - Low Intensity Backfires or Small Strip Headfires	Winter to green-up	6-15	4-20	40-60	30-80	35-45	35-65	2-3 Tons	Not before 10 years old. Kills trees <4" diameter. After 10 years old, burn at 5-10 year intervals to suppress hardwoods.
Mesquite (slick bark or following aerial spraying)	Anytime, with growing seasons burns having the most impact when adequate fuel is present.	6-12	4-20	30-50	20-80	60-80	35-110	3000+	At least every 3rd year until desired level of control is achieved. Thereafter, as needed for desired level of suppression.
Mesquite (converting mature trees to a savanna; moderate fine fuel loads) 14/	January to March (before area is too green to burn)	10-15	8-20	30-40	25-45	55-65	45-75	1300+	Approximately every 3-5 years.
Mesquite (converting mature trees to a savanna; limited fine fuel loads) 14/	January to March (before area is too green to burn)	12-18	10-20	25-35	20-40	60-70	55-80	850-1300	Approximately every 3-5 years.
Mixed Brush Communities such as: Blackberry, Buckbrush, Sand Sagebrush, Sumac, Plum, or other Mixed Brush Species	Anytime	6-12	4-20	30-50	20-80	60-80	35-110	3000+	Initially every one or two years until desired level of control is achieved. Thereafter, every 3-5 years as needed to maintain desired level of suppression.
Pinion Pine/Rocky Mountain Juniper 11/, 12/, 15/	Anytime	6-12	4-20	30-40	20-60	60-70	50-80	600+	Approximately every 5-10 years, if needed.
Oaks - Mature	Fall, Winter, Spring	10-15	4-20	30-50	30-80	40-60	35-70	2500+	9/, 14/
Oaks - Postoak, Blackjack Oak and Associated Hardwoods 16/	Anytime	10-15	4-20	30-50	20-80	50-80	35-110	2000+	Prior to canopy closure which limits fuel loading and/or in years with heavy hardwood leaf litter with dry fuel conditions. Growing season burns with adequate fine fuel loads works well.
Prickly Pear Cactus (light pear cover; adequate fine fuel)	Winter to green-up	6-12	4-20	30-50	20-80	60-80	35-110	2000+	As needed.

Vegetation Type and Specific Purpose	Season	Wind Speed (mph)		Relative Humidity (%)		Air Temperature (ºF)		Fine Fuel (lbs/ac) 2/	Frequency of Burning
		Optimum	Maximum Range	Optimum	Maximum Range	Optimum	Maximum Range		
Prickly Pear Cactus (heavy pear cover; limited fine fuel) 17/	Fall	10-15	4-20	20-40	20-60	80-95	60-110	850+	As needed.
Redberry Juniper 11/, 12/, 13/, 15/	Anytime	6-12	4-20	30-50	20-80	60-80	35-110	2500+	Before growth reaches 6' or seedlings reach 7 years of age.
Saltcedar (Tamarisk) 18/	Anytime; dry soil moisture is optimum.	6-12	4-20	30-50	20-80	60-80	35-110	2500+	Every 2-5 years or as needed.
Sand Shinnery Oak 10/	Anytime	6-12	4-20	30-50	20-80	60-80	35-110	3000+	Approximately every 2-3 years to maintain open stands and preserve fuel loading.
Shortleaf Pine (to trigger resprouting and suppress hardwoods)	Anytime	6-12	4-20	30-50	20-60	45-70	35-80	2000+	Approximately every 3-5 years.
Warm-Season Grasses 3/	Anytime	6-12	4-20	30-50	20-80	60-80	35-110	2000+	Every 1-3 years or as needed to meet specific objectives.

FOOTNOTES

1/ It is recognized that the installation of blacklines is typically done during safe burning conditions following the 60:40 rule, however they can be installed with nearly any prescription so long as all factors involved are assessed appropriately and additional safety measures are applied. The maximum ranges are included for use when conditions are warranted for specific objectives. Examples of factors that may be assessed include but not necessarily limited to combinations of firebreak width, fuel load, relative humidity, wind speed, amount of equipment, quality of equipment, number of personnel on the fire crew, experience of the fire crew, etc. The prescribed burn plan will address these measures adequately and the fireboss in charge of the burn should ensure all requirements of the burn plan are in place prior to ignition.

2/ Fuel continuity must be considered along with fuel loading. If a complete burn is the objective, continuity must be high. If a mosaic burn is desired there should be areas of discontinuous fuel or appropriate firebreaks. Fuel loads listed are the minimum level required to achieve satisfactory results. Burning may be accomplished with less fuel loads, but results will be variable and/or a mosaic burn will be the result.

3/ For forage production burns, the area should be in high vigor and should have adequate fuel to carry the fire with continuity. The upper surface of the soil should be sufficiently moist to allow rapid forage regrowth, but the fine fuels should be dry enough to carry the fire. These conditions typically occur 1-3 days following the passage of a front that has produced 1/2 to 1 inch of rainfall.

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

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5/ The standing seed crop of the annual threeawn will be destroyed if burned before the seeds fall to the ground.

6/ Burning during dry periods can damage the crown of broomsedge bluestem and shift the successional advantage to rhizomatous grasses as long as the desirable grasses exist.

7/ Fall burning of broomsedge bluestem will tend to break the allelopathic cycle and allow desirable plant communities to re-establish. Fall burning will reduce winter forage availability and increase the opportunity for cool-season annual plants to germinate. Reduced forage should only impact the dormant season after the burn. This effect should only last the season after the burn.

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

9/ Burning in mature oak stands will thin the understory and very gradually thin the overstory. Burning is best accomplished soon after leaf-drop and before leaves become weathered and matted down by winter storms. Dry, low relative humidity weather conditions should exist 7-14 days prior to the burn so that leaf litter has an opportunity to adequately dry out. It will take many years and multiple burns to open up the overstory with burning alone. Burning initially can prune lower limbs and scar the bark on the base of trees, which starts the process of disease invasion. Gradually, as sunlight penetrates to the ground, herbaceous vegetation increases and with prescribed grazing accumulates fuel loads for subsequent hotter burns.

10/ Sand shinnery oak generally returns to pre-burn status within 2 - 3 years following a single burn. However, multiple burns begin to reduce shinnery stature and increase herbaceous composition. Integrated treatments of fire, goats, and herbicides may be considered to reach a desired objective.

11/ Green juniper leaf moisture should be less than 70% to aid in accomplishing a higher level of success. Leaf moistures higher than 70% requires too much time for fire to evaporate their moisture and raise the leaf and cambium temperature required to be lethal.

12/ A canopy crown fire may develop when juniper canopy exceeds 30%. Other brush management alternatives should be considered when juniper canopies exceed 30%.

13/ Research indicates that following mechanical control, Redberry Juniper seedlings can be effectively controlled with fire until they reach approximately 7 years of age or 3 feet tall, when the bud zone becomes covered by soil. This may happen more quickly on deeper soil sites and less quickly on shallow, rocky sites. Burning Redberry Juniper when they are greater than 6 feet tall or greater than 7 years old can be effective in reducing canopy, but bud zone kill should not be expected.

14/ Savannas can be created utilizing low-intensity fires. The goal is to maintain 30-60% of the foliage and not top kill the trees. Top killing causes resprouting species to basal sprout and form a multi-stemmed thicket. By utilizing low-intensity fires and maintaining 30-60% of the foliage, the trees will maintain apical dominance and have very little basal sprouting. After several fires, the lower limbs are pruned to create what appears to be a browse line. The desired “savanna” effect will likely take 3 to 4 fires in a 10 to 15 year period. Repeated low-intensity fires approximately every 3-5 years will prevent increases in density by maintaining suppression of shorter, top-killed trees and killing some seedlings and seeds on the ground. Burn prescriptions are very specific to achieve the desired results and any other conditions that create hotter fires (e.g. slower wind speed, lower relative humidity, higher air temperature, heavier fine fuel loads) will likely cause greater top kill and potentially induce basal sprouting.

15/ Fire behavior and fireline intensity are more important for top-killing or scorching small trees than seasonality (dormant season vs. growing season burns).

16/ Maintenance and follow-up are particularly important. In many cases, a long-term regime of prescribed burning will be needed to achieve the objectives, not one or two burns. Multiple burns or a combination of burning, mechanical, and/or biological brush management will be needed to achieve the objectives.

17/ With these conditions, the burn is in the “high risk” category. See Table 1.

18/ For headfires in Tamarisk, the 10 hour time lag fuel moisture should be 5% or less. With these conditions, spotfires are certain, so additional crew members and more equipment will be required.

REFERENCES AND OTHER READING MATERIAL

Ansley, R. J., J. F. Cadenhead, B. Kramp. 1996. Mesquite Savanna: A Brush Management Option. Texas Agricultural Experiment Station, Vernon, Texas.

Bidwell, T. G., D. M. Engle, P. L. Claypool. 1990. Effects of spring headfires and backfires on tallgrass prairie. J. Range Manage. 43(3)209-212.

Bidwell, T. G., D. M. Engle, J. R. Weir, R. E. Masters, J. D. Carlson. 2004. Fire Prescriptions for Maintenance and Restoration of Native Plant Communities. Fact Sheet F-2878, OK Coop. Ext. Serv., OSU, Stillwater, OK

Bidwell, T. G., D. M. Engle, R. E. Masters, J. R. Weir. 2003. Fire Effects in Oklahoma. Fact Sheet F-2877, OK Coop. Ext. Serv., OSU, Stillwater, OK

Bidwell, T. G., J. R. Weir, D. M. Engle. 2002. Eastern Redcedar Control and Management – Best Management Practices to Restore Oklahoma's Ecosystems. Fact Sheet F-2876, OK Coop. Ext. Serv., OSU, Stillwater, OK

Bidwell, T. G., J. R. Weir, J. D. Carlson, M. E. Moseley, R. E. Masters, P. McDowell, D. M. Engle, S. D. Fuhlendorf, J. Waymire, S. Conrady. 2006. Using Prescribed Fire in Oklahoma. Circular E-927, OK Coop. Ext. Serv., OSU, Stillwater, OK.

Davis, R. et.al, 1991. Oklahoma's voluntary Smoke Management Guidelines. ODAFF, Forestry Div., Oklahoma City, OK.

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

Engle, D. M., J. F. Stritzke, T. G. Bidwell, and P. L. Claypool. 1993. Late-summer fire and follow-up herbicide treatments in tallgrass prairie. J. Range Manage. 46(6):542-547.

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

Engle, D. M., T. G Bidwell, J. F. Stritzke, and D. Rollins. 1990. Atrazine and burning in tallgrass prairie infested with prairie threeawn. J. Range Manage. 43(5)424-427.

Long, A. J. 1999. Benefits of Prescribed Burning, University of Florida.

Masters, R. E., J. Waymire, T. Bidwell, and K. Hitch. 2001. Effects of Timber Harvest and Fire Frequency on Integrated Land Management Options in the Ouachita Mountains. Dept. of Forestry, Oklahoma State University.

Ohlenbusch, P. D., J. W. Kunkel. 1996. Prescribed Burning Safety, Kansas State University.

Racher, B. 2003. Prescription Development for Burning Two Volatile Fuel Types. Dissertation in Range Science, Texas Tech University.

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

Weir, J. R. 2004. Probability of Spotfires During Prescribed Burns. Fire Management Today. 64:22-26.

Weir, J. R. 2006. Prescribed Fire Equipment and Spot Fire Training Manual. Circular E-989, OK Coop. Ext. Serv., OSU, Stillwater, OK

Weir, J. R., et.al, 2009. Oklahoma Prescribed Burning Handbook. Circular E-1010, OK Coop. Ext. Serv., OSU, Stillwater, OK

Weir, J. R., et.al, 2011. Burning in the Growing Season. Circular E-1025, OK Coop. Ext. Serv., OSU, Stillwater, OK

Weir, J. R., J. D. Carlson. 2011. Smoke Management for Prescribed Burning. Circular E-1008, OK Coop. Ext. Serv., OSU, Stillwater, OK

Weir, J. R., T. G. Bidwell. 2005. Prescribed Fire Associations. Fact Sheet F-2880, OK Coop. Ext. Serv., OSU, Stillwater, OK.

Wright, H. A., A. W. Bailey. 1982. Fire Ecology. John Wiley & Sons, Inc. NYC, NY

USDA-NRCS Electronic Field Office Technical Guide. eFOTG, Section 1, G. Maps. Oklahoma Forestry Services Fire Protection Area Map.

USDA-NRCS Electronic Field Office Technical Guide. eFOTG, Section 1, J. Laws. Notification Requirements & Considerations for Safe & Lawful Prescribed Burning in Oklahoma.

USDA-NRCS Directives. General Manual, Title 190, Part 413 – Prescribed Burning.

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