Arkansas Voluntary Smoke Management Guidelines

GUIDELINES FOR WHEN TO BURN AND HOW TO MANAGE SMOKE

Arkansas Forestry Commission

forestry.arkansas.gov

BEFORE YOU BURN, CALL 1-800-830-8015

ARKANSAS VOLUNTARY SMOKE MANAGEMENT GUIDELINES

Fire in Arkansas's forests—whether natural, accidental, or deliberate—has always been an important process in the ecology of the state. The use of prescribed fire (controlled burning) to accomplish specific natural resource management objectives—such as site preparation, removal of vegetation to reduce competition, wildlife habitat improvement, ecosystem restoration, and to reduce the hazard of wildfire—is regarded as an indispensable tool of the natural resource manager.

Today, nearly 6.4 million acres a year are burned by prescription in the southern United States, according to the Coalition of Prescribed Fire Councils. In Arkansas, approximately 300,000 acres are burned annually by prescribed fire.

REASONS FOR HAVING A SMOKE MANAGEMENT PROGRAM (SMP)

The purpose of the Arkansas Smoke Management Program (SMP) is to assure adherence to air quality standards and to manage smoke from prescribed fire to keep the smoke's impact on people and the environment within acceptable limits. In 1997, the Environmental Protection Agency (EPA) reported that fine particles (2.5 micrometers or smaller) have the potential to significantly impair human health when people are exposed to high levels. The fine particles that can impair human health can also reduce visibility in federally mandated Class I areas such as Caney Creek Wilderness Area and Upper Buffalo Wilderness Area, where the United States has established a goal to make reasonable progress at removing any human impairment of visibility. An estimated 70 percent of the particulate matter emissions in smoke are fine particles. Therefore, prescribed fire should follow these guidelines to limit public safety hazards posed by smoke intrusion into populated areas, prevent deterioration of air quality, prevent National Ambient Air Quality Standards (NAAQS) violations, and protect visibility impairment at Class I areas and other smoke-sensitive areas.

The purposes of the Arkansas Voluntary Smoke Management Guidelines (guidelines) are to assure adherence to air quality regulations and to manage smoke from prescribed fire so the smoke's impact on people will be acceptable.

These guidelines will allow the prescribed fire manager to minimize the impact of particulate matter released into the atmosphere by estimating how many tons of fuel may be consumed in an area. The amount of fuels that can be consumed in an airshed (36 square miles) is based upon the ability of the atmosphere to disperse the particulate matter, the distance downwind to a smoke-sensitive area and the tons of fuel being consumed.

These guidelines address when to burn and how to manage the smoke production, not how to burn. Prescribed fire is a complex tool and should be used only by trained and experienced in its use. Contact the Arkansas Forestry Commission (AFC) state headquarters at (501) 296-1940 to get a sample burn plan. Every prescribed burn should have a plan.

BURN NOTIFICATION

The AFC Dispatch Center coordinates prescribed fire activities, reports the fire weather and assists with smoke management. Prescribed fire managers must notify the AFC Dispatch Center on the morning of the prescribed fire by calling 1-800-830-8015.

The fire weather or forestry forecast is available on the National Weather Service web site at **www.srh.noaa.gov**. Here, you can determine which forecast office covers your area of Arkansas. The state is covered by five offices.

The AFC recommends that a prescribed fire manager prepare a written prescribed fire plan before starting a prescribed fire. On the day of a planned prescribed fire, the prescribed fire manager must provide the following information the AFC Dispatch Center:

1. person in charge of prescribed fire and how he/she can be contacted;
2. location of prescribed fire (Section, Township, Range or GPS reading and county);
3. number of acres to be burned;
4. purpose of prescribed fire (such as site preparation, either natural or artificial regeneration, hazard fuel reduction, wildlife habitat, ecosystem restoration, forage/grazing, or others);
5. fuel type and total available fuel loading to be consumed (see Smoke Management Procedures Step 1);
6. distance to nearest smoke-sensitive area; and
7. planned ignition time and duration of prescribed fire.

The AFC Dispatch Center will map each prescribed fire in the center of the airshed for purposes of complying with these guidelines. If the fuel tonnage for a single prescribed fire causes the fuel loading tonnage for a given airshed to exceed permissible limits, the AFC Dispatch Center will recommend to the prescribed fire manager that the plan should be altered (either by delaying the burn or reducing the acreage to be burned).

SMOKE MANAGEMENT PROCEDURES

The prescribed fire manager will take measures to keep the smoke's impact within acceptable limits.

The recommended procedure to accomplish this objective follows a four-step screening system:

1. determine fuel type and total available fuel loading;
2. identify nearest smoke-sensitive area;
3. determine category day; and
4. determine tons of fuel allocated to an airshed.

Step 1: Determine fuel type and total available fuel loading

The emission data needed by the AFC Dispatch Center is the consumption of "available" fuels for the entire burn. The prescribed fire manager may need to consider a higher fuel loading estimate than shown in Table 1 for forest stands that have been fuel-loaded by insects, diseases, tornadoes, ice storms, or other factors. Once the fuel type and fuel loading range are identified, multiply the available fuels value times the number of acres to determine the total available fuels to be consumed by the prescribed fire. (Available fuel loading per acre x total acres to be burned = total available fuel loading for the burn.)

Fuel Loading Range can vary by amount and age of fuels or number of years since last burned: low, less than 2 years since last burned; medium, 2 to 5 years; and heavy, 6 years or more. Fuel Loading Range for dispersed slash and piled debris is based on the prescribed fire manager's estimate of fuel loading.

Table 1. Common Fuel Types and Loadings and Typical Fuel Model Numbers (Table 1 is an average)

TYPICAL ARKANSAS TIMBER AND VEGETATIVE TYPES	FUEL LOADING RANGE	AVAILABLE FUELS (TONS/ACRE)
GRASS/BRUSH – FIRST FUEL TYPE TO APPEAR ON SITE PREPARED, BURNED, OR CUTOVER AREAS. ALSO APPLIES TO PASTURES, OLD FIELDS, OR YOUNG PINE STANDS WHERE GRASS IS THE PRIMARY CARRIER OF THE FIRE. (103, 105, 108, 123, 124)	LOW MEDIUM HEAVY	2.0 3.0 5.0
SHORTLEAF PINE REGENERATION – OVERSTORY COMPOSED OF IMMATURE SHORTLEAF PINE MIXED WITH SCATTERED OAK BRUSH. SURFACE FUEL IS MOSTLY GRASS, BRIERS AND LOW SHRUBS. (143, 144, 146, 148, 149)	LOW MEDIUM HEAVY	2.6 3.8 5.1
LOBLOLLY PINE REGENERATION – OVERSTORY COMPOSED OF IMMATURE LOBLOLLY PINE MIXED WITH SCATTERED OAK BRUSH. SURFACE FUELS ARE MOSTLY GRASS, BRIERS AND LOW SHRUBS. (143, 144, 146, 148, 149)	LOW MEDIUM HEAVY	4.4 7.6 8.5
SHORTLEAF/LOBLOLLY WITH GRASS – OPEN OVERSTORY COMPOSED OF LOBLOLLY OR SHORTLEAF PINE. AMOUNT OF GRASS OR LITTER WILL VARY WITH AGE OF THE STAND, DEGREE OF CROWN CLOSURE, AND AGE OF ROUGH. (106, 163)	LOW MEDIUM HEAVY	1.5 3.8 5.9
SHORTLEAF PINE WITH OAK – OVERSTORY COMPOSED OF SHORTLEAF PINE STANDS MIXED WITH OAK OR OAK/HICKORY. AMOUNT OF LITTER WILL VARY WITH THE AGE OF THE STAND, DEGREE OF CROWN CLOSURE, SPECIES AND AGE OF ROUGH. (181, 183, 184, 185, 188)	LOW MEDIUM HEAVY	3.0 4.0 4.4
LOBLOLLY PINE WITH OAK – OVERSTORY COMPOSED OF LOBLOLLY PINE MIXED WITH OAK OR OAK/HICKORY. AMOUNT OF LITTER WILL VARY WITH AGE OF THE STAND, DEGREE OF CROWN CLOSURE, SPECIES, AND AGE OF ROUGH. (181, 183, 184, 185, 188)	LOW MEDIUM HEAVY	6.4 6.8 7.9
HARDWOOD LEAF LITTER – OVERSTORY USUALLY COMPOSED OF OAK OR HICKORY WITH A MIXTURE OF OTHER HARDWOODS SUCH AS MAPLE, ELM, OR GUM. AMOUNT OF LITTER WILL VARY WITH THE AGE OF THE STAND, DEGREE OF CROWN CLOSURE, SPECIES, AND AGE OF ROUGH. (182, 186, 189)	LOW MEDIUM HEAVY	0.8 1.5 2.5
DISPERSED SLASH – NORMALLY FOLLOWS HEAVY THINNING, OR A CLEAR-CUT, WHERE DEBRIS IS NOT PILED. NEEDLE OR LEAF LITTER MAY OR MAY NOT BE PRESENT. LIMB-GATE PILES SHOULD BE EXCLUDED BECAUSE OF RESIDUAL SMOKE. (201, 202, 203)	LOW MEDIUM HEAVY	4.0 6.0 8.0
PILED DEBRIS – NORMALLY FOLLOWS LAND CLEARING OR TIMBER CUTTING WHERE ALL DEBRIS IS PILED. DUE TO HEAVY FUEL LOADING, FUEL SIZE AND ARRANGEMENT, AND INEFFICIENT BURNING, PILED DEBRIS PRODUCES GREATER AMOUNTS OF SMOKE AND PARTICULATE MATTER FOR LONG TIME PERIODS.	LOW MEDIUM HEAVY	5.0 7.5 10.0

(Fuel model numbers represent standard fire behavior fuel models described in U.S. Forest Service General Technical Report RMRS-GTR-153, June 2005. This publication is available online at **www.fs.fed.us/rm/publications/titles/rmrs_gtr.html**.)

Step 2: Identify the nearest smoke-sensitive area

Try to keep smoke away from smoke-sensitive areas. Examples are airports, highways, communities, Class I areas (see Glossary), recreation areas, schools, hospitals, nursing homes, and industries (especially facilities that emit sulfur dioxide—smelters, coal fired power plants, and factories with large boilers).

Follow these five steps to identify smoke-sensitive areas:

1. Locate on a map the prescribed fire and all potential smoke-sensitive areas, plus areas known to already have

air pollution problems. (Table 3 considers distance to smoke-sensitive areas from 0 miles to >20 miles from the prescribed fire.)

2. Determine the wind direction for the burn that will have the least impact on smoke-sensitive areas.
3. Draw a line representing the centerline of the smoke plume path using the wind direction chosen in step 2.
4. Determine the distance from the edge of the prescribed fire to the nearest smoke-sensitive area.
5. To allow for horizontal dispersion of the smoke, as well as shifts in wind direction, draw two other lines from the burn at an angle of 30 degrees from the centerline(s). For a small burn, draw as in Figure 1. For a large burn, draw as in Figure 2.

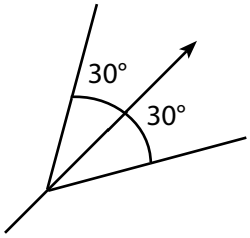

Figure 1. Small burn

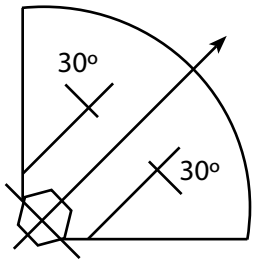

Figure 2. Large burn

Figures 1 and 2. Examples of how to estimate smoke plume dispersion for prescribed fire planning.

Planning and public notification are recommended when igniting large areas in a short amount of time, such as is done with aerial ignition. The heat produced from the prescribed fire may allow the smoke to penetrate above the mixing height where dispersion of the smoke is minimal. Smoke from these larger prescribed fires may travel long distances before descending to the ground. Therefore, it is important to monitor the smoke column downwind to determine if a problem will develop.

Step 3: Determine category day

The category day can be obtained from the AFC Dispatch Center or National Weather Service. See Table 2 for burning guidelines by category day.

Table 2. Category Day Burning Guidelines

CATEGORY DAY	BURNING GUIDELINES
1	DAYTIME BURNING ONLY, BETWEEN 11 A.M. AND 4 P.M., MAXIMUM OF 100 ACRES, AND NOT BEFORE SURFACE INVERSION HAS LIFTED. NO BURNING IN SLASH, PILED DEBRIS OR HEAVY FUEL LOADS.
2	NO BURNING UNTIL 11 A.M. AND NOT BEFORE SURFACE INVERSION HAS LIFTED. BURNING SHOULD BE SUBSTANTIALLY OVER BY 4 P.M.
3	BURN ONLY AFTER SURFACE INVERSION HAS LIFTED.
4	BURN ANYTIME.
5	"UNSTABLE" AND WINDY. EXCELLENT SMOKE DISPERSAL. BURN WITH CAUTION.

Step 4: Determine tons of fuel allocated to an airshed

The prescribed fire manager determines the fuel tonnage in a burn (see Table 3 page 5). AFC will notify the prescribed fire manager if the tons exceed the allotment for the airshed.

Table 3. The maximum tons of fuel that can be allocated to an airshed based upon the downwind distance to the nearest smoke-sensitive area and the category day. Example: If a smoke-sensitive area is located 1/4 (0.25) mile downwind, the maximum total available fuel loading allocated to the airshed for a Category 4 day would be 720 tons.

DISTANCE TO SMOKE-SENSITIVE AREA (MILES)	CATEGORY DAY 2	CATEGORY DAY 3	CATEGORY DAY 4	CATEGORY DAY 5
	TONS OF FUEL			
0-0.19 (0-1,000 FT.)	RECOMMEND DO NOT BURN			
0.2-4.9	488	560	720	1,280
5-9.9	1,000	1,200	1,840	3,200
10-19.9	1,840	2,240	4,200	7,200
20 OR GREATER	2,880	3,280	6,400	11,600

SPECIAL SMOKE CONCERNS

The following situations could result in smoke impacting downwind areas, particularly when there has been a large production of smoke:

1. Transport wind speed exceeds 25 mph, and average surface wind speed is over 20 mph with stronger gusts. This prevents smoke from rising.
2. Transport wind direction carries smoke over a large lake, causing smoke to descend to the ground.
3. A thick layer of smoke from a large burn significantly reduces the heating of the ground. This may cause the smoke to descend to the ground.
4. Transport wind direction moves smoke from a fire on the slope of a ridge toward and over the top of the ridge. Smoke may return to the ground in the eddy that can develop on the downwind side of the ridge.

Exercise caution with high transport wind speeds and low mixing height, or low transport wind speeds and high mixing height. These conditions can cause poor smoke dispersion and difficult burn behavior problems.

NIGHTTIME BURNING

Predicting visibility and smoke drift is more difficult at night. Winds may lessen or die out completely, and smoke will tend to stay near the ground. Although burning at night may help achieve other objectives, it may aggravate smoke management problems. Nighttime burning will require the same planning as daytime burns.

Prescribed burn managers should evaluate frequently traveled roads within one mile of the prescribed fire, especially if these roads are down hill of the burn. Residual smoke flows and settles in low areas during the night and early morning and may contribute to heavy fog, which creates hazardous road conditions.

For nighttime burns, consider the following recommendations:

1. Burn in light fuels.
2. Use backing fire.
3. Burn when humidity is 80 percent or less.
4. Do not burn if overnight low temperature is within 5 degrees of dew point.
5. Burn with surface wind speed of 4 miles per hour or more.
6. Monitor smoke down hill and low areas, especially populated areas, airports or roads near the burn site.

GLOSSARY

Airshed – the atmosphere covering a 36 square mile area (6 miles by 6 miles) approximately 23,000 acres. The amount of fuel that can be burned in the airshed depends on the distance to the nearest downwind smoke-sensitive area and meteorological conditions.

Available fuel – an estimate of the tons of fuel per acre that will actually be consumed by a burn under a specific set of burning conditions. It is influenced by fuel moisture and other factors.

Category day – a scale from 1 to 5 based on transport wind speed and mixing height. For smoke dispersal, 1 is poor and 5 is excellent.

Class I area – an area set aside under the Clean Air Act to receive the most stringent protection from air quality degradation. Designated Class I areas in Arkansas are Caney Creek and Upper Buffalo Wilderness.

Dispersion index – an estimate of the atmosphere's capacity to disperse smoke from prescribed burns over a 1,000-square-mile area. It takes into account mixing height, transport wind, and stability near the ground.

Fuel loading – total amount of fuel at the prescribed burn site.

Inversion – increase of temperature with height in the atmosphere. This condition often exists in the morning and prevents smoke from rising into the atmosphere.

Mixing height – the layer of the atmosphere that pollutants are dispersed into due to turbulent mixing. A forecast of mixing height indicates the height of the top of the layer with respect to mean sea level.

Prescribed fire – any fire ignited by management actions to meet specific objectives.

Prescribed fire manager – person responsible for managing a prescribed fire, from planning to ignition and mop up.

Residual smoke – smoke that continues after the initial burn has passed through the fuel.

Screening distance – the area to examine for possible smoke-sensitive areas.

Smoke management – conducting a prescribed fire under fuel moisture, meteorological conditions, and firing techniques that keep the impact of the smoke on the environment within acceptable limits.

Smoke plume – the column of smoke resulting from prescribed fire.

Smoke-sensitive area – areas that can be harmed by smoke. Examples: airports, major highways, communities, Class 1 areas, recreation areas, schools, hospitals, nursing homes, factories, etc.

Transport wind – the average wind speed and direction through the mixing height. Higher wind speeds allow for more rapid transport of pollutants downwind.

Wind direction – compass direction from which the wind is blowing.

ACKNOWLEDGMENT

The Arkansas Prescribed Fire Council— **www.arfirenetwork.org**—made a significant contribution toward the preparation of the *Arkansas Voluntary Smoke Management Guidelines.* Members of this council represent the following organizations, listed alphabetically:

Arkansas Department of Parks and Tourism – **arkansasstateparks.com**
Arkansas Forest Resources Center - University of Arkansas – **afrc.uamont.edu**
Arkansas Forestry Association – **arkforests.org**
Arkansas Forestry Commission – **forestry.arkansas.gov**
Arkansas Game and Fish Commission – **agfc.com**
Arkansas National Guard – **arguard.org**
Arkansas Natural Heritage Commission – **naturalheritage.org**
National Weather Service – **weather.gov**
The Nature Conservancy - Arkansas Field Office – **nature.org/arkansas**
Resource Management Service, LLC – **resourcemgt.com**
U.S. Army Corps of Engineers – **usace.army.mil**
USDA Natural Resources Conservation Service – **ar.nrcs.usda.gov**
USDA Forest Service/Ouachita and Ozark-St. Francis – **fs.fed.gov**
U.S. Fish and Wildlife Service – **fws.gov**

Advisory Council Members
Arkansas Attorney General's Office – **ag.arkansas.gov**
Arkansas Department of Environmental Quality – **adeq.state.ar.us**
Central Hardwoods Joint Venture – **chjv.org**

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