ILLINOIS SMOKE MANAGEMENT PLAN

AQPSTR 08-05

May 8, 2009

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST

P.O. BOX 19276

SPRINGFIELD, ILLINOIS 62794-9276

Table of Contents

List of Acronyms

AQI	**Air Quality Index**
CAA	**Clean Air Act**
CAAA	**Clean Air Act Amendments**
FOFEM	**First Order Fire Effects Model**
IDNR	**Illinois Department of Natural Resources**
Illinois EPA	**Illinois Environmental Protection Agency**
IPCB	**Illinois Pollution Control Board**
ISWS	**Illinois State Water Survey**
MOA	**Memorandum of Agreement**
NWS	**National Weather Service**
NO_X	**Nitrogen Oxides**
NAAQS	**National Ambient Air Quality Standards**
PM	**Particulate Matter**
SASEM	**Simple Approach Smoke Estimation Model**
SMP	**Smoke Management Plan**
SIP	**State Implementation Plan**
TNC	**The Nature Conservancy**
USEPA	**United States Environmental Protection Agency**
USFS	**United States Forest Service**
USFWS	**United States Fish and Wildlife Service**
USNPS	**United States National Park Service**
VOC	**Volatile Organic Compounds**

Executive Summary

Prescribed fire and managed wildfire have been used in Illinois for many years to improve and maintain natural resources. Reasons for burning include hazardous vegetative fuel reduction, site preparation, seed production, wildlife habitat improvement and maintenance, range/pasture improvement and maintenance, disease and insect control (forest health), ecosystem management, restoration and maintenance of biological diversity, restoration of fire as a natural process, research, and training.

This Smoke Management Plan (SMP) is based on Section VI "Smoke Management Programs" of the U.S. Environmental Protection Agency's (U.S.EPA) "Interim Air Quality Policy on Wildland and Prescribed Fires" (April 23, 1998). According to this policy, the purpose of a SMP is to mitigate the nuisance and public safety hazards posed by smoke intrusions into populated areas (including on roadways and at airports); prevent deterioration of air quality and National Ambient Air Quality Standards (NAAQS) violations; and address visibility impacts in mandatory Federal Class I Areas.

The impetus for developing a SMP for Illinois is the anticipated increase in the use of prescribed fire in Illinois, the need to mitigate nuisance hazards, and the goal to utilize a voluntary program to prevent particulate matter (PM) NAAQS violations related to emissions from prescribed fires and wildland fires managed for resource benefits in Illinois. With the projected increasing need for prescribed burning in Illinois, particularly in the prairies and grasslands near Chicago and northeastern Illinois, it is prudent to set in place a voluntary SMP so that emissions from prescribed burning do not contribute to exceedances of the NAAQS in nonattainment areas (NAAs).

The planning process for this SMP began early in 2004 with preliminary discussions between the Illinois EPA, U.S.EPA, and the Illinois Department of Natural Resources (IDNR), U.S. Fish & Wildlife Service (USFWS), U.S. National Park Service and the U.S. Forest Service (USFS). In 2007, the Illinois Smoke Management Committee was assembled to undertake the effort. Participants include representatives from the Illinois EPA, IDNR, USFS, The Nature Conservancy (TNC), Lake County Forest Preserve and the Forest Preserve District of Cook County. This document is the product of this Smoke Management Committee. It is anticipated that future prescribed fires in Illinois will be conducted in accordance with this SMP. Environmental laws, including the Illinois Environmental Protection Act (Illinois Act) and the Clean Air Act (CAA) that implement the NAAQS address both regional haze and criteria pollutants. The Illinois EPA and Illinois Pollution Control Board (Board) have the authority to adopt regulations that implement and enforce federal air quality standards.

For the purposes of the SMP, prescribed burn plans must include the following elements:

- Location and description of the area to be burned
- Personnel responsible for managing the fire
- Type of vegetation to be burned
- Area (acres) to be burned
- Amount of fuel to be consumed (tons/acre)
- Fire prescription, including smoke management components and dispersion index
- Criteria concerning smoke management that the fire manager will consider when making

burn/no burn decisions
- Safety and contingency plans

While government entities involved in prescribed burning have utilized elements of this SMP for prescribed burns in the past, not all of the elements above would necessarily have been included in previous burn plans. Specifically, two of the above-delineated elements, the inclusion of fuel loads and the desired dispersion index for proposed prescribed burns, will be new to some government entities. Methods for deriving these elements are discussed in this document. In addition, as a result of this SMP, the NWS will include ventilation indices on their daily fire weather forecasts for regions of the State. Open burning permits for prairie and ecological management may be obtained from the Illinois EPA, Division of Air Pollution Control, Permit Section. Applications are available on the internet at **www.epa.state.il.us/air/permits/openburn/index.html**.

To evaluate the effectiveness of the SMP, the Illinois EPA will annually collect and review information on acres burned with prescribed fire and/or wildland fire use. Reports of nuisance complaints or smoke intrusions will be noted. The Illinois EPA and the Illinois Smoke Management Committee will use this information to measure the effectiveness of this SMP and make recommendations for future revisions of the SMP.

Every attempt has been made in this document to use terminology that is easy to understand. The reader should refer to the "Glossary" in Section 5.0 of this document if unfamiliar terms are encountered.

1.0 Introduction

Historically, wildland fires in Illinois' ecosystems have been an important process in the ecology of natural communities, such as forests, woodlands, savannas, prairies, and wetlands, located within the state. While wildland fire is an integral part of ecosystem management and is essential in maintaining functional ecosystems, air pollutants emitted from these fires can be harmful to human health and welfare. Because of public and governmental concerns about the possible risk of wildland fire smoke to public health and safety, as well as nuisance, visibility, and regional haze impacts, smoke management plans (SMPs) and air quality policies are being developed and implemented with support from research and land management agency programs.

2.0 Background

The Clean Air Act (CAA) requires each state to submit a State Implementation Plan (SIP) that provides for attainment with air quality standards established by the United States Environmental Protection Agency (U.S.EPA). The SIP must detail the emissions-reducing measures that the State will implement in the affected area in order to meet and maintain the National Ambient Air Quality Standards (NAAQS) for a particular pollutant.

Regarding wildland fires, the U.S.EPA has created guiding principles for States to consider in developing and implementing SIPs:

- Air quality and visibility impacts from fires managed for resource benefits should be treated equitably with other source impacts;
- States should promote land and vegetation management practices that are best for wildland ecosystems, yet protect public health and avoid visibility impairment;
- States/tribes should foster collaborative relationships among wildland owners/managers, air quality managers and the public in developing and implementing SMPs;
- States/tribes should be allowed the flexibility (prior to measuring violations of the $PM_{2.5}$ or PM_{10} NAAQS attributable to fires managed for resource benefits) to decide when a SMP is needed and how the program will be designed to prevent adverse air quality impacts;
- The SMP does not preclude wildland owners/managers from including smoke management components in burn plans for fires they conduct in the absence of an applicable State/tribal program;
- All parties (wildland owners/managers, air quality managers and the public) are expected to act in good faith and will be held accountable for implementing their respective parts of fire and smoke managements plans.

2.1 Climate Factors

According to the Illinois State Water Survey (ISWS), the climate in Illinois has five major controlling influences: the latitude and solar input; weather systems caused by the large scale circulation of the atmosphere; topography; Lake Michigan; and cultural effects. The sun's energy is higher in the southern part of the state than in the north, contributing to a gradient in temperatures throughout Illinois with the south generally warmer than the north. Weather systems have a noticeable effect on precipitation, clouds, and winds during the fall, winter and spring when the jet stream is often located over or near Illinois.

The other controlling factors affect climate on a more local scale. In the Shawnee Hills across southern Illinois, elevation or topographic changes influence precipitation, while Lake Michigan provides a moderating influence which produces cooler summers and warmer winters near the lake compared to inland locations. Finally, urban areas tend to be warmer than the surrounding countryside and contribute to precipitation downwind of the city due to the urban "heat island" effect.

The above climatic factors result in different temperatures, precipitation, and types of severe weather in northern Illinois compared to southern Illinois. Annual temperatures average 48ºF in the north and 58ºF in the south. Summer temperatures are consistent across the state with lows in the 60s and highs

in the 80s. During other seasons, there is an approximately 10ºF difference between the north and south, with the north cooler on average than the south. Precipitation also varies north to south. The north receives 32 inches of precipitation on average and the south receives 48 inches. The north receives considerably more snowfall, while the south has more days with an inch or more of precipitation. Overall, May and June are the wettest months and January and February are the driest.

2.2 Use of Fire as a Land Management Tool

Prescribed fire is a tool used by natural resource land managers to accomplish natural resource restoration and management objectives which include:

- Controlling invasive species.
- Increasing moisture filtration into the soil.
- Opening the dense vegetation to allow light penetration to the soil for plant growth.
- Enhancing habitat diversity by increasing plant quality/vigor and increasing the quantity of wildlife and plants.
- Increasing nutrient cycling by fixing nitrogen in the soil from burn debris.
- Reducing thatch build-up that can lead to dangerous fires.
- Helping to maintain and protect listed species and dedicated Illinois Nature Preserves and Land and Water Reserves. The State of Illinois has statutorily mandated the IDNR to protect these species and State designated natural areas.

As noted above, prescribed burning generates emissions that can negatively impact public health and safety; however, if prescribed burns are implemented correctly, such impact will be negligible. Several reasons listed below account for this and will be highlighted in the SMP.

1. Prescribed fires are implemented when fuels are dry, limiting greater emissions.
2. Prescribed fires are implemented when Pollution Action Days are unlikely to occur.
3. Prescribed fires are implemented on days when smoke dispersal conditions are optimal.
4. Prescribed fires are implemented under specific weather conditions to reduce emissions.
5. Prescribed fires prevent fuel build-up which can lead to unplanned wildland fires occurring during inappropriate times.
6. Prescribed fires promote vigorous herbaceous plant growth, which stores atmospheric carbon in the roots and soil of these habitat areas, thereby offsetting carbon dioxide emissions.

Properly implemented, prescribed fire will provide excellent benefits to the natural ecosystem while reducing potential health and safety issues. The resulting improvement to the natural ecosystems found within the State of Illinois will increase the quantity and aerial coverage of native plants. These native plants are excellent filters of pollutants from the air while storing vast amounts of atmospheric carbon in the extensive roots systems.

Implementation of the SMP will assure that land managers in Illinois will be conducting prescribed burns in a manner that minimizes impacts to air quality, while allowing the appropriate use of an important management tool.

2.3 Reasons for Having a Smoke Management Plan

The SMP is intended to provide a basic framework of procedures and requirements for managing smoke from prescribed fires. The SMP is typically developed by States/tribes with cooperation and participation by wildland owners/managers. The purpose of the SMP is to mitigate the nuisance and public safety hazards posed by smoke intrusions into populated areas (e.g. on roadways and at airports); to prevent impacts to human health due to deterioration of air quality; to prevent NAAQS violations; and to address visibility impacts in mandatory federal Class I areas (U.S.EPA 1998). The NAAQS referred to here are for particulate matter less than 2.5 microns ($PM_{2.5}$) and particulate matter less than 10 microns (PM_{10}).

U.S.EPA encourages the use of SMPs to minimize impacts of burning activities on air quality and visibility impairment, without prohibiting the use of fire for land management. U.S.EPA supports and is willing to partner with Federal, State, Tribal and private land managers to ensure equitable and appropriate use of fire while meeting air quality goals and standards.

According to the U.S.EPA's "Interim Air Quality Policy on Wildland and Prescribed Fires" (Interim Policy, April 1998), "strong indications" that a SMP is necessary are:

1. Citizens increasingly complain of smoke intrusions;
2. The trend of monitored air quality values is increasing (approaching the 24-hour or annual NAAQS for $PM_{2.5}$ or PM_{10}) because of significant contributions from fires managed for resource benefits;
3. Fires cause or significantly contribute to monitored air quality that is already greater than 85 percent of the daily or annual NAAQS for $PM_{2.5}$ or PM_{10}; or
4. Fires in the area significantly contribute to visibility impairment in mandatory Federal Class I Areas.

There are two areas in Illinois, the Chicago metropolitan area and the Metro-East area of St. Louis, which are currently designated as nonattainment for the $PM_{2.5}$ NAAQS. Illinois does not have a federal Class I area. To date there is no evidence that fire emissions are significantly contributing to $PM_{2.5}$ violations; however fire emission can be measured as a component of particulate levels in these areas.

Two primary reasons exist for developing a SMP for Illinois. First, a significant increase in the use of prescribed fire is anticipated in Illinois. There is a nationwide trend among federal and state and local land managers to increase the use of prescribed fire on the landscape in order to improve habitat for plant and animal communities, increase biodiversity and productivity, and reduce fuel loads that are largely due to a long history of fire suppression in wildlands. Public agencies and non-governmental organizations in Illinois anticipate a continued increase of acres treated using prescribed burning. These agencies/organizations anticipate an increasing trend in the next five years.

Second, the goal of the Illinois SMP is to utilize a voluntary program to prevent future PM NAAQS violations related to emissions from prescribed fire management for resource benefit. Implementation of the SMP by land management agencies as well as the private sector should reduce potential emissions and smoke impacts from prescribed fires so that emissions do not cause or

contribute to NAAQS violations. As explained in the U.S.EPA interim policy document, states that implement U.S.EPA-certified SMPs and have exceedances of the PM_{10} or $PM_{2.5}$ standards will not have areas designated as "nonattainment" as a result of those exceedances, if it is demonstrated that prescribed fires significantly contributed to the air concentrations of pollutants that exceeded the standards. This policy provided by U.S.EPA for implementation of a SMP can be very important if an area of a state were to have exceedances of the air quality standards due to smoke from prescribed burning. (Under U.S.EPA's "Natural Events Policy," smoke from wildland fire is not counted against an area when determining attainment of the NAAQS.). This policy is outlined in U.S.EPA's Exceptional Events Rule dated March 22, 2007 (72 FR 13560).

According to the National Fire and Aviation Executive Board, prescribed fire is defined as any fire ignited by management actions to meet specific resource management objectives. Prescribed fire qualifies as an exceptional event if it meets the following criteria:

- Unlikely to recur at the same location and not reasonably controllable or preventable; and
- Where the State certifies that a smoke management program or that basic smoke management practices were in place.

States are provided flexibility regarding the structure of the SMP; thus, a SMP can be extensive and detailed, or simply identify the basic smoke management practices for minimizing emissions and controlling impacts from prescribed fire (burn plan practices).

If an area of a state has been designated as a nonattainment area for the $PM_{2.5}$ or PM_{10} NAAQS, the CAA requires the state to prepare a SIP that is submitted to U.S.EPA for approval. The SIP sets forth measures that the state will undertake to reduce emissions of designated pollutants and attain and maintain the NAAQS. Air monitors for $PM_{2.5}$ and PM_{10} collect air samples that are analyzed to measure emissions of specified pollutants. Monitoring is also used to improve air pollution models. Air modeling is done to determine the sources of the pollutants and the effect of emission reductions on the concentrations of those pollutants. The SIP requirements can include restrictions on the construction of new sources of emissions, or emissions reductions for existing sources whose emissions contributed to the violations.

2.4 Planning Process and Participants

The planning process for this document began in early 2004. Over the course of the next two years, discussions were held with U.S.EPA, multiple states, the U.S. Department of Agriculture, USFS, and IDNR staff regarding SMP requirements and framework development. A meeting was held on October 17, 2007 to facilitate efforts to develop a SMP for the State of Illinois. Following this meeting, a multi-agency committee was formed to develop a state-wide SMP. Committee participants include: representatives from the USFS, IDNR, Illinois EPA, TNC, Lake County Forest Preserve and the Forest Preserve District of Cook County. This document is the product of this committee.

3.0 Compliance and Responsibilities

The U.S.EPA does not directly regulate the use of fire within a State. The U.S.EPA's authority is to enforce the requirements of the CAA. The CAA requires States and tribes to attain and maintain the NAAQS adopted to protect public health and welfare.

3.1 Environmental Laws and Regulations

Prior to 1990 the CAA did not directly address prescribed burning. However, the 1990 Clean Air Act Amendments (CAAA) contains a number of provisions that may result in both direct and indirect regulatory controls. As a result of the CAAA, regulatory rules referenced as, Regional Haze Regulations (64 FR 35714) were developed to address impairment of visibility and emission reductions.

3.1.1 The Clean Air Act and Visibility

Regulatory requirements regarding visibility and regional haze date from 1977 when Congress addressed sources and air pollutants which "...may reasonably be anticipated to cause or contribute significantly to impairment of visibility." In 1980, USEPA established rules addressing "reasonably attributable" sources of visibility impairment, which is to say, individual sources or groups of sources whose emission "plumes" could be observed to affect visibility in federal Class I areas.

In 1990, Congress amended the CAA adding requirements addressing regional haze. In 1999, the U.S.EPA published final rules that required SIP submittals by all states and implementation of "reasonable progress goals" for all federal Class I areas. (The regional haze rules and related information can be found at this U.S.EPA website: http://www.epa.gov/ttn/oarpg/). The regional haze SIP will include emission reductions necessary to meet a goal of showing continuous improvement in visibility in the Federal Class I Areas on the 20 percent "worst" days, and no degradation of visibility on the 20 percent "best" days, as determined by IMPROVE monitoring data. The national goal is to achieve "natural background" visibility in all federal Class I areas by 2064. Emission reductions are to be achieved from all sources in the state, including prescribed burning. Although it is not required, the present SMP may be submitted to the U.S.EPA as part of the regional haze SIP. The first regional haze SIP was due in December 2007 with review every 5 years and revision every 10 years.

3.1.2 Visibility Emissions from Fire

Both the scattering of light and the absorption of light by particles in the atmosphere reduce visibility. Light transmission is inversely related to the concentration of small particles in the air. Because of this correlation, measured levels of $PM_{2.5}$ can be used to calculate visibility impairment. IMPROVE monitors measure different chemical species of $PM_{2.5}$ (and PM_{10}) in air samples so that the effect of different pollutants on visibility can be determined.

Vegetative burning produces various chemical compounds. These compounds include nitrogen oxides (NOx), organic compounds, carbon monoxide, and PM. The pollutants that affect visibility that derive from vegetative burning are PM_{10}, $PM_{2.5}$, nitrates, ozone, organic carbon, and elemental carbon. Ozone, which can form "smog" or haze, is not directly produced by fires, but from chemical reactions in the atmosphere of precursor pollutants (primarily NOx and volatile organic compounds,

VOCs). Air quality tests indicate that 90 percent of smoke particles from wildland and prescribed fires, depending on organic compounds, are composed of PM_{10} while about 70 percent of PM_{10} is composed of $PM_{2.5}$ (Interim Policy, USEPA 1998).

3.1.3 National Ambient Air Quality Standards

Both PM and ozone are "criteria" pollutants, meaning that there are NAAQS established to limit concentrations of these substances in the air. This means that emissions of these pollutants and their precursors from fire can contribute to exceedances of these air quality standards. There are no national or state air quality standards for organic carbon particles or for elemental carbon. However, these pollutants are measured by the IMPROVE monitors, as are other $PM_{2.5}$ species, so concentrations in air samples will be used to measure long-term improvement in visibility. The modules of an IMPROVE monitor measure sulfates, nitrates, organic carbon, elemental carbon (which are all $PM_{2.5}$) and PM_{10}. The IMPROVE monitors inside or adjacent to the federal Class I areas can be considered "compliance" monitors that measure degradation in regional haze due to air pollutants. The IMPROVE monitoring network is designed for measurement of the composition and concentration of the fine particles that cause light extinction that affects visibility within Federal Class I areas. Any similar monitoring outside of Class I areas does not need to conform to the standards or methods that are set forth in the IMPROVE program. Additional sites, known as IMPROVE Protocol sites, exist in Illinois and are used primarily to expand monitoring coverage and improve the understanding of PM and haze in regions without federal Class I areas.

U.S.EPA has established PM air quality standards that differentiate particulate matter based on the size of individual particles. The PM_{10} NAAQS targets suspended PM that is ten microns or less in aerodynamic diameter. Similarly, $PM_{2.5}$ refers to particulate matter that is less than 2.5 microns in aerodynamic diameter.

U.S.EPA established the PM_{10} NAAQS in 1987. There are two forms of the PM_{10} standards: a 24-hour average concentration and an annual average concentration. U.S.EPA issued a revised standard for PM_{10} that took effect on September 16, 1997. The annual standard was 50 micrograms per cubic meter of air (ug/m^3), calculated as an arithmetic mean of three years of values. The 24-hour standard is 150 ug/m^3 calculated as a three-year average of the 99^{th} percentile of measured samples. In October of 2006, the PM_{10} standard was revised. The effective date for the new standard was December 18, 2006. In this action, U.S.EPA retained the 150 ug/m^3 for 24-hour PM_{10} and revoked the 50 ug/m^3 annual PM_{10} standard.

There are presently 18 PM_{10} monitors operating in Illinois. Illinois is considered attainment for PM_{10}; however, Illinois currently has four PM_{10} maintenance areas where PM_{10} violations have occurred in the past. A maintenance area is defined as any geographic region previously designated nonattainment pursuant to the CAAA and subsequently redesignated to attainment subject to the requirements of Section 175A of the CAAA. Two of the four maintenance areas are located in Cook County, and referenced as the Lyons Township and Lake Calumet (Southeast Chicago) maintenance areas. A third is located in Madison County and is identified as the Granite City and Nameoki Township maintenance areas. The fourth area is located in LaSalle County and is referenced as the Oglesby maintenance area.

In 1997, U.S.EPA established annual and 24-hour NAAQS for $PM_{2.5}$ for the first time. In October 2006, U.S.EPA revised the 24-hour NAAQS for $PM_{2.5}$. The revised standard for $PM_{2.5}$ took effect on December 18, 2006. The NAAQS for $PM_{2.5}$ has both annual and 24-hour average times. The annual standard is 15 ug/m^3, calculated as the arithmetic mean of three years of annual averages. The 24-hour standard was strengthened in 2006, from 65 ug/m^3 to 35 ug/m^3, and is calculated as a three-year average of the 98^{th} percentile of measured daily concentrations.

There are presently 38 $PM_{2.5}$ monitors around the state, with 19 located in the Chicago metropolitan area, three in northern Illinois, four in east central Illinois, three in west central Illinois, eight in the Metro-East St. Louis area and one in southeast Illinois (see Appendix A). In addition to these "mass" monitors that measure total $PM_{2.5}$, Illinois also has $PM_{2.5}$ speciated samplers that are located in populated areas. Speciated samplers measure individual components of $PM_{2.5}$. During the period of 2004 – 2006, Illinois values show an average of 17 violations of the 24-hour standard for total $PM_{2.5}$. The highest values are at monitors in the Chicago metropolitan area.

Ozone (O_3) is a gas composed of three oxygen atoms. It is not usually emitted directly into the air, but is created in the atmosphere by chemical reactions between NOx and VOC in the presence of sunlight.

In 1997, U.S. EPA replaced the previous one-hour ozone standard with an 8-hour standard. The 1997 NAAQS for ozone is 0.08 parts per million (ppm), calculated as an average of three years of the fourth highest 8-hour values.

U.S. EPA recently strengthened the air quality standards for ground-level ozone. On March 12, 2008, U.S. EPA revised the level of the 8-hour ozone standard to 0.075 parts per million (ppm). With regard to the secondary standard for ozone, U.S. EPA is revising the current 8-hour standard by making it identical to the revised primary standard. These changes will improve both public health as well as protect sensitive trees and plants.

There are presently 20 ozone monitors around the state with the majority of the monitors located in the Chicago metropolitan area.

3.2 Agency Authority

According to Illinois' Environmental Protection Act, the Illinois Pollution Control Board has the authority to adopt regulations that protect federal air quality standards. It is the responsibility of the Illinois EPA to develop and propose new regulatory requirements, and then to implement and enforce regulations adopted by the Board. If air monitoring in a state exceeds the NAAQS for a criteria pollutant, then the area that exceeds the standard is designated as a "nonattainment" area, meaning it does not "attain" or meet the standard. Section 110 of the CAA requires states with NAAs to submit a SIP to the U.S.EPA that contains enforceable measures to reduce emissions affecting the area, in order to attain and maintain compliance with the standard. Section 110 requires that each plan include "enforceable emission limitations and other control measures" for facilities and sources that contribute to a violation of the standard. The plan must also regulate the construction and modification of stationary sources within the areas covered by the plan and contain adequate provisions prohibiting any source "or other type of emissions activity within the state from emitting any air pollutant in amounts which will contribute significantly to nonattainment in any

other state."

By implementing the requirements of a SIP that have been approved by the Board and the U.S.EPA, the Illinois EPA ensures compliance with air quality standards in Illinois. There are four regulatory instruments that can be included in a SIP in order for an area to attain and maintain an air quality standard.

1. **Statutory requirements** might be imposed by the state legislature on particular sources that would be enforced by the Illinois EPA, with or without rulemaking by the Agency.

2. **State rulemaking** through the Board might be undertaken to impose emissions reductions on particular pollution sources.

3. **Administrative orders through a court system** might be issued to individual facilities with requirements for compliance with lower emission limits.

4. **The air pollution operating permit** issued to a particular source that limits the amount of pollution that can be emitted to the ambient air might be amended to reduce air emissions that affect regional haze. Violations of permit conditions are subject to enforcement action.

Historically, options 3 and 4 have been used when nonattainment areas are small and relatively few sources contribute to the problem. Violations of statutes, rules, orders, or permit conditions are subject to enforcement action by the state. These same measures might be incorporated into a regional haze SIP in order to implement a statewide program of continuous improvement in visibility.

Existing air quality regulatory programs and the regional haze program are related by the implementation plans developed by the states (i.e., SIPs). As described above, areas within a state are subject to designation by the U.S.EPA as "attainment" or "nonattainment" with the NAAQS. A SIP must be submitted to, and approved by, the U.S.EPA for any areas that do not meet ("attain") any one of the NAAQS. Such a SIP is a separate document from the regional haze SIP.

The regional haze SIP will be prepared by the Illinois EPA to directly address emissions that cause visibility impairment in Federal Class I Areas. A regional haze SIP developed by a state will be a plan that describes all measures the state will implement to reduce regional haze. For this reason, although a NAAQS SIP and the regional haze SIP are two different plans, the haze SIP would also include all measures that have been included in a SIP for a visibility pollutant.

4.0 Elements of the Illinois Smoke Management Program

This section describes the components of Illinois' Smoke Management Program. The following topics are addressed:

- authorization to burn from the Illinois EPA
- ways to address smoke management in the preparation of the prescribed burn plan;
- actions to consider to minimize smoke impacts;
- how to estimate the amount of fuels to be consumed by the prescribed fire;
- identification of smoke sensitive populations and areas;
- public notification and procedures to reduce human exposure;
- monitoring of air quality impacts;
- consideration of weather conditions to ensure maximum dispersion;
- consideration of Air Pollution Action Days and the Air Quality Index;
- public education and awareness;
- surveillance and enforcement;
- program evaluation.

4.1 Authorization to Burn

The Illinois EPA issues permits for open burning in Illinois pursuant to the Illinois Pollution Control Board regulations (part 237). Federal and state agencies are required to comply with state burning regulations (CAA Sec. 118). Open burning permits for prairie and ecological management are obtained from the Illinois EPA, Division of Air Pollution Control, Permit Section. Applications for "open burning" permits are also available on the internet at: www.epa.state.il.us/air/permits/openburn/index.html

Burn managers will monitor Illinois EPA alerts for areas of "Air Pollution Action" days. In areas of the State with "Air Pollution Action" days, prescribed burners are expected to cease all burning.

4.2 Preparation of the Burn Plan

The prescribed burn manager should take measures to reduce the impact of smoke. To this end, at a minimum, the prescribed burn plan must include the following elements:

- Location and description of the area to be burned.
- Illinois EPA office, local fire department or sheriff's office to be contacted.
- List of occupants to be contacted that may have significant smoke impacts from the prescribed fire.
- Personnel responsible for managing the fire.
- Type of vegetation to be burned.
- Number of acres to be burned.
- Amount of fuel to be consumed (tons/acre).
- Fire prescription, including weather, ignition techniques, personnel and equipment.

- If available, documentation (along with any maps or tables) from atmospheric dispersion models/smoke dispersion prediction models which present information on what impact the smoke may have on any smoke sensitive areas.
- Optimal wind direction for the burn
- Actions needed to stop a burn if weather conditions degrade from the forecast values.
- Smoke management criteria the fire manager will consider when making burn/no burn decisions.
- Safety precautions for personnel on the prescribed fire.
- Areas of concern around the burn unit, i.e. schools, major roadways, etc.

4.3 Actions to Minimize Smoke Impacts

The prescribed fire plan should document the steps taken before, during and after the burn to reduce smoke impacts. Where applicable, use one or more of the following approaches:

- Reduce the size of the burn to achieve the allowed emissions.
- Utilize different firing techniques to accomplish burn objectives and minimize smoke emissions. For example: Use of backing, strip-head, flanking, and dot firing patterns, etc.
- Reduce the fuel loading in the area to be burned by mechanical methods or by using frequent, low-intensity burns to gradually reduce fuels.
- Reduce the amount of fuel consumed by the fire by burning when fuel moistures for the larger fuels and duff moistures are high.
- Record smoke dispersion behavior during the burn rapid and complete mop-up after the burn or mop-up of certain fuels.
- Use alternative techniques to vegetation management, such as herbicides, where appropriate.

4.4 Estimate the Amount of Fuels to be Consumed by the Prescribed Fire

Determining the amount of fuel to be consumed by the prescribed fire is an important part of the smoke analysis. Prescribed burn managers should examine the results of their analysis to determine if the prescribed fire could be divided into smaller units since the prescribed burn at issue may not be the sole burn in the vicinity.

A wide variety of fuel types and conditions are found in Illinois. Table 1 describes those fuel types that are found in greatest quantities on typical prescribed fire sites. In most prescribed fires, "available" tons of fuel will be less than "total" tons of fuel. Due to fuel moisture and other factors, the burn may not consume all the fuel. The prescribed burn manager must provide reasonable estimates of the total amount of available fuels that will be burned by the prescribed fire. The prescribed burn manager may need to consider a higher fuel loading estimate than shown in Table 1 for forests that have never been burned or have been impacted by pests, diseases, storm damage, or other factors.

Fuel models are composed of fuel size classes, which are determined by the length of time it takes for fuels to reach 63 percent of the equilibrium moisture content. The sizes of the dead fuel classes are 1 hour - 0 to 1/4 inch; 10 hour - 1/4 to 1 inch; 100 hour - 1 to 3 inches; 1,000 hour - 3 to 7 inches.

Some fuel models also have a "Live" fuel component that adds to the flaming front as it dries from preheating.

To calculate fuel loading during the prescribed fire planning process, agencies should first use site-specific data if available. Lacking this type of data, other local sources of information should be used, such as the National Wildfire Coordinating Group's "Stereo Photo Series for Quantifying Natural Fuels, Volume 5." Table 1 below contains fuel-loading information from the Anderson fuel model series, which can serve as a third source of fuel loading information.

Table 1 Fuel Loading-Tons per Acre*

Fuel Model	Fuel Type	1 hr	10 hr	100 hr	Live	Total
1	Short grass (1 foot)	.74	0	0	0	.74
2	Timber, grass understory	2.0	1.0	.5	.5	4.0
3	Tall grass (2.5 feet)	3.0	0	0	0	3.0
8	Closed timber litter	1.5	1.0	2.5	0	5.0
9	Hardwood litter or long needle pine litter	2.92	.41	.15	0	3.48
10	Timber (litter & understory)	3.0	2.0	5.0	2.0	12.0
11	Light slash	1.5	4.5	5.5	0	11.5
12	Medium slash	4.0	14.0	16.5	0	34.5
13	Heavy slash	7.0	23.0	28.0	0	58.0

*Fuel models 4, 5, 6 and 7 are not widely used in Illinois. This chart is a general reference guide. For more information on fuel loading, refer to "Aids to Determining Fuel Models for Estimating Fire Behavior" by Hal E. Anderson, General Technical Report INT-122, available from the National Interagency Fire Center in Boise, Idaho.

Once the amount of fuels that will be consumed has been determined, multiply the value times the amount of acres to be burned. For example, if an organization plans to burn 300 acres of hardwood leaf litter (Fuel Model 9 in Table 1); the prescribed fire would be expected to consume 1,044 tons of fuel (3.48 tons/acres X 300 acres).

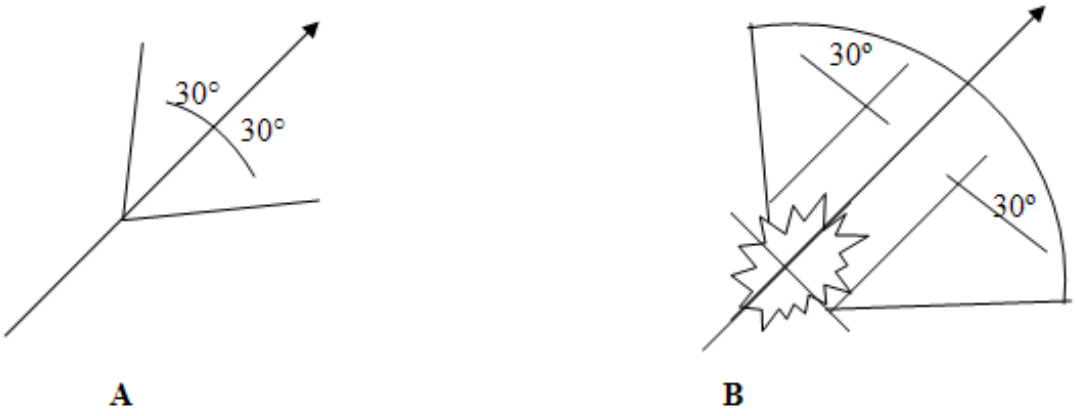
4.5 Identification of Smoke Sensitive Populations and Areas

Prescribed fire plans should identify and evaluate potential smoke impacts on sensitive receptors. The plan should identify the distance and direction from burn site to local sensitive receptor areas where appropriate.

Efforts should be made to keep smoke away from sensitive populations and areas, such as communities, schools, hospitals and nursing homes, airports, four-lane and larger highways, and

industrial areas. Industrial areas may include areas that are already experiencing an air pollution or visibility problem. Smoke-sensitive targets may be determined using the following steps:

1. Locate on a map the prescribed fire and all potential smoke sensitive targets (such as airports, highways, hospitals, schools etc), plus areas known to already have air pollution problems. (consider targets up to 30 miles from the prescribed fire.)
2. Determine the wind direction that will have the least impact on smoke sensitive targets.
3. Draw a line representing the centerline of the path of the smoke plume using the wind direction chosen in the previous step.
4. Determine the distance from the edge of the prescribed fire to the nearest smoke sensitive target.
5. To allow for the 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). If a prescribed fire is represented as a spot, draw as in Figure A. If larger, draw as shown in Figure B.



Figures A and B

Additionally, the prescribed burn managers should evaluate frequently traveled roads within one mile of the prescribed fire, especially if these roads are down wind or down smoke-drainage 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.

Planning and public notification are recommended when igniting large areas in a short time period, such as 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 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 actually develops.

4.6 Public Notification and Exposure Reduction Procedures

The prescribed fire plan should identify actions that will be taken to notify people and authorities at "smoke-sensitive areas" before the prescribed fire. The prescribed fire plan should identify contingency actions that will be taken during a prescribed fire to reduce the exposure of people at smoke-sensitive areas, if smoke intrusions occur. Appropriate contingency actions may include:

1. Provide information regarding upcoming burning activities on an internet website if available.
2. Post signs at location of the burn(s).
3. Suggesting actions be taken by sensitive persons to minimize their exposure (e.g. remain indoors, leave the area, avoid vigorous activity, avoid exposure to tobacco smoke and other respiratory irritants).
4. Halting ignitions of any additional prescribed burning that could add smoke to the same area.

4.7 Monitor Air Quality

The prescribed fire plan should include monitoring of the smoke from the prescribed fire. The extent of the monitoring should be commensurate with the size of the fire. For small, or short duration fires (such as those in grass or leaf litter), visual monitoring of the direction of the smoke plume and monitoring nuisance complaints by the public may be sufficient. Other monitoring techniques include: posting personnel on vulnerable roadways to look for visibility impairment and to initiate safety measures for motorists; posting personnel at other smoke sensitive areas to look for smoke intrusions; using aircraft to track the progress of smoke plumes; and continued tracking of meteorological conditions during the fire. For prescribed fires in fuels with longer duration burning (such as timber litter or slash), and which are expected to last more than one day, locating real-time PM monitors at smoke-sensitive areas may be warranted to facilitate timely response to smoke problems.

4.8 Consideration of Weather Conditions and Smoke Dispersion

The National Weather Service (NWS) forecast offices that serve Illinois provide a twice-daily fire weather forecast with 12-hour forecast intervals during spring and fall fire seasons for much of the state. The fire weather forecast includes smoke management information and is available by 0600 hours and 1500 hours. The seasonal range is flexible, but will normally run from February 15 – May 1 and October 1 – November 30. The forecast consists of a brief weather discussion and a detailed forecast of weather temperatures, relative humidity, winds and smoke dispersion parameters. Site specific (spot) forecasts are non-routine products issued upon request of users. Prescribed burn managers who intend to ignite burns, should consult their local National Weather Service office or consult their website for their area to determine the anticipated ventilation index (dispersion category) at the time of ignition. Prescribed fire managers who plan ignitions at times other than forecast times, may request ventilation/dispersion criteria as part of the spot weather forecast from the NWS. Fire weather information for Illinois is available at the following websites:

Lincoln - central and southeast Illinois - http://www.crh.noaa.gov/ilx/firewx.php

Chicago - northeast Illinois - http://www.crh.noaa.gov/lot/?n=firewx

Paducah, KY - far southern Illinois - http://www.crh.noaa.gov/pah/?n=firewx

St. Louis, MO - southwest Illinois - http://www.crh.noaa.gov/lsx/?n=firewx

Davenport, IA - northwest Illinois -http://www.crh.noaa.gov/dvn/?n=fireweather (*NOTE: Davenport provides spot forecasts, not routine fire weather forecasts.)*

To ensure optimum dispersal of smoke emissions during prescribed burns, the mixing layer must be deep enough and with sufficient transport wind speed to ensure the dilution and dispersal of emission concentrations. Ventilation is a function of atmospheric stability, mixing height, and transport wind speed. Ventilation information is included as part of the daily fire weather forecast. The fire weather forecast which is issued twice daily, describes the mixing height, transport wind speed, as well as an average ventilation rate (vent rate) for an area in its forecast. Table 2 provides a ventilation index (also known as the Dispersion Index), which is determined by multiplying the mixing height (measured in feet) and transport wind speed (measured in knots). The index describes the ability of the atmosphere to disperse emissions. As the ventilation index increases so will the ability of the atmosphere to disperse smoke in an effective manner (exceptions noted below). Due to the fact that the ventilation index is also reported in meters squared per second (m^2/sec) and miles per hour feet (mph-ft) by different NWS offices, these additional units are provided in Table 2.

Table 2 Ventilation Index

VENTILATION INDEX (m^2/sec)	VENTILATION INDEX (mph-ft)	VENTILATION INDEX (knot-feet)	DISPERSION CATEGORY
> 23,445	> 172,617	> 150,000	Excellent
15,630 – 23,445	115,078 – 172,617	100,000 – 150,000	Very Good
9,378 – 15,630	69,047 – 115,078	60,000 – 100,000	Good
6,252 – 9,378	46,031 – 69,047	40,000 – 60,000	Fair
< 6,252	< 46,031	< 40,000	Poor

NOTE: In using the Ventilation Index, exercise caution with high transport wind and low mixing height or low transport wind and high mixing height which, although they combine to give an acceptable category, can inhibit smoke dispersion, as well as potential control problems!

When utilizing the ventilation index it is important to take into consideration the total fuel load being burned, both in terms of fuel loading (tons of fuel per acre) and total area to be burned (see Table 1). The proximity of downwind smoke sensitive areas to the burn unit should also be considered; prescribed burns may be safely conducted when lower total fuel consumption is expected and when the smoke sensitive area is farther away. Conversely, when higher total fuel consumption is expected and the smoke sensitive area is closer to the prescribed burn unit, conditions should be in higher ventilation categories to safely conduct the burn. In addition, steps taken which reduce the total fuel available for consumption can lower the acceptable dispersion category.

Below are two methods for utilizing the ventilation index to mitigate smoke impacts during burn plan formulation. The first method (Method A), may be used as a general guide to utilizing the ventilation index to screen for downwind smoke sensitive receptors and is recommended for burns with low to moderate potential for smoke impacts. The second method (Method B) is more rigorous and is recommended for complex prescribed burns with a high degree of potential for smoke impacts. Note that these are voluntary guidelines which may vary by the local unit's definition of smoke sensitive receptor and the ability to mitigate potential smoke problems by instituting traffic controls when smoke could impact major roads or by burning under fuel moisture conditions which limit consumption of heavier fuels.

Method A: Recommended for prescribed burns where there is a low – moderate degree of potential for smoke impacts.

1. Use Table 3 below to determine the recommended minimum distance to downwind smoke sensitive areas for your burn(s). On a map, locate any downwind sensitive receptors that could be impacted from your smoke.
2. Determine the general fuel category of the burn area (e.g. grass, leaf litter, timber, slash, piled fuels). Select that category in the table. For burns with multiple fuel categories, utilize the fuel model which best characterizes the majority of the area.
3. In the second column select the acreage to be burned for the single day (daily basis).
4. Select the proper Dispersion Category from Table 2, and look at the corresponding row in Table 3 to determine the recommended minimum distance the burn should take place upwind of a sensitive receptor.

Method B: Recommended for Complex Prescribed Burns where there is a high potential for smoke impacts.

1. Estimate the fuel loading for the area to be burned. This may be done formally, utilizing site-specific survey data if available or by consulting the fuel model information found in Table 1.
2. Determine the acreage to be burned in one day.
3. Estimate the expected fuel consumption using hand calculations or computer models such as First Order Fire Effects Model (FOFEM) or CONSUME. Selection of higher fuel moistures (such as higher 100 and 1,000 hour fuel moisture), which will reduce the fuel available for consumption, should be factored into the calculations.
4. Determine the total PM_{10} and $PM_{2.5}$ emissions per day based on outputs from previous bullet (#3).
5. Locate downwind sensitive receptors that could be impacted from your smoke.
6. Utilize a dispersion computer program such as the Simple Approach Smoke Estimation Model (SASEM) or V-SMOKE to screen for the potential to exceed ambient air quality standards.

Table 3 Minimum Distances to Smoke Sensitive Areas

General Fuel Category	Daily Fire Size (acres)*	Dispersion Category	Minimum Distance to Downwind Smoke Sensitive Areas (miles)
Single large pile or Scattered small piled fuels	NA	POOR	0.25
	NA	FAIR or BETTER	No limitation
Grass or Leaf litter	< 50	POOR	0.25
	< 50	FAIR or BETTER	No limitation
	50 - 150	POOR	No burning
	50 - 150	FAIR or BETTER	No limitation
	150 - 500	POOR	No burning
	150 - 500	FAIR	0.25
	150 - 500	GOOD or BETTER	No limitation
	500+	POOR	No burning
	500+	FAIR	0.75
	500+	GOOD	0.50
	500+	EXCELLENT	0.25
Timber, slash, or piled fuels	< 50	POOR	No burning (See above exception for pile(s))
	< 50	FAIR	0.50
	< 50	GOOD or BETTER	No limitation
	50 -150	POOR	No burning
	50 - 150	FAIR	0.50
	50 - 150	GOOD or BETTER	No limitation
	150 - 500	POOR	No burning
	150 - 500	FAIR	0.75
	150 - 500	GOOD	0.50
	150 - 500	EXCELLENT	0.25
	500+	POOR	No burning
	500+	FAIR	1.0
	500+	GOOD	0.75
	500+	EXCELLENT	0.50

*Assumes no more than one unit within a 5-mile radius.

Note: On Poor Category days no burning is suggested within ¼ mile of any downwind smoke sensitive area and is not recommended in general.

Night Time Burning

Residual night burning requires the same planning as daytime burns; however, 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 or residual night burning may help achieve other objectives, it may aggravate smoke management problems. In general, prescribed burning

should be conducted during day time hours and concluded at sunset. Preferred hours to initiate a prescribed burn are between 8:00 A.M. and 4:00 P.M. Central Standard Time and 9:00 A.M. and 5:00 P.M. when Central Daylight Savings Time is in effect. In the event that residual night burning is required, these special circumstances should be documented and the following recommendations should be considered:

1. Burn in light fuels
2. Use back firing
3. Burn when humidity is 80 percent or less
4. Do not burn if overnight low is within 5 degrees of dew point
5. Burn with surface wind speed of 5 miles per hour or more
6. Obtain a nighttime dispersion index. Monitor down drainage and low areas, especially populated areas, airports or roads near the burn area.

Special Smoke Concerns

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

1. Transport wind speed exceeds 25 mph and average wind speed is over 20 mph with stronger gusts.
2. Transport wind direction carries smoke over a large lake.
3. A thick layer of smoke from a large burn significantly reduces the heating of the ground.

Transport wind direction moves smoke from a fire on the slope of a ridge toward and over the top of a ridge. Smoke may return to the ground in an eddy that can develop on the lee side of the ridge.

4.9 Air Pollution Action Days and Air Quality Index

The Illinois EPA collects air quality data from a network of air monitoring stations located throughout the state. When data from these monitors indicate conditions are conducive for unhealthful levels of ozone and/or PM, an “Air Pollution Action Day” will be declared. On an “Air Pollution Action Day” the public is advised to avoid ozone and or fine particle-generating activities until the health threat has passed. “Air Pollution Action Day” information is accessible on the internet at http://www.epa.state.il.us/air/aqi/index.html. This website can be checked on a daily basis. Prescribed burn managers should not initiate prescribed fires on “Air Pollution Action Days.”

The Illinois EPA also participates in the development of the Air Quality Index (AQI). The AQI is an index for reporting daily air quality and is an indicator of expected local air quality. The higher the AQI value, the greater the level of air pollution and the greater the health concern. An AQI value of 100 generally corresponds to the NAAQS for the pollutant. An AQI of 0-50 is good, 51 – 100 is moderate, 101 – 150 is unhealthy for sensitive groups, 151 – 200 is unhealthy, 201 – 300 is very unhealthy, and values greater than 300 are hazardous. The U.S. EPA has assigned a specific color to each AQI category. For example, the color orange means that conditions are "unhealthy for sensitive groups," while red means that conditions may be "unhealthy for everyone." Air Pollution Action Days are called when the AQI is forecast to be “unhealthy for sensitive groups,” or considered “code orange” air quality days.

The Air Quality Index (AQI) has recently changed to reflect the new 8-hour ozone NAAQS. AQI categories now reflect the new ozone standard making the upper end of the "moderate" range equal to 0.075 ppm. Other categories have also changed proportionally. Under the revised AQI, ozone levels above 0.075 ppm are considered in the "unhealthy for sensitive groups" category (U.S. EPA, 2008).

4.10 Public Education and Awareness

The Illinois EPA and prescribed fire partners (Federal, State, Local Governmental land management agencies, non-governmental land management agencies, and private individuals) have developed a state-wide prescribed fire council. The agencies and the council will work to explain the importance of prescribed fire in ecosystem management, implications for public health, and the goals for the Illinois SMP. Educational programs include: public presentations, posters, teacher/classroom educational materials, television and radio spots, presentations, as well as the distribution of literature at public events including state and county fairs, and open houses.

4.11 Surveillance and Enforcement

Prescribed burning is conducted under the direct supervision of a certified prescribed burn manager, or burn boss. This prescribed burn manager/boss ensures that the burn is conducted in accordance with the prescribed fire plan. For prescribed fires in nonattainment areas, the burn manager or burn boss should not only be sufficiently trained, but also experienced.

Government entities directly involved in burning activities should have methods and procedures to track and follow up on complaints by the public. The Illinois EPA enforces state air quality laws and regulations and investigates nuisance complaints. Section 9(a) of the Environmental Protection Act is applicable to open burning, i.e. persons affected by such open burning may lodge complaints with the Illinois EPA if the burning is injurious to human, plant or animal life, to health or to property, or unreasonably interferes with the enjoyment of life or property. If it is determined that the actions of any agency burn manager or the burn plan/prescription violates any provision of the guidelines of this SMP, or threatens the public health and safety, he/she will be subject to internal agency review. The Illinois EPA will also notify the identified government entities of such complaint(s) and apprise them of the progress of the investigation. This SMP does not exempt open burning from applicable local restrictions.

4.12 Program Evaluation

Evaluation of the Smoke Management Plan is recommended every 3-5 years and should be reviewed by wildland owners/managers, air quality managers, and the public. This periodic review should include an evaluation of the effectiveness of the program in preventing smoke intrusions. Use of information from nuisance complaints or significant smoke intrusions should be used to the measure the effectiveness of the SMP.

Changes in the SMP should be based on effectiveness and input from all government entities/parties. Information related to acres of fires managed for resource benefits planned for the coming year, acres burned by site location and county, as well as citizen complaints received and resolution of such complaints should be provided to the Illinois EPA in electronic form on an annual basis. Additional

records should be maintained to demonstrate an Exceptional Event, per 40 CFR part 51, Sec. 14 and Part 52, Subpart Y, Treatment of Data Influenced by Exceptional Events; Final Rule. Records should be saved for approximately four years or the duration necessary under U.S.EPA's reporting requirement.

5.0 Glossary

Air Quality Manager -- The regulatory body responsible for managing the air quality protection program for a State, local or tribal government.

Air Quality -- The characteristics of the ambient air (all locations accessible to the general public) as indicated by concentrations of the six air pollutants for which national standards have been established, and by measurement of visibility in mandatory federal Class I areas.

Ambient Air -- That portion of the atmosphere, external to buildings, to which the general public has access.

Attainment Area -- A geographic area in which levels of a criteria air pollutant meet the health-based primary standard (national ambient air quality standard, or NAAQS) for the pollutant. An area may have an acceptable level for one criteria air pollutant, but may have unacceptable levels for others. Thus, an area could be both attainment and nonattainment at the same time. Attainment areas are defined using pollutant limits set by U.S.EPA.

Burn Boss -- Person trained in application of prescribed fire that will be in charge of planning and executing a prescribed burn. Different agencies have different training requirements for burn bosses.

Burn Plan – Commonly used term for the Prescribed Fire Plan

Certified Prescribed Burn Manager -- An individual who successfully completes an approved training program and receives proper certification.

Combustion – Burning -- Many important pollutants, such as sulfur dioxide, nitrogen oxides, and particulates are combustion products, often products of the burning of fuels such as coal, oil, gas and wood

Complexity (Complex) -- A system for rating the potential difficulty of a prescribed burn by analyzing the cumulative elements which may be involved in the burn such as safety, threats to boundaries, fuel types, values to be protected, organization needed, air quality values to be protected, etc. Complexity is usually rated as Low, Moderate and High. Qualifications of prescribed burn practitioners are usually specific to the different complexity levels.

CONSUME Model -- Is a software program which predicts total smoldering fuel consumption during wildfires. Using these predictions, the resource manager can accurately determine when and where to conduct a prescribed burn to achieve desired objectives, while reducing impacts on other resources.

Criteria Pollutants -- A group of common air pollutants regulated by U.S.EPA on the basis of criteria (information on health and/or environmental effects of pollution) and for which NAAQS have been established. In general, criteria pollutants are widely distributed over the country. They are: particulate matter (PM), carbon monoxide (CO), nitrogen oxides (NOx), sulfur dioxide (SO2), ozone (O3), and lead (Pb).

Dispersion Index -- a numerical index developed by Lee Lavdas (Southern Forest Fire Laboratory). This index is an estimate of the atmosphere's capacity to disperse smoke form prescribed burns over a 1,000-square mile area. It is related to the Ventilation Index, but also considers the rate of pollutant dispersion.

Emission -- Release of pollutants into the air from a mobile source (e.g. vehicle), stationary source (e.g. industry), or area source (e.g. gas stations, chimneys, vegetative burning).

Equilibrium Moisture Content (EMC) -- The value that the actual moisture content approaches if the fuel is exposed to constant atmospheric conditions of temperature and relative humidity for an infinite length of time. EMC determines the amount of water vapor that a specific piece of wood can hold.

Federal Class I Area -- An area set aside under the Clean Air Act (CAA) to receive the most stringent protection from air quality degradation. Mandatory federal Class I areas are (1) international parks, (2) national wilderness areas which exceed 5,000 acres in size, (3) national memorial parks which exceed 5,000 acres in size, and (4) national parks which exceed 6,000 acres and were in existence prior to the 1977 CAA Amendments. The extent of a mandatory Federal Class I Area includes subsequent changes in boundaries, such as park expansions. NOTE: There are no federal Class I areas in Illinois.

Federal Land Manager (FLM) -- With respect to any lands in the United States, the Secretary of the Federal department with authority over such lands. Generally, the Secretaries delegate their authority to specific elements within each department.

Fire Dependent Ecosystem -- A community of plants and animals that must experience recurring disturbances by fire in order to sustain its natural plant succession, structure and composition of vegetation, and maintain appropriate fuel loading and nutrient cycling to ensure proper ecosystem function.

First Order Fire Effects Model (FOFEM) – Is a computer program for predicting tree mortality, fuel consumption, smoke production, and soil heating caused by prescribed fire or wildfire.

Fuel -- Includes combustible vegetative matter such as grass, trees, shrubs, limbs, branches, duff, and stumps.

Government Entity-- A subordinated unit of federal, state, or local government created to carry out a governmental function or to implement a statute or statutes.

Haze -- An atmospheric aerosol of sufficient concentration to be visible. The particles are too small to see individually, but reduce visual range by scattering light.

IMPROVE -- Interagency Monitoring of Protected Visual Environments is a program that uses air monitors in federal Class I areas or outside federal Class I areas (IMPROVE protocol) to measure visibility pollutants---sulfates, nitrates, organic and elemental carbon, and PM.

Inversion -- A layer in the atmosphere where the temperature increases with altitude.

Land Use Plan -- A broad scale, long range plan (e.g., forest plan, refuge plan or resource management plan) that identifies the scope of actions and goals for the land and resources administered by a land owner/manager.

Mechanical Methods -- Mechanical site preparation designed to clear unwanted vegetation, move logging slash, or cultivate upper soil layers. Techniques include:

- Bedding: plowing to form cultivated beds with a slightly elevated center.
- Blading: using bulldozer-mounted blades to uproot trees and shrubs.
- Chaining: dragging heavy chains using bulldozers to remove vegetation and scarify soil surface.
- Chopping: using heavy rolling choppers to crush or break apart debris.
- Clearing: using Seppi, Fecon or other horizontal mower mounted on mover apparatus.
- Mowing: using rotary, fail or other type of mower apparatus to reduce height of vegetation.
- Contouring, terracing, leveling: moving soil with bulldozers to change medium-scale topography and drainage.
- Disking: plowing with rollers to incorporate organic material into the mineral soil.
- Ditching: constructing ditches to improve soil drainage within the rooting zone.
- Piling: using bulldozer-mounted blades to push debris into piles or rows (windrows).
- Plowing: dragging a plow by bulldozer to scarify surface soil and mix surface litter.
- Subsoiling: plowing the subsoil to break or puncture an impervious soil layer and improve drainage.
- Shearing: cutting residual trees using a swept-back blade horizontally mounted on a crawler tractor

Mixing Height -- the maximum height that rapid vertical mixing takes place in the atmosphere. In general, the more unstable the atmosphere, the higher the mixing height. It acts as a lid on the height smoke can reach.

Mobile Sources -- Moving objects that release pollution. Mobile sources include cars, trucks, buses, planes, trains, motorcycles and gasoline-powered lawn mowers. Mobile sources are divided into two groups: road vehicles, which include cars, trucks and buses, and non-road vehicles which include trains, planes and lawn mowers.

Monitoring (monitor) -- Measurement of air pollution is referred to as monitoring. U.S. EPA and

state and local agencies measure the types and amounts of pollutants in the ambient air. The CAA requires certain large polluters to perform enhanced monitoring to provide an accurate picture of how much pollution is being released into the air. The 1990 CAA requires states to monitor community air in polluted areas to check on whether the areas are being cleaned up according to schedules set out in the law.

National Ambient Air Quality Standards (NAAQS) -- Standards for maximum acceptable concentrations of "criteria" pollutants in the ambient air to protect public health with an adequate margin of safety (primary standard), and to protect public welfare from any known or anticipated adverse effects of such pollutants (e.g., visibility impairment, soiling, materials damage, etc.) in the ambient air (secondary standard).

Nonattainment Area -- A geographic area in which the level of a criteria air pollutant is higher than the level allowed by the federal standards. It has been estimated that 60 percent of Americans live in nonattainment areas.

Nuisance (Smoke) -- Amounts of smoke in the ambient air that interfere with a right or privilege common to members of the public, including the use or enjoyment of public or private resources.

Ozone -- Ozone (O_3) is a gas composed of three oxygen atoms. It is not usually emitted directly into the air, but at ground-level is created by a chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Ozone can be "good" or "bad," depending on its location in the atmosphere.

Particulate Matter (PM) -- A mixture of very small particles that are suspended in the atmosphere, except uncombined water, which exists as a solid or liquid at standard conditions (e.g., dust, smoke, mist, fumes, or smog).

PM_{10} -- Particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers (including $PM_{2.5}$). Concentrations in the air are measured as micrograms per cubic meter of air (ug/m^3).

$PM_{2.5}$ -- Particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers. Concentrations in the air are measured as micrograms per cubic meter of air (ug/m^3).

Prescription -- Measurable criteria that guide selection of appropriate management response and actions. Prescription criteria may include the meteorological conditions affecting the area under prescription, as well as factors related to the state of the area to be burned such as the fuel moisture condition and other physical parameters. Other criteria which may be considered include safety, economic, public health, environmental, geographic, administrative, social or legal considerations, and ecological and land use objectives.

Prescribed Burn Manager -- Person responsible for managing a prescribed fire from planning to ignition and mop up.

Prescribed Burning -- The planned application of fire to naturally occurring vegetative fuels under specified environmental conditions and following appropriate precautionary measures, which causes the fire to be confined to a predetermined area and accomplish the planned land management

objectives.

Prescribed Fire -- Any fire ignited by management actions to meet specific objectives (i.e., managed to achieve resource benefits).

Prescribed Fire Plan -- A strategic plan that defines a program to manage wildland and prescribed fires, and documents the fire plan to meet management objectives outlined in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, burn plans and prevention plans. Also referenced as Fire Plan.

Project Plan -- A strategic plan for accomplishing specific actions and goals (objectives) established in a land use plan. A project may include several activities such as cutting and hauling trees and shrubs, planting trees, building trails, and fire treatment.

Regional Haze -- Generally, concentrations of fine particles in the atmosphere extending hundreds of miles across a region and causing deteriorated visibility conditions or wide-spread visibility impairment, especially in mandatory Federal Class I Areas where visibility is an important value.

Residual Night Burning -- Planned prescribed burns initiated during the daytime hours and are allowed to burn into the night with reduced intensity. Residual night burning generally occurs in the interior of the burn unit and involves creeping ground fires and smoldering woody materials.

Simple Approach Smoke Estimation Model (SASEM) -- This program calculates the consumption of fuel, emission of particles, and dispersion of these pollutants produced by prescribed burning of forest and range vegetation.

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 Sensitive Area -- An area on which, for reasons of visibility, health or human welfare, smoke could have an adverse impact. Examples: Airports, major highways, communities, Federal Class I Areas, recreation areas, schools, hospitals, nursing homes and factories, etc.

Smoke Sensitive Populations -- Those populations for whom smoke may present particular health risks.

Smoke Sensitive Receptors -- Locations where human population tend to concentrate and where smoke could impact the health of those population or significantly impact visibility that may be detrimental to either health or the enjoyment of scenic qualities of the landscape. These may be residential concentrations in the form of towns or cities, or locations where people tend to gather in groups such as parks. Travel routes such as highways may be labeled as sensitive receptor sites where smoke can be a factor in potential motor vehicle accidents. Particular areas along highways or other locations may be more prone to being declared sensitive receptor sites because of topographic and microclimate features.

Smoke Management Plan/Program (SMP) -- Establishes a basic framework of procedures and requirements for managing smoke from fires that are managed for resource benefits. The purposes of

SMPs are to mitigate the nuisance and public safety hazards posed by smoke intrusions into populated areas (e.g., on roadways and at airports); to prevent deterioration of air quality and NAAQS violations; and to address visibility impacts in mandatory Federal Class I Areas in accordance with the regional haze rules.

Source -- Any place or object from which pollutants are released. A source can be a power plant, factory, dry cleaning business, gas station or farm. Cars, trucks and other motor vehicles are sources, and consumer products and machines used in industry. Sources that stay in one place are referred to as stationary sources; sources that move around, such as cars or planes, are referenced as mobile sources.

State Implementation Plan (SIP) -- A detailed description of the programs a state will use to carry out its responsibilities under the CAA. State implementation plans are collections of the regulations and emission reduction measures used by a state to reduce air pollution in order to attain and maintain NAAQS or to meet other requirements of the Act. The CAA requires that USEPA approve each SIP. Members of the public are given opportunities to participate in review and approval of SIPs.

Stationary Source -- A place or object from which pollutants are released and which does not move around. Stationary sources include power plants, gas stations, incinerators, etc.

Suppression -- A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Temperature Inversion -- One of the weather conditions that are often associated with serious smog episodes in some portions of the country. In a temperature inversion, air does not rise because it is trapped near the ground by a layer of warmer air above it. Concentrations of pollutants increase in the lower atmosphere.

Transport Wind – an average of the horizontal wind speed and direction from the surface to the mixing height.

Vent Rate – Average Ventilation rate for a given time. The ventilation rate is defined as the product of the Transport Wind Speed and the Mixing Height and is used to forecast smoke behavior and trajectories.

Volatile Organic Compounds (VOC) -- Any organic compound that participates in atmospheric photochemical reactions. Photochemical reactions of VOC's with oxides of nitrogen and sulfur can produce O_3 and PM.

Wildfire -- An unplanned unwanted wildland fire including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland forest where the objective is to put the fire out.

Wildland Fire -- Any non-structural fire, other than prescribed fire, that occurs in a wildland. Note: Wildland fires include unwanted (wild) fires and naturally ignited fires that are managed within a prescription to achieve resource benefits. Three distinct types of wildland fire have been defined and included wildfire, wildland fire use, and prescribed fire.

Wildland Fire Use -- The application of the appropriate management response to naturally ignited wildland fires to accomplish specific resource management objectives in pre-defined designated areas outlined in Fire Management Plans.

Wildland -- An area where development is generally limited to roads, railroads, power lines, and widely scattered structures. The land is not cultivated (i.e., the soil is disturbed less frequently than once in 10 years), is not fallow, and is not in the United States Department of Agriculture Conservation Reserve Program. The land may be neglected altogether or managed for such purposes as wood or forage production, wildlife, recreation, wetlands or protective plant cover. [The distinction between wildlands, to which the recommendations in this document apply, and agricultural lands are subject to further discussion.] In urban areas of Illinois wildlands may occur amongst developed areas, such as State Parks and Forest Preserve lands.

References

Anderson, Hal E. United States Department of Agriculture, Forest Service, *Aids to Determining Fuel Models for Estimating Fire Behavior* (1982), *available at* http://www.fs.fed.us/rm/pubs_int/int_gtr122.pdf.

Angel, James R. et al., *Climate of Illinois* (2003), *available at* http://www.sws.uiuc.edu/atmos/statecli/General/Illinois-climate-narrative.pdf

Control of Pollution from Federal Facilities, Section 118 of Clean Air Act, 42 USC 7418

Illinois Prescribed Burn Act, (095-0108), August 13, 2007

Lavdas, L.G., 1986. *An Atmospheric Dispersion Index for Prescribed Burning*. Research Paper SE-256. Asheville, NC USDA Forest Service Experiment Station. 35 pp.

National Ambient Air Quality Standards for Particulate Matter, 62 *FR* 38855 - 38701, July 18, 1997.

National Ambient Air Quality Standards for Particulate Matter, 71 *FR* 61143 - 61233, October 17, 2006.

National Ambient Air Quality Standards for Ozone, Final Rule, 73 FR 16436 – 16514, March 27, 2008.

National Wildfire Coordination Group, Fire Use Working Team, *Smoke Management Guide for Prescribed and Wildland Fire* (2001), *available at* http://www.nwcg.gov/pms/pubs/SMG/SMG-72.pdf.

Nyland, Ralph D. *Silviculture: Concepts and Applications* (1996).

Open Burning, Title 35 Illinois Administrative Code Part 237.

Operating Plan, Fire Weather Services for Most of Missouri and Adjacent Counties of Eastern Kansas, Southern, Illinois, Southwest Indiana, and Western Kentucky, 2008

Regional Haze Regulations – 40 CFR Part 51 Subpart P (Visibility), July 1, 1999

Revisions to Ambient Air Monitoring Regulations, 71 *FR* 61236 - 61328, October 17, 2006

The National Coalition of Prescribed Fire Council, *Guide to Smoke Management* (2007), *available at* http://www.air.dnr.state.ga.us/airpermit/smoke_plan/downloads/the_national_coalition_of_prescribed_fire_councils_guide_to_smoke_management.pdf

Treatment of Data Influenced by Exceptional Events, 72 *FR* 13560 - 13581, March 22, 2007.

United States Environmental Protection Agency, *Interim Air Quality Policy on Wildland and Prescribed Fires* (1998), *available at* http://www.epa.gov/ttncaaa1/t1/memoranda/firefnl.pdf.

United States Environmental Protection Agency, *Prescribed Burning Background Document And Technical Information Document for Prescribed Burning Best Available Control Measure*s (1992).

Werth, J. and P. Werth, 1998. *Haines Index Climatology for the western United States*. Fire Management Notes 58(3):8-17.

Wisconsin Department of Natural Resources, *Draft Wisconsin Smoke Management Plan for Prescribed Fire*, May 2, 2008

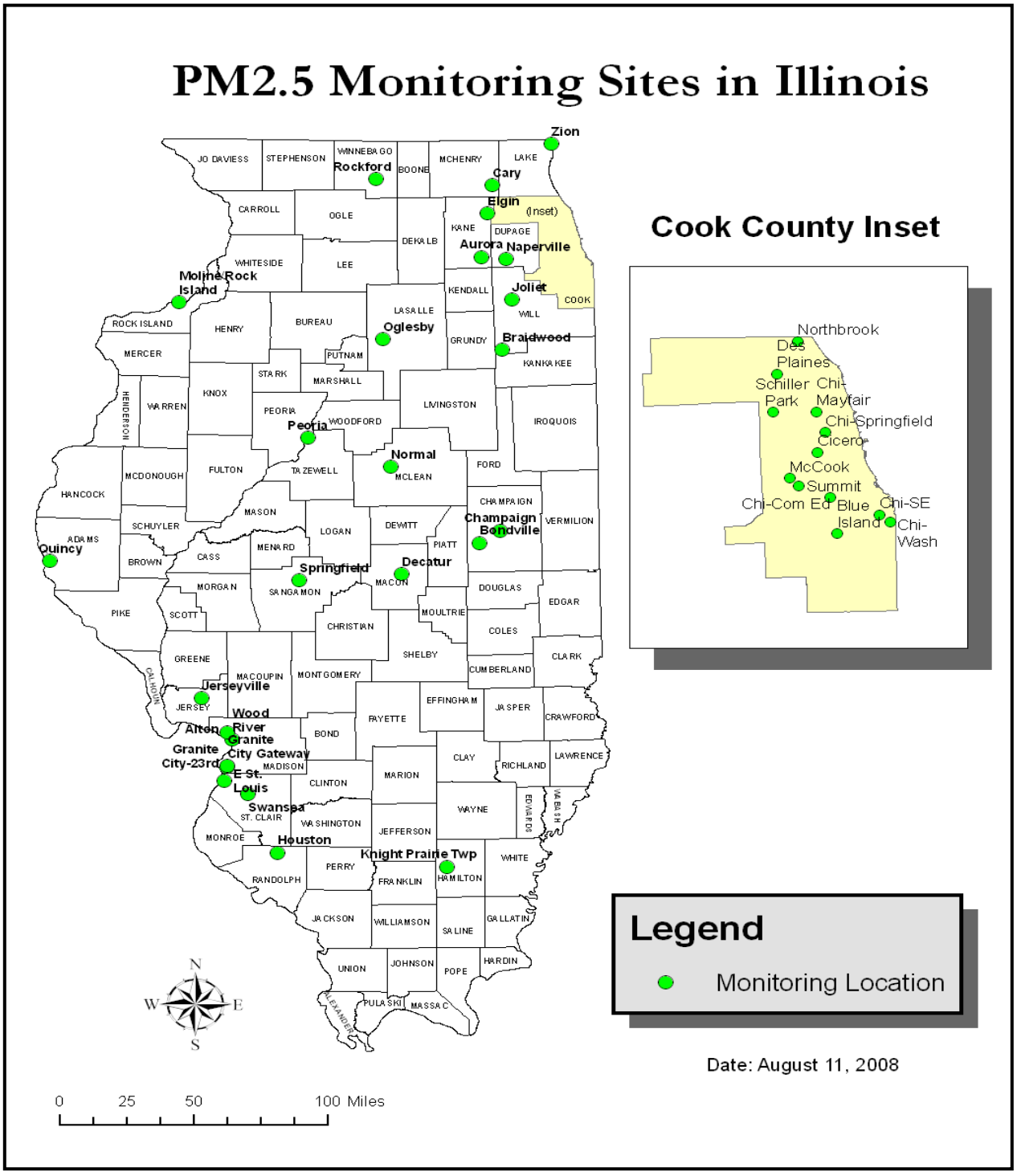
Smoke Management Plan Websites:

http://www.forestry.state.ar.us/manage/smoke_managment.pdf, Arkansas Smoke Management Program

http://files.dnr.state.mn.us/forestry/wildfire/rxfire/mnsmokemgmtplan.pdf, Minnesota Smoke Management Plan

http://www.epa.gov/ttn/faca/pbdirs/smpdrft4.pdf, Elements of a Smoke Management Program

APPENDIX A


PM2.5 Monitoring Sites in Illinois
Zion
Rockford
Cary
Elgin
(Inset)
Aurora
Naperville
Joliet
Moline
Rock Island
Oglesby
Braidwood
Peoria
Normal
Champaign
Bondville
Springfield
Decatur
Quincy
Jerseyville
Wood River
Alton
Granite City Gateway
Granite City-23rd
E St. Louis
Swansea
Houston
Knight Prairie Twp
JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
MCHENRY
LAKE
CARROLL
OGLE
DEKALB
KANE
DUPAGE
WHITESIDE
LEE
KENDALL
WILL
COOK
ROCK ISLAND
HENRY
BUREAU
LASALLE
GRUNDY
KANKAKEE
MERCER
PUTNAM
STARK
MARSHALL
KNOX
WARREN
HENDERSON
PEORIA
WOODFORD
LIVINGSTON
IROQUOIS
FULTON
TAZEWELL
MCLEAN
FORD
MCDONOUGH
HANCOCK
CHAMPAIGN
VERMILION
MASON
SCHUYLER
LOGAN
DEWITT
PIATT
ADAMS
BROWN
CASS
MENARD
MACON
DOUGLAS
EDGAR
MORGAN
SANGAMON
PIKE
SCOTT
CHRISTIAN
MOULTRIE
COLES
GREENE
MACOUPIN
MONTGOMERY
SHELBY
CUMBERLAND
CLARK
CALHOUN
JERSEY
EFFINGHAM
JASPER
CRAWFORD
FAYETTE
BOND
CLAY
RICHLAND
LAWRENCE
MADISON
CLINTON
MARION
WAYNE
EDWARDS
WABASH
ST. CLAIR
WASHINGTON
JEFFERSON
MONROE
PERRY
WHITE
RANDOLPH
FRANKLIN
HAMILTON
JACKSON
WILLIAMSON
SALINE
GALLATIN
UNION
JOHNSON
POPE
HARDIN
ALEXANDER
PULASKI
MASSAC
N
W
E
S
0
25
50
100 Miles
Cook County Inset
Northbrook
Des Plaines
Schiller Park
Chi-Maytair
Chi-Springfield
Cicero
McCook
Summit
Chi-Com Ed
Blue Island
Chi-SE
Chi-Wash
Legend
Monitoring Location
Date: August 11, 2008