

# LOUISIANA

## Voluntary Smoke Management Guidelines



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## **PREFACE**

The use of prescribed fire as a forest management tool has long been regarded as “indispensable” by the forest community. Numerous plant communities and animal populations require periodic fire to maintain a healthy and viable population. Periodic prescribed fire also removes excessive vegetation fuel loading, thereby reducing the threat of a stand-replacing wildfire.

Annually, more than 300,000 acres are burned under controlled situations in the state of Louisiana. These areas include forest lands, range lands and agricultural lands. Because of the ecological benefits and the cost effectiveness of prescribed fire, the usage of fire upon these acreages is expected to increase in the future.

In order to lessen the impact of smoke generated from prescribed burning on the public’s health and welfare, the Louisiana Department of Agriculture and Forestry and the Louisiana Forestry Association developed these Voluntary Smoke Management Guidelines.

Proper application of these guidelines will minimize concentrations of smoke in sensitive areas and assist in maintaining air quality standards, while retaining fire as an ecological and economical land management option.

## **ACKNOWLEDGMENTS**

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# **LOUISIANA**

## **VOLUNTARY SMOKE MANAGEMENT GUIDELINES**

### **I OBJECTIVE**

These guidelines are intended to assure adherence to air quality regulations and to manage smoke from forestry prescribed burning operations in such a way as to keep the smoke's impact on the environment within acceptable limits.

### **II CONTROL**

All burning in Louisiana is regulated by the Division of Air Quality, Louisiana Department of Environmental Quality (LDEQ) and the United States Environmental Protection Agency (EPA).

The State Forester has accepted responsibility for the dissemination and administration of a voluntary smoke management plan for prescribed burning that is related to forestry activities.

Nothing contained in this plan shall be construed as allowing any person to be in violation of any regulations, laws, ordinances or orders of the state of Louisiana or other governmental entities having jurisdiction or relieve any person from the consequences of damages or injuries which may result from his/her burning activities.

### **III ADMINISTRATION, COORDINATION AND RESPONSIBILITIES**

#### **A. Louisiana Office of Forestry**

The State Forester or their designee will administer this plan through the foresters of the Louisiana Office of Forestry (LOF). The State Forester will continue to coordinate all forestry burning with the Louisiana Department of Environmental Quality, Air Quality Division.

Primary responsibility at the LOF district level for the coordination of prescribed burning activities shall be the Regional Forester's. The Regional Forester will designate a qualified individual or individuals (usually the Dispatcher) to perform the day-to-day activities, including routine retrieval of the National Weather Service Fire Weather data and to make this information available to the public, upon request.

#### **B. Cooperator**

On the day of a prescribed burn, cooperators shall inform the appropriate LOF District Office of the intent to execute a prescribed burn. The cooperator will provide all required information (fire location, estimated acreage to be burned, Fire Boss name and contact information) and may request information on the Category Day forecasts.

It is suggested that cooperators contact adjacent landowners regarding the intent to prescribed burn. This notification may bring awareness to social or health concerns (asthmatic individuals, children, elderly residents, etc.), which may have been overlooked during the smoke screening process.

- **National Weather Service**

The National Weather Service (NWS) broadcasts the Category Day on the National Oceanic and Atmospheric Administration (NOAA) Weather Channel.

Fire Weather forecasts for Louisiana can be obtained by visiting: [www.nws.noaa.gov](http://www.nws.noaa.gov). Click on the state of Louisiana, and then select “Fire Weather” under the Forecast section. Click on the parish for which the prescribed burn will be located. Please ensure that you have received the proper parish’s forecast before executing any prescribed burn.

Occasionally, during periods of relatively stagnant air, the NWS at the request of DEQ will issue an ***Air Stagnation Advisory*** (ASA) which requires a smoke management Category Day 1. When such an ASA is issued, the LOF Regional Forester’s designee will notify the cooperators burning within the district at that time. ***No burning or ignition of any new prescribed fire is allowed, under the LA. Smoke Management Guidelines, during Category 1 periods.***

- A. **Designation of Smoke Management Category**

LOF District Office’s will receive Fire Weather forecasts from the NWS daily. The Category Day designation is based upon the expected Ventilation Rate of the atmosphere.

- B. **Training and Communications**

- 1. **Louisiana Forestry Association’s Responsibilities**

The LFA, with input from the Regulatory Affairs Committee, will develop an implementation plan for these voluntary guidelines and shall promote an educational training program related to smoke management.

- 2. **Cooperator’s Responsibility**

Cooperators should provide training regarding smoke management guidelines to their “Fire Bosses” and their “on-the-ground” personnel.

## IV. PROCEDURES

When prescribed burning is to be used, the cooperator will take all necessary measures to keep the smoke's impact on the environment within acceptable limits. The recommended procedure to accomplish this objective follows a five-step screening system:

- A. Determine Category Day
- B. Determine Proper Screening Distance
- C. Determine Trajectory of Smoke Plume
- D. Identify Smoke-Sensitive and any other potentially impacted areas
- E. Plan accordingly, then evaluate the results

In forestry prescribed burning, it is recognized that numerous variables affect the fire's behavior and the resulting smoke. This system does not attempt to consider all of the variables; it only offers the basic guidance regarding smoke management.

Moisture content of the targeted vegetation (live or dead) will greatly determine the amount and duration of the smoke produced. Cooperators shall plan accordingly. For those areas that may burn or smolder into the evening/night time, cooperators shall take precautions regarding the possibility of a night time inversion restricting smoke dispersion.

### A. Determine Category Day

The cooperator will receive the fire weather forecast, Category Day and the Surface Inversion Lifting Temperature (SILT) from either the NWS Fire Weather forecast or from the appropriate LOF District Office on the morning of the proposed burn.

### **Minimum Ventilation Rates**

(both minimum rates MUST BE MET to be valid)

Minimum Mixing Height: 500 meters or 1,640 feet

Minimum Transport Wind Speed: 4 meters per second or 8.8 miles per hour

\* Ventilation rate is calculated by multiplying the afternoon mixing height in meters by the transport wind speed in meters per second. The minimum recommended mixing height (500 meters) and the minimum recommended transport wind speed (four meters per second) provide the **minimum recommended ventilation rate of 2000** (500 meters x 4 meters per second).

## Category Day Smoke Management Guidelines

Category Day	Guidelines	Ventilation Rate
1	<b><i>NO BURNING!</i></b>	Less than 2,000
2	No burning until after 11:00 am and not before surface inversion has lifted. <b><i>Fire should be substantially burned out by 4:00 pm.</i></b>	2,000 – 4,000
3	<b><i>Daytime burning only</i></b> but not before surface inversion has lifted.	4,000 – 8,000
4	Burning anytime. <b><i>For night burns, use backing fires with surface wind speeds greater than 4 mph and a Relative Humidity less than 80%.</i></b>	8,000 – 16,000
5	“Unstable” and windy. Excellent smoke dispersal. <b><i>BURN WITH CAUTION.</i></b>	Greater than 16,000

IMPT: The above listed ventilation rates utilize METERS and METERS PER SECOND for compilation rates.

To utilize FEET and MILES PER HOUR, then convert:

- 1 meter = 3.28 feet
- 1 meter per second = 2.2 miles per hour

## B. Determine Screening Distance

Place your planned burn into one of the four following categories:

1. Backing fire less than 1000 acres.
2. Head fire less than 1000 acres.
3. More than 1000 acres
4. Piles/Windrows

The size and firing technique coupled with the Category Day will determine the number of miles downwind from the burn site for the screening process to apply.

Using the following table, locate the block that represents the type of burn and the forecasted category day. The number in the appropriate block is the **MINIMUM RECOMMENDED** number of miles downwind from the burn to screen for smoke sensitive areas, such as airports, highways, communities, recreational areas, schools, hospitals, nursing homes and factories.

### Type of Burn

### Category Day

	1	2	3	4	5
<b>Backing Fire</b> less than 1,000 acs.	<b>N</b>	10	5	2.5	.75
<b>Head Fire</b> less than 1,000 acs.	<b>O</b>				
	<b>B</b>	20	10	5	.75
	<b>U</b>				
<b>More Than</b> 1,000 acs	<b>R</b>	20	10	5	.75
	<b>N</b>				
	<b>I</b>				
<b>Piles/Windrows</b>	<b>N</b>	30	15	8	.75
	<b>G</b>				

Minimum screening distance, in miles,  
for downwind sensitive areas.

## C. Determine Trajectory of Smoke Plume

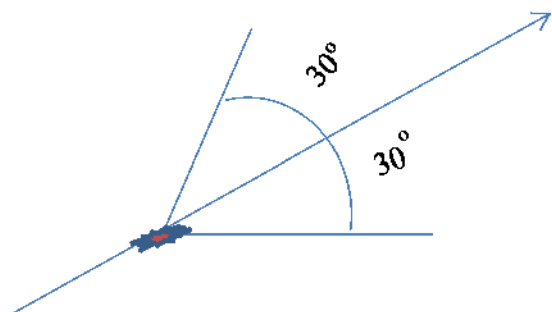
### 1. Aerial Map

Locate burn on an aerial map and draw a line representing the centerline of the predicted path of the smoke plume, based upon the Transport Wind direction, for the proper screening distance. NOTE: The Surface Wind direction may vary as compared to the Transport Wind direction. If the burn will last three hours or more, draw another line showing the predicted Transport Wind direction at the estimated completion of the burn.

To allow for the horizontal dispersion of the smoke, as well as shifts in wind direction, draw two other lines from the fire at an angle of 30 degrees from the centerline(s). If the fire is represented as a spot, draw as in Figure A. If larger, draw as in Figure B.

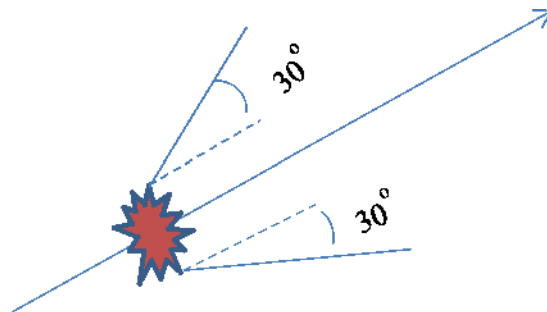
**Figure A.**

for example: less than 20 acres



**Figure B.**

20 acres or greater



### 2. Simple Smoke Screening Tool (online version)

The Southern High Resolution Modeling Consortium (SHRMC) has developed a simple digital graphical mapping tool for initial smoke management planning. This mapping tool is best used for daytime conditions for burns smaller than 300 acres that will be completed within current input conditions.

Web address: <http://shrmc.ggy.uga.edu/maps/screen.html>

The screening area shown on the map is divided into two zones, Red & Yellow. The Red zone is used to identify critical smoke-sensitive areas. This is the most probable area of smoke impact. If there are smoke sensitive targets within this critical zone **burning is not recommended under the current prescription.**

The Yellow zone represents area of less severe smoke impact.

Note: This is a simple screening tool designed to help identify smoke sensitive targets, not to predict smoke concentrations.



- D. Identify Smoke Sensitive and Other Impacted Areas (Targets)** Smoke-sensitive areas can be adversely affected by smoke. Cooperators shall ensure that all necessary steps to protect these areas from smoke intrusions have been made, prior to ignition.

**Using the Minimum Screening Distance from Step B**

1. Determine any potential smoke sensitive areas
2. Recognize potential smoke sensitive areas that already have an air pollution or visibility problem.
3. Identify any potential areas where emission of sulfur dioxide (SO<sub>2</sub>) may merge with the smoke plume. Present research indicates that SO<sub>2</sub> in the presence of particulate matter might be a health hazard. Likely sources are smelters, electric power plants and factories where coal is burned.
4. Should other known sources of smoke overlap your trajectory towards a sensitive area, consider increasing the recommended screening distance.

**E. Evaluate the Results**

If you identify any areas in step D that could be adversely impacted by smoke production from your burn, either take necessary precautions or consider burning under more favorable conditions. This may include delaying the burn until a more favorable wind direction or Category Day exists, reducing the size of the area to be burned under the current weather conditions or changing the firing technique to a backfire, if applicable.

# Smoke Dispersion Indexes

All of the weather elements that affect the behavior of fire will affect the production and dispersion of smoke. Listed below are weather forecast indices that prescribed burners should become familiar with regards to smoke management.

## Atmospheric Stability

There is a vertical as well as horizontal motion in the atmosphere. Stability is an indication of how rapidly vertical mixing is taking place. The more unstable the atmosphere, the more quickly smoke is lifted and dispersed. Stability is usually expressed as; very unstable, unstable, slightly unstable, neutral, slightly stable, stable, or very stable. During slightly unstable or stable periods, higher concentrations of smoke may come back to the ground some distance downwind even though it was lifted initially by the heat of the fire.

The atmosphere, generally, is most unstable during the afternoon. This is because of the heating of the earth's surface during the day. The air above the surface is heated and expands. In turn it begins to rise resulting in a vertical movement. The more unstable, the higher smoke should be lifted.

After dark, atmospheric conditions change rapidly to becoming stable. Under stable conditions smoke will not rise except from the heat of the fire and then, only for a short distance. Any smoke in the air will drop back down to the ground.

***!!! ANY PRESCRIBED BURNING BEING EXECUTED AFTER SUNSET SHOULD USE CAUTION!!!***

## Pasquill Index of Atmospheric Stability

The Pasquill Index prescribes one of a series of stability classes, which may be named by a single letter or a descriptive phrase. Either type of class identification may be found on a Fire Weather Forecast report.

LETTER	STABILITY PHRASE
A	Very Unstable
B	Unstable
C	Slightly unstable
D	Neutral
E	Slightly stable
F	Stable
G	Very Stable

## Dispersion Index

The Dispersion Index is a numerical indicator of how well and how rapidly smoke will be dispersed. It utilizes stability, mixing height, and transport wind speed as the major factors. Other factors are: the amount and angle of sunlight and temperature.

### SMOKE DISPERSION INDEX

Numerical Rating	Interpretation
100 or Over	<b>Excellent Dispersion</b> <ul style="list-style-type: none"><li>• May indicate hazardous fire control conditions</li></ul>
61 – 100	<b>Good Dispersion</b> <ul style="list-style-type: none"><li>• Typically, good prescribed burning days</li><li>• Most good prescribed burning days will fall in this category.</li></ul>
41 – 60	<b>Generally Good Dispersion</b> <ul style="list-style-type: none"><li>• Use care with marginal burns.</li></ul>
21 – 40	<b>Fair Dispersion</b> <ul style="list-style-type: none"><li>• Marginal day for burning</li><li>• Stagnation may be indicated if accompanied by persistent low wind speeds.</li></ul>
13 – 20	<b>Generally Poor Dispersion</b> <ul style="list-style-type: none"><li>• Stagnation will develop if poor conditions persist.</li><li>• Better than average for most nights.</li></ul>
7 – 12	<b>Poor Dispersion</b> <ul style="list-style-type: none"><li>• Stagnant conditions during the day and night.</li></ul>
1 – 6	<b>Very Poor Dispersion</b> <ul style="list-style-type: none"><li>• DO NOT BURN</li></ul>
















**Note: The decision to burn should not be based solely on the Dispersion Index.**

## KEETCH – BYRAM DROUGHT INDEX (KBDI)

KBDI Index is a soil/duff drought index that ranges from 0 (no drought) to 800 (extreme drought) and is based on the soil's capacity to hold 8 inches of water.

The index is a measure of meteorological drought; it reflects water gain or loss within the soil.

This index can be useful for fire practitioners with regards to smoke management resulting from prescribed burns. A prolonged drought (high KBDI) influences fire intensity largely because fuels, generally, will have a lower moisture content. The below listed KBDI ranges and the expected fire results are for GENERAL INFORMATION PURPOSE ONLY!

### KBDI Index 0 – 200

Much of the understory prescribed fire work is done at this level. This level basically corresponds to the early spring dormant season conditions following winter rains. Soil moisture is “high” and fuel moistures in the 100 and 1000 HR fuel classes are sufficiently high and these larger fuel classes do not readily ignite. Nearly all organic matter, duff and the associated litter layers are left intact. ***Smoke management concerns are primarily centered around the smoke generated during the burn and not from large smoldering materials following the completion of the burn.*** This index range should not be utilized as an indicator of fuel moisture for 1 HR and 10 HR fuels, as they are almost totally dependent on daily atmospheric conditions.

### KBDI Index 200 - 400

Normally found in the late spring season. Lower litter layers and duff beginning to show signs of water loss. Fire practitioners should expect an increase in fuel consumption as the index moves towards the upper end of this range. Heavier dead fuels classes may become involved, with the majority of duff and the organic layer remaining intact. ***Expect down logs, stumps and similar materials to smolder and the resulting smoke to carry into the night.*** Mitigation measures should be implemented when necessary.

### KBDI Index 400 - 600

This range is typically encountered during the Summer and early Fall. This level represents the upper range at which most normal understory type burning should be implemented. Site preparation burns usually occur at this range. Most duff and associated organic layers will be sufficiently dry enough to burn, contributing to smoke production. Most fuel size classes will burn at this time, with all but the largest fuels being completely consumed. ***Larger fuels not consumed may smolder for several days.*** Mitigation measures should be implemented.

### KBDI Index 600 - 800

This range represents the most severe drought conditions identified within the index. ***Fire practitioners should consider the mid to upper 600 range the limits of acceptability for igniting prescribed fires unless specific local conditions dictate otherwise.*** Live vegetation, 2 - 3 inches at ground line, should be considered as available fuel. The majority of organic soil materials will be consumed, if exposed to fire. Expect stumps and roots that ignite to be completely consumed.

## GLOSSARY

- Air Stagnation Advisory (ASA):** A statement issued by the National Weather Service Forecast Office when atmospheric conditions are “stable” enough that the POTENTIAL exists for air pollutants to accumulate in a given area. The statement is initially issued when conditions are expected to last for at least 36 hours.
- Backing Fire:** The fire spreads against the wind or downhill. Flames tilt away from the direction of the spread. This burning technique generally produces the least amount of smoke.
- Category Day:** A scale of 1 to 5 based on the ventilation rates. For smoke dispersal, 1 is “poor” and “5” is excellent.
- Cooperators:** Those individuals who have agreed to carry out prescribed burning in such a manner as to adhere to the Voluntary Smoke Management Guidelines.
- Fire Boss:** The individual responsible for the “on ground” execution of the prescribed burn. This individual should remain at the site from the time of ignition till the control burn is completed.
- Heading Fire:** A fire spreading with the wind or generally uphill. Flames tilt in the direction of the spread.
- Inversion:** An increase of temperature with height in the atmosphere. Vertical motion in the atmosphere is inhibited allowing for pollution buildup. A “normal” atmosphere has temperature decreasing with height.
- LOF:** Louisiana Office of Forestry
- Meter (m):** Basic unit of length in the metric system; there are 39.37 inches/meter, 3.28 feet/meter, 1.1 yards/meter. **Minimum mixing height of 500 meters = 1,640 feet.**
- Meters Per Second (mps):** Expression of distance travel per second. One meter per second is equal to 2.2 miles per hour (mph). **Minimum transport wind speed of 4 mps = 8.8 mph**
- Mixing Height:** Measured from sea level upward, the height to which relatively vigorous mixing occurs due to convection. Use of this term normally implies the presence of an inversion and the base of the inversion is the top of the mixing layer. The height to which smoke will normally ascend, following the SILT has been met.
- Plume:** The segment of the atmosphere occupied by the emissions from a single source or a grouping of sources close together. A convection column, if one exists, forms a specific part of the plume.
- Prescribed Burning:** The controlled application of fire to wildlands fuels, under specific conditions of weather, fuel moisture, soil moisture, etc. as to allow the fire to be confined to a specific area and at the same time to produce the intensity of heat and rate of spread required for certain planned objectives of silviculture, wildlife habitat management, grazing, fire hazard reduction, etc.

**Screening Distance:** The area to examine for possible sensitive targets, prior to the burn.

**Sensitive Targets:** Areas or populations that can be adversely affected by smoke. Examples include Airports, Highways, Communities, Schools, Hospitals, Nursing Homes, etc.

**Smoke Management:** Conducting a prescribed fire under fuel moisture and meteorological conditions, and with a firing technique that keeps the smoke's impact on the environment within acceptable limits.

**Surface Inversion Lifting Temperature (SILT):** The minimum ambient air temperature in which the heating of the earth's surface should allow smoke particles to rise into the atmosphere.

**Timelag Categories:** The approximate time necessary for a fuel particle (based upon size) to gain or lose approximately 63% of the difference between its initial moisture content and its equilibrium moisture content.

1 hour	up to 'A inch diameter
10 hour	'A to 1 inch diameter
100 hour	1 to 3 inch diameter
1000 hour	3 to 6 inch diameter

**Transport Wind Speed:** A measure of the average rate of the horizontal transport of air within the mixing layer. May also be the wind speed at the final height of the plume rise. Generally refers to the rate at which emissions will be transported from one area to another.

**Ventilation Rate:** The mixing height time the transport wind speed gives a rate indicating the capability of the lower atmosphere to diffuse and disperse smoke. **Ventilation rate is calculated by multiplying the afternoon mixing height in meters by the transport wind speed in meters per second.** The minimum recommended Mixing Height (500 meters) and the minimum recommended Transport Wind Speed (4 meters per second) provide the minimum recommended Ventilation Rate of 2000 (500 x 4).

**Warm Front:** The leading edge of a relatively warm air mass which moves in such a way so that the warm air displaces the colder air. Winds associated with the warm front activity are usually light and mixing is limited. The atmosphere is relatively stable as compared to a cold front activity.

**Wind Shear:** A variation in wind speed and/or direction in a layer of the atmosphere or between layers. The variation may be horizontal or vertical and may result in significant turbulence depending upon the magnitude of the wind speed/direction difference. A strong wind shear may act like an inversion and inhibit plume rise. It may also fracture the smoke plume, not allowing smoke to rise much above terrain levels. A strong horizontal anticyclonic shear results in a downward motion and may bring smoke aloft to the surface.

### District Office Information

**District 1**

**740** Covington Rd. **754 Hwy SO East 215 Hangar Rd. 9418 Hwy 165**

**Haughton. LA 71037 Monroe, LA 71203 Trout LA 71371 Oberlin, LA 70655**

**1318)** 949-3225

**District 2**

(318) 145-7595

**District 3**

(318) 992-1400

**District 4**

(337) 639-4978

**District 5**

**1638 Creswell Ln, Suite 1**

**Opelousas. LA 70570**

(337) 948-0230

**District 6**

**47076 N. Morrison Blvd.**

**Hammond. LA 70401**

(985) 543-4057