**FEWG – A WORKING GROUP FOR NCDFR MTM**

**NC SMP Technote 6 – October 10th, 2008**
***Nighttime Prescribed Fire & smoke Sensitive Areas***

Use of prescribed fire in North Carolina's forests and natural ecosystems are often constrained not only by weather conditions, fuel and soil moisture, and distance to smoke sensitive areas, but also other demands that may be locally unique. Neighbors or persons impacted from smoke that is the direct result from the use of prescribed fire, can be asked and may be willing to tolerate smoke for a day, but after 2-3 days, anyone's patience can wear thin. This article will speak to two aspects of the NC Smoke Management Program (SMP): prescribed burning at night and smoke sensitive areas.

## NIGHTTIME PRESCRIBED FIRE

Prescribed burning, if properly applied, is the most economical means of eliminating the wildfire hazard of increased fuel loading that is created and left after each year of growth. If prescribed burns can be conducted at night, the number of hours available for burning is increased. To accomplish this practice, natural resource practitioners are requested that they voluntary comply with the NC SMP. Favorable wind conditions, direction and speed are essential in order to generate an acceptable rate of spread to the fire, dissipate its convective heat and disperse its smoke.

Under the present NC SMP, 20 ft wind speeds need to be equal to or better than 9 mph in order to conduct prescribed fire operations at night or early morning hours. Nighttime dispersion for smoke management is currently determined by wind speed as outlined in the table below.

### Nighttime Smoke Dispersion

| Nighttime Dispersion | Forecast Surface Wind | Interpretation |
|---|---|---|
| Stagnant | Near Calm | Day burning needs to conclude 3 hrs. prior to sunset / **No Burning at night** |
| Very Poor | 2 – 4 MPH | Day burning needs to conclude 2 hrs. prior to sunset / **No Burning at night** |
| Poor | 5 -8 MPH | Day burning needs to conclude prior to sunset / **No Burning at night** |
| Fair | 9-12 MPH | **Nighttime burning permissible** |
| Good | >12 MPH | **Nighttime burning permissible** |
| Excellent | >14 MPH | **Nighttime burning permissible but dangerous** |

Atmospheric conditions tend to become stable at night with wind speeds very smooth and light. It is important for any nighttime prescribed burning to have steady persistent winds with "acceptable speeds to disseminate smoke". Stable conditions tend to keep smoke near the ground. Usually down slope or down drainage winds generally prevail at night and smoke will therefore flow down drainage and concentrate in low areas. When relative humidity rises above 80 percent and smoke is present, the

formation of fog becomes increasingly likely as moisture condenses on the smoke particles. There are no satisfactory solutions to these problems, so they should be avoided entirely whenever possible. Wind speeds at 9 mph or better indicate at least **"fair conditions"** to disperse smoke. They also indicate that inversions and smoke induced fog are very unlikely events which are important to conduct successful nighttime prescribed burns.

The **Low Visibility Occurrence Risk Index (LVORI)** is another tool which can estimate the atmosphere's potential to contribute to low visibility. LVORI has a scale from 1 to 10. When smoke is present in the atmosphere and **the LVORI has a value of ≥ 7, visibility issues can be magnified** as weather conditions can act synergistically to impair visibility. Other factors that need to be considered include:

a. The fire is more than three miles from a road or smoke sensitive areas. Most nighttime visibility problems occur within three miles, but in exceptional cases problems may extend out to 30 miles from the fire.
b. The vegetation is continuous and heavy between the burn and a road. Heavy vegetation acts as both as a filter or a barrier, and slows the movement of smoke.
c. Logging roads, power lines, streams, or similar features can provide an unobstructed pathway, a conduit between the burn and state roads.
d. State roads are at a higher elevation than the burn.

The NWS will be including the LVORI in the Fire Weather Forecasts as the NCDFR Fire Environmental Work Group works in partnership with the NWS. The LVORI is currently projected 3 days out by SHRMC @ website: http://shrmc.ggy.uga.edu/state_maps.php (**Select the Field Low Visibility Risk Index / Select North Carolina / Select Time Loop All).** Also within the Fire Weather Forecast the Surface Winds are forecasted WND20FT2MIN/EARLY and WND20FT2MIN/LATE. This is done to give a forecast of wind speeds between 6PM and midnight. Wind speeds are usually higher during this time period and therefore can provide opportunities for nighttime burning. - Surface wind speed and direction represent a two-minute average at 20 feet above the ground or 20 ft above the vegetative cover. Wind direction is the direction the wind blows from, to eight points of the compass. The "EARLY" designation refers to morning hours (before noon) during daytime periods, and also the evening hours (before midnight) during nighttime periods. "LATE" refers to the afternoon hours during the daytime periods, and also the pre-dawn hours (after midnight) during the nighttime periods. Wind gusts, which are rapid fluctuations in wind speed of usually less than 30 seconds in duration, are indicated in the forecast if gustiness is expected. Forecasts for highest probable gust will be preceded by "G".

Prescribed burning at night is a management tool for natural resource managers. It certainly can increase the opportunities available for burning and provide an additional means of regulating the prescribed fire's intensity when stand fuel conditions can generate intense burns due fuel loadings and fuel moistures.

**SMOKE SENSITIVE AREAS (SSAs)**

In the wildland-urban interface, prescribed burns are constrained by impacts of smoke. As defined by NWCG, Smoke Sensitive Areas are areas that may be adversely affected by smoke from a prescribed burn or wildfire. Smoke from outside sources is intolerable, for reasons such as heavy population, existing air pollution, or intensive recreation or tourist use. Under the NC SMP what can be considered a SSA? This can include but is

not limited to Class I areas (there are five in NC) and other locations of scenic and/or important vistas, especially during periods of significant public use. There are also urban and rural population centers, schools, hospitals, nursing homes, day care centers, transportation facilities such as roads and airports, recreational areas, and other locations that may be sensitive to smoke impacts for health, safety, and/or aesthetic reasons.

When working under the NC Ventilation Index System, the closest SSA needs to be determined as this assists in setting the limits for the amount of permissible tonnage that can be released to the atmosphere within the 25 sq. mi. area. The SSA is determined by the acceptable wind direction for the burn and then generating a Dispersion Impact Zone (DIZ). This zone is shaped by a 60 degree arc extending 30 miles downwind from the project to be prescribed burned. Burners need to assess potential smoke impacts of their prescribed burn project within the DIZ. The total permissible tons to be released are considered for their downwind impacts to public health and visibility. All SSAs within a ½ mile of the project and in the DIZ result in a no burn situation. This can be overcome if the SSA can be mitigated. If a SSA is mitigated under any circumstance, then in essence there is no SSA and the prescribed burn can proceed and be accomplished.

• **Class I Areas:** Class I areas must be identified and be considered by burn bosses. Impacts to visibility from smoke need to be evaluated when burning. Prescribed Burn Projects located near Class I area need to document the timing, duration, and severity of their smoke impacts from the burn on visibility in the Class I area. These areas include Forest Service wildernesses and national memorial parks over 5,000 acres, National Parks exceeding 6,000 acres, international parks, as well as other designated lands.

• **Recreational Areas:** Recreational areas need to be identified and be considered by burn bosses as to their smoke visibility impacts.

• **Urban and Rural Population Centers:** Urban and rural population centers need to be identified and be considered by burn bosses as to their smoke visibility impacts. All population centers within a 30 mile radius of the burn that appear as cities, towns or urban areas on the current NC Department of Transportation's maps are to be considered smoke-sensitive areas. If there are several SSAs in the DIZ, it will be necessary to determine the closest SSA so the permissible tonnage that can be released can be determined. Residences that are in groups too small to appear on the above mentioned map must also be considered as a SSA.

Even if it is a single residence burners are expected to limit their smoke exposure. In some cases homeowners have been more than willing to accept limited smoke so burns can be accomplished. If this is so, then such SSA is said to have been mitigated. It is also the law that adjoining landowners be informed that the practice of prescribed fire will be used. Therefore, Prescribed Fire Practitioners when using this natural resource management tool need to provide adjoining neighbors, residents, sufficient information about prescribed fire plans so that they can be informed.
This good neighbor courtesy allows adjoining landowners to know what is happening in their surroundings and to make any necessary adjustments.

• **Other Sensitive Populations:** Schools, hospitals, day care centers and nursing homes in the DIZ need to be identified and evaluated for impact.

• **Transportation Facilities:** Transportation facilities such as roads and airports need to be identified as smoke-sensitive areas. The likelihood of prolonged exposure to particulate matter (PM) levels on potentially impacted roads or airports needs to be evaluated as reduced visibility is a threat to one's safety. In 2008 two first responders lost their lives in the line of duty while responding to vehicle accidents that where caused by wildfire smoke that reduced visibility well beyond the road's posted speed limit. It is possible that this could have been a Super fog Event. Super fog is a dense fog that reduces visibility to a few meters. This would make driving unsafe. It can occur when residual smoke from prescribed burns combines with just the right ambient temperature and relative humidity.

Prescribed Fire Prescriptions need to consider and protect the public on the road or at an airport. It is a goal and objective of the NC SMP and the responsibility of natural resource prescribed fire practitioners to minimize and protect the public safety from potential smoke intrusions onto roads, airports or other transportation related facilities. This is necessary as driving and flying safety problems may occur with poor visibility on roads or runways at levels far below the PM standard for human health.

As the NC SMP transitions to also include the use Atmospheric Dispersion Models such as VSMOKE (for daytime burns) and PB-PIEDMONT (for nighttime residual smoke or burns), SSAs will be reviewed differently and in more detail. They will be examined for modeled particulate matter (PM) plume concentrations and visibility plume concentrations. These modeled plumes will be interpreted as to their individual potential impact and thereby, provide assistance in reaching a "Go or No Go" decision to proceed with prescribed fire.

**SSA for PM 2.5** is an unmitigated area that can have a population of individuals who are sensitive to breathing air with high concentrations of smoke particulate matter. Examples are hospitals, nursing homes, schools, day care centers and some communities. It is important to note that the elderly, very young and persons with chronic illness have a higher sensitivity to smoke concentrations than normal healthy adult populations. This definition may also include businesses or farms where smoke could cause an adverse affect on crops, poultry, cause contamination issues, or interrupt operations. Mitigation of an area may include assessment, notification, and confining peak smoke emissions during certain times or other means to avoid impacting the SSA-PM at an "unacceptable" level.

**SSA for Visibility Hazard** is an unmitigated area where reduced visibility from smoke or smoke induced fog poses a hazard to human safety on roads, airports, and other locations. Mitigation may include posting warning signs and other notifications, traffic control, road closures or other positive steps to reduce the hazard to acceptable conditions.

Using dispersion models necessitates a closer examination of meteorological conditions and interpretation of modeled smoke impacts. This extra effort was exercised under the Operation Research Evaluation Burn Project. Over a 4 year period burning days were increased by 32 days. A total 91 management units were successfully burned covering some 43,000 acres. The key to effective smoke management when using prescribed fire is to utilize favorable weather conditions, best science, prescribed fire techniques, and keep smoke emissions to a minimum as far as impacting SSAs.