FIRE POLICY

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ACRONYMS

AIRS	Atmospheric Infrared Sounder
AIRSIS	Private company providing access to satellites for data collection
AOD	Aerosol Optical Depth
AQI	Air Quality Index
AQRV	Air Quality Related Values
ASOS	Automated Surface Observing Systems
ATMOS	Atmospheric Trace Molecule Spectroscopy
AVHRR	Advanced Very High Resolution Radiometer
AWOS	Automated Weather Observation Systems
BUV	Backscatter Ultraviolet Spectrometer
CAA	Clean Air Act
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation
CLAES	Cryogenic Limb Array Etalon Spectrometer
CMAQ	Community Multiscale Air Quality
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CPS	Conservation Practice Standard
DAAC	Distributed Active Archive Center (NASA Goddard Earth Sciences)
DOI	U.S. Department of the Interior
DoD	U.S. Department of Defense
EBAM	A particular manufacturer's model name for one of its Beta Attenuation Monitors for particulate matter, with features allowing communication of data via satellite data service
EER	Exceptional Events Rule
EOS	Earth Observation System
EPA	U.S. Environmental Protection Agency
ESA	European Space Agency
FCCS	Fuelbed Characteristic Classification System
FEM	Federal Equivalent Method
FIP	Federal Implementation Plan
FLM	Federal Land Manager
FMP	Fire Management Plan
FRM	Federal Reference Method
FWS	U.S. Fish and Wildlife Service
GOES	Geostationary Operational Environmental Satellites
HALOE	Halogen Occultation Experiment
HCHO	Formaldehyde

HAP	Hazardous Air Pollutant
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
IDEA	Infusing Satellite Data into Environmental Applications
ISAMS	Improved Stratospheric and Mesospheric Sounder
LIDAR	Light Detection and Ranging
LIMS	Limb Infrared Monitor of the Stratosphere
LVORI	Low Visibility Occurrence Risk Index
MISR	Multi-angle Imaging Spectroradiometer
MLS	Microwave Limb Sounder
MM5	Meteorological modeling system developed by Pennsylvania State University and the National Center for Atmospheric Research (NCAR)
MODIS	Moderate Resolution Imaging Spectroradiometer
MOPITT	Measurement of Pollution in the Troposphere
MOU	Memorandum of Understanding
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NASA	U.S. National Aeronautics and Space Administration
NCore	A planned multipollutant ambient air monitoring network integrating measurement systems for particles, gases, and meteorology.
NEPA	National Environmental Policy Act
NO_2	Nitrogen Dioxide
NOAA	U.S. National Oceanic and Atmospheric Administration
NO_X	Nitrogen Oxides
NPS	U.S. National Park Service
NWS	U.S. National Weather Service
O_3	Ozone
OLS	Operation Linescan System
PAH	Polycyclic Aromatic Hydrocarbons
PARASOL	Polarization and Anisotropy of Reflectance's for Atmospheric Sciences coupled with Observations from a Lidar
Pb	Lead
PM	Particulate Matter
$PM_{2.5}$	Fine particles in the air that measure 2.5 micrometres or less in size
PM_{10}	Fine particles in the air that measure 10 micrometres or less in size
PPM	Parts Per Million
PSD	Prevention of Significant Deterioration
RASS	Radio Acoustic Sounding System (for measuring the atmospheric temperature lapse rate)
READY	Real-time Environmental Applications and Display System

RPO	Regional Planning Organization
SBUV	Solar Backscatter Ultraviolet Spectrometer
SBUV/2	Second generation of Solar Backscatter Ultraviolet Spectrometer
SIP	State Implementation Plan
SMP	Smoke Management Program
SO_2	Sulfur Dioxide
TIP	Tribal Implementation Plan
TOMS	Total Ozone Mapping Spectrometer
USDA	U.S. Department of Agriculture
UTC	Greenwich Mean Time updated with leap seconds
UXO	Unexploded Ordinance
VOC	Volatile Organic Compound
WF_ABBA	Wildfire Automated Biomass Burning Algorithm
WRAP	Western Regional Air Partnership

FOREWORD

This document contains EPA policy and does not establish or affect legal rights or obligations. It does not establish a binding norm and it is not finally determinative of the issues addressed. In applying this policy in any particular case, the EPA will consider its applicability to the specific facts of that case, the underlying validity of the interpretations set forth in this document, and any other relevant considerations, including any that may be required under applicable law and regulations.

FIRE POLICY

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has long recognized the role fire plays as a resource management tool. Existing EPA policy, the *Interim Air Quality Policy on Wildland and Prescribed Fires*, May 1998, (the Interim Policy) only addresses wildfires and prescribed burns managed to achieve resource benefits on public, tribal and privately-owned wildlands. Although the Interim Policy did not address prescribed burning for agricultural purposes, it has always been the EPA's intent to address this practice. Thus, in recognition of the need to expand EPA guidance regarding the use of fire as a resource management tool and as a result of commitments made in the *Treatment of Data Influenced by Exceptional Events Rule* (EER) as published in 72 FR 13560 (March 22, 2007), the EPA has developed broader, more inclusive guidance. As such, this guidance supersedes the *Interim Air Quality Policy for Wildland and Prescribed Fires*, and any directions to refer to the Interim Policy within the General Conformity Rule should now be considered to refer to this guidance, consistent with the description in the rule.

This guidance applies to all wildfires, wildland fire use fires and prescribed burns when used as a resource management tool on all land types (e.g., forestland, cropland, rangeland, pastureland and wetlands) regardless of ownership (e.g., public, tribal and private). Examples of resource management fires include, but are not limited to, fires used on various land types to: control pests and disease; control invasive species; manage lands for endangered species; promote various vegetation responses; and reduce fuel loading to minimize catastrophic wildfires. This guidance addresses the impact of fire on national ambient air quality standards (NAAQS); the prevention of significant deterioration (PSD) of air quality; impairment of visibility in Class I Federal areas; and general conformity regulations. As discussed in the preamble to the EER (72 FR at 13566-67), a wildfire is defined as an unplanned, unwanted wildland fire (such as a fire caused by lightning), and includes unauthorized human-caused fires (such as arson or acts of carelessness by campers) and escaped prescribed burn projects (escaped control due to unforeseen circumstances), where the appropriate management response includes the objective to suppress the fire. In contrast, a wildland fire use fire is the application of the appropriate management response to a naturally-ignited (e.g., as the result of lightning) wildland fire to accomplish specific resource management objectives in predefined and designated areas where fire is necessary and outlined in fire management or land management plans.

In previous EPA guidance and rules (e.g., the Interim Policy and the EER), the term "prescribed fire" was used to denote a man-made fire used to achieve specific resource management objectives. The EPA's usage of this term was consistent with how it was used by Federal Land Managers (FLMs). However, FLMs have begun using the term "prescribed burn" in lieu of "prescribed fire." This transition is also consistent with the United States Department of Agriculture's (USDA) usage of "prescribed burn." Thus, throughout this guidance, EPA uses the term "prescribed burn," which is defined as any fire ignited by management actions to meet specific resource management objectives.

The Interim Policy encouraged states and tribes to adopt and implement smoke management programs (SMPs) to address and control emissions from prescribed burns. (SMPs outline procedures that burners should use when fire is used as a resource management tool.) As an incentive for adopting a SMP, the Interim Policy indicated that EPA would give special consideration of the data, if a prescribed burn, despite having implemented a SMP, caused an exceedance or violation of the particulate matter (PM) NAAQS. The EER now addresses under what circumstances air quality data impacted by emissions from a prescribed burn can be excluded from air quality considerations. Under the EER, one factor that EPA considers in determining whether to exclude air quality data affected by a prescribed burn is whether a SMP or basic smoke management practices were in place at the time of the fire. This document provides guidance on SMPs and basic smoke management practices for those states that anticipate they may, in the future, seek to have data excluded, but is not intended to address other aspects of the EER. Adopting SMPs or basic smoke management practices does not guarantee that data adversely affected by a prescribed burn will qualify for exclusion as an exceptional event under the EER. In order for air quality data impacted by emissions from a prescribed burn to be excluded from regulatory determinations, site-specific circumstances related to a specific fire will need to be evaluated under the provisions outlined in the EER which are summarized in section 2.6. More broadly, this guidance is designed to promote the adoption of SMPs to protect air quality and minimize associated impacts for all states and tribes engaged in prescribed burning activities. Where a state or tribe has determined that a comprehensive SMP is not needed to protect air quality, EPA encourages the use of basic smoke management practices. Section 3.2 of this guidance discusses SMPs and basic smoke management practices in more detail.

1.1 Purpose and Scope of Guidance

The major objectives of this guidance are to protect public health and air quality and minimize impacts associated with emissions from the types of fire identified above. The EPA believes that these objectives can best be accomplished by promoting the use of SMPs that reduce the amount and impact of smoke and promotes communication and coordination of prescribed burn usage. Furthermore, EPA believes that SMPs should be developed through a cooperative process involving an array of stakeholders. Essential stakeholders are state/tribal/local air quality managers, state/tribal agencies responsible for agriculture and forest management, public and private land owners/managers who use fire, and the public.

This guidance is not intended to limit opportunities for private land owners/managers to use fire as an appropriate resource management tool or to limit the ability of federal, state, tribal or local governments to regulate prescribed burning. Furthermore, this guidance does not address other open burning activities, such as burning at residential, commercial or industrial sites; or open burning of land clearing or construction debris. Typically these types of open burning activities are regulated by the state, tribal, or local air quality agency. However, this guidance (in Appendix A) does address the use of air curtain incinerators when used in open burning of forest debris.

This guidance also addresses (in sections 2.4 and 2.5, respectively) the PSD and conformity requirements (for federal agencies) of the Clean Air Act (CAA) that can be impacted by fire.

The effects of smoke from a prescribed burn on air quality is discussed throughout this document. The term air quality, as used in this document, refers to ambient concentrations of criteria pollutants for which NAAQS have been established, and, where applicable, to impacts on visibility in mandatory Class I federal areas and air toxic pollutants. The term "air quality managers" includes state, tribal and local air quality personnel. The term "land managers" includes all federal, state, tribal and local land managers as well as private land owners, including growers, farmers, and ranchers. Section 6 contains a more complete list of the terms and definitions used throughout the document.

1.2 Role of Fire

As a natural phenomenon, fire serves an important ecological role. Historically, both natural (e.g., fire started by lightning) and man-made (e.g., prescribed burn) fires have been a frequent and major ecological factor in North America. As a result of natural fires, ecosystems have been created that contain fire-dependent flora, fauna and wildlife. In addition, natural fires reduce the heavy fuel accumulations in a forest which can ultimately lead to a catastrophic wildfire.

In order to achieve the benefits of natural fires, land managers use prescribed burning to maintain fire-dependent ecosystems and reduce fuel loading. Prescribed burning is also used to promote various vegetation responses and control weed/insect infestation and disease.

In limited situations, prescribed burning is also used to accomplish safety objectives. An example is the Department of Defense's (DOD) use of prescribed burning to provide a safe environment for DOD personnel when removing unexploded ordinances (UXO) at both inactive and active weapons ranges by clearing overlying dense vegetation. In this limited situation, prescribed burning is currently the most effective practice available to remove vegetation for personnel safety.

1.3 Role of Air Quality and Land Managers

Air quality and land managers may have very different and seemingly competing goals and objectives with regard to prescribed burning. An air quality manager's goal is to protect public health and the environment, while a land manager's goal is to effectively manage their lands for various reasons (e.g., ecosystem maintenance or crop production). Because of these potentially competing goals, air quality and land managers should strive for collaboration to overcome barriers associated with achieving their respective objectives. Another reason for collaboration between air quality and land managers is that the responsibility for attaining and maintaining the NAAQS and implementing a SMP within the same airshed may be divided between different state or tribal agencies, e.g., air quality and agricultural/forestry departments. Lastly, where airsheds extend beyond political boundaries, the various air quality and land managers are encouraged to collaborate with each other as they develop and implement regional SMPs. The EPA encourages state and tribal air quality managers to participate in planning activities involving the identification, evaluation, and selection of appropriate resource management treatments, and techniques for either public or private lands. It is essential that air quality impacts are identified and addressed during these planning activities. Likewise, air quality managers should solicit the early participation of all affected land owners/managers when developing or revising regulations, plans or policies applicable to prescribed burning and smoke management.

Both public and private land managers and owners have the responsibility of complying with all applicable federal, state, local and tribal rules and regulations. With respect to the use of prescribed burning and smoke management, both types of land managers should participate with other stakeholders and air quality managers in developing State Implementation Plans (SIPs), Tribal Implementation Plans (TIPs) and meeting other regulatory requirements.

2.0 FIRE EMISSIONS AND AIR QUALITY

The amount of emissions generated in a wildfire or prescribed burn depends on the characteristics of each particular fire and the ecosystem in which it occurs. Factors that influence the amount of fire emissions are the quantity of fuel available and consumed, fuel type and characteristics, and whether the fuel is consumed in a flaming or smoldering environment. Important characteristics affecting consumption include moisture; fuel size, type and condition;

ignition methods; meteorology (air temperature, relative humidity and wind) and the micrometeorology effects created by the fire itself.

2.1 Characterization of Air Pollution Emissions From Fire

Wildfires, wildland fire use fires and prescribed burns emit gases and particulate matter. The gaseous emissions can include criteria pollutants and hazardous air pollutants (HAP). Criteria pollutants include sulfur dioxide (SO_2), carbon monoxide (CO), volatile organic compounds (VOC), and nitrogen oxides (NO_X). The HAP emitted by wildfires and prescribed burns are presented in Table 1.

Table 1. Hazardous air pollutants emitted by wildland fires and prescribed burns.

1,3-Butadiene	Benzo[e]Pyrene	Mercury
1-Methylpyrene	Benzo[g,h,i]Perylene	Methyl Chloride
Acetaldehyde	Benzo[k]Fluoranthene	Methylanthracene
Acrolein	Benzofluoranthenes	Methylbenzopyrenes
Anthracene	Carbonyl Sulfide	Methylchrysene
Benz[a]Anthracene	Chrysene	Perylene
Benzene	Fluoranthene	Phenanthrene
Benzo(a)fluoranthene	Formaldehyde	Pyrene
Benzo(c)phenanthrene	Hexane	Toluene
Benzo[a]Pyrene	Indeno[1,2,3-c,d]Pyrene	Xylenes

Table 2 presents the emissions of selected pollutants from all 2002 U.S. wildfires and prescribed burns. The fire emissions shown in Table 2 are responsible for 20% or more of the national emissions of $PM_{2.5}$, VOC, formaldehyde, acetaldehyde, 1-3 butadiene and acrolein and lesser amounts of ammonia, SO_2, NO_X, benzene and chlorine (US EPA, 2002). Ammonia, VOC, NO_X, SO_2 and several of the HAP are also precursors to $PM_{2.5}$ and ozone (O_3) formation. Polycyclic aromatic hydrocarbons (PAH), some of which are known carcinogens, can exist in both the gas and particle phase. VOC are a key contributor to O_3 formation and, when produced by fire, are highly oxygenated, making them highly reactive in forming O_3 under favorable conditions of nitrogen dioxide (NO_2) and sunlight.

Table 2. Emissions of selected pollutants from all 2002 U.S. wildfires and prescribed burns.

Pollutant	National Emissions from Fires (TPY)	Fires as % of National Emissions from all Sources
$PM_{2.5}$	1,526,650	25%
VOC	3,925,000	20%
Ammonia	261,400	6%
SO_2	386,100	3%
NO_X	208,500	1%
Acrolein	17,900	66%
Formaldehyde	108,500	42%
1-3 Butadiene	17,000	36%
Acetaldehyde	17,200	22%
Benzene	47,400	13%
Chlorine (ag. only)	1,160	9%

The concentration of direct and precursor pollutants downwind of a fire depends on the amount of each pollutant emitted, existing ambient concentration, the initial plume rise dynamics, the meteorology aloft and the additive effect of multiple fires in the airshed, each of which are highly variable from fire to fire. The formation of O_3 and $PM_{2.5}$ is enhanced under certain weather conditions and by the presence of emissions from other types of sources, notably motor vehicles, utility boilers and industrial facilities.

There are examples in the literature of the role that fires play on short-term air quality, specifically concentrations of PM (McMeeking et al., 2005; Westerling et al., 2002). There are also multiple examples (Colarco et al., 2004; DeBell et al., 2002) of the significant influence fire has on air quality at great distances from the source for both PM and gases. A recent study

(Bertschi and Jaffe, 2005) links elevated high ground-level O_3 concentrations to forest fire plumes that had been transported great distances.

Organic carbon is the primary component of the fine particulate emitted by fires, which has been used by many researchers and air quality planners as an indicator of an area's ambient smoke levels. As an example, the satellite photo in Figure 1 shows transported smoke (approximately outlined in red) resulting from the large Quebec wildfires of 2002, which engulfed a large portion of the Eastern United States on July 7, 2002. The bar graph in Figure 2 shows the chemical composition of the $PM_{2.5}$ mass during this event at multiple urban and rural sites that were affected by this transported smoke. The height of the bar corresponds to the $PM_{2.5}$ mass measured by each of the monitors on that day. It should be noted that all these sites had $PM_{2.5}$ concentrations above 35 $\mu g/m^3$, which is the level of the current 24-hour standard for $PM_{2.5}$. It should also be noted that the two blue portions of the bar, which show the total organics in the $PM_{2.5}$ mass during this smoke event, indicate that organic carbon from all sources was 75-90% of the total $PM_{2.5}$ mass. Organics make up only about 35-60% of $PM_{2.5}$ mass on average at sites when there are no fires nearby.

Generally, the contribution of fire (wildfires, wildland fire use fires or prescribed burns) to ambient $PM_{2.5}$ levels depends on the size and duration of the fire, fuel conditions and meteorology. Dramatic, short-term increases in $PM_{2.5}$ concentration due to fire have been observed (such as with the Quebec fire example above), while longer fire seasons are responsible for broader, season-long increases in $PM_{2.5}$ over large regions.

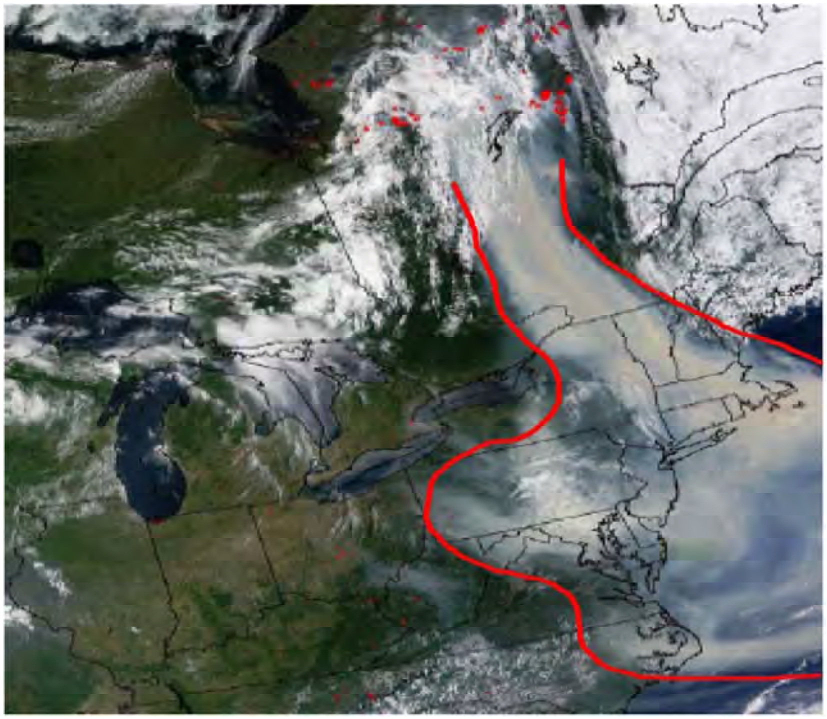

FIGURE 1. MODIS VISIBLE IMAGE OF EASTERN CANADA AND NORTHEASTERN U.S. FOR JULY 7, 2002

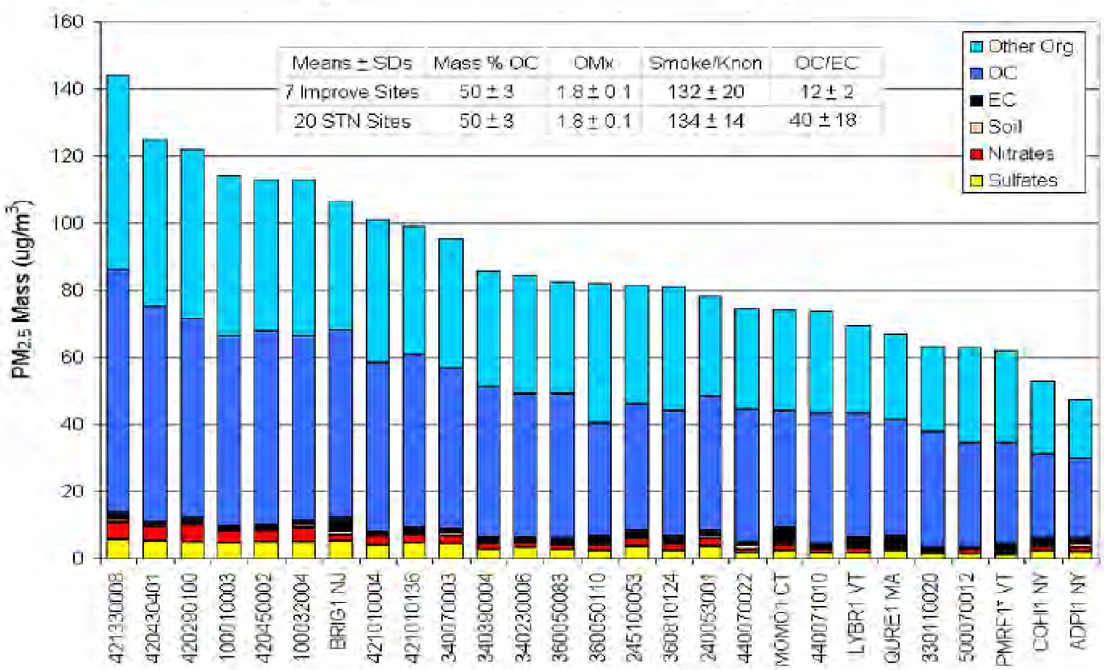

FIGURE 2. $PM_{2.5}$ MASS COMPOSITIONS FOR SITES HEAVILY IMPACTED BY SMOKE ON JULY 7, 2002

2.2 Clean Air Act and National Ambient Air Quality Standards

Ambient air quality is the primary indicator of public health impacts and is regulated through the NAAQS program. The CAA requires EPA to set NAAQS for the protection of health and welfare (40 CFR Part 50) and to review these standards every five years. There are NAAQS for six criteria pollutants (i.e., O_3, PM, SO_2, CO, NO_x and Pb). The EPA calls these "criteria" air pollutants because it regulates them by developing human health-based and/or environmentally-based criteria (science-based guidelines) for setting permissible levels. The NAAQS limits based on human health are called primary standards. Whereas NAAQS limits intended to prevent environmental and property damage are called secondary standards. Additional information on the NAAQS can be found at http://www.epa.gov/ttn/naaqs.

A geographic area that meets or has air quality better than the primary standard is called an attainment area. Areas that do not meet the standards, or that contribute pollution to nearby areas that do not meet standards, are called nonattainment areas. In some instances where there is insufficient information an area may be designated unclassifiable until such time as more information becomes available. Maintenance areas are former nonattainment areas where air quality has improved to be in compliance with the relevant NAAQS. An area may be designated attainment for some pollutants and non-attainment for others.

The CAA requires states and tribes[1] to adopt plans and rules sufficient to attain and maintain national air quality standards, prevent significant deterioration of air quality and remedy existing and prevent future visibility impairment in mandatory Class I federal areas caused by man-made sources of pollution. Air quality managers accomplish this by developing either SIPs or TIPs which include all programs and rules required by the CAA to meet and assure

[1] Under the Tribal Authority Rule, tribes are allowed to implement air quality programs. Where a tribe is unable or chooses not to develop air quality programs, EPA has the responsibility to address the NAAQS in Indian country.

maintenance of federal air quality standards. If a state or tribe does not adopt an implementation plan to address air quality protection, the EPA has the authority to adopt and implement a Federal Implementation Plan (FIP). Development of a SIP, TIP or FIP is done through a public process involving all stakeholders. During the development of an implementation plan, stakeholders are invited to provide input on the technical components of the plans including: (1) emission inventories, (2) modeling analyses, (3) attainment demonstrations, (4) transportation and general conformity emission budgets, (5) analyses of air quality data, and (6) control strategy development.

When fire emissions impact air quality, effective management of these emissions is an important component of an implementation plan to attain and maintain the NAAQS. In addition to public health impacts, emissions from fire may have public welfare impacts, including visibility impairment and contributions to regional haze, both of which are regulated under the Regional Haze Rule (see section 2.3). Where fire causes or contributes to violations of the NAAQS or impairs visibility in mandatory Class I federal areas, states and tribes are required to address this source of emissions through their SIP or TIP.

As reflected in section 2.1, various studies have documented that emissions from prescribed burning impact PM and O_3 NAAQS. Scientific studies have found an association between exposure to PM and significant adverse health effects, including: aggravated asthma, chronic bronchitis, reduced lung function, irregular heartbeat, heart attack and premature death in people with heart or lung disease. Based on this evidence, the 24-hour and annual $PM_{2.5}$ standards are 35 and 15 $\mu g/m^3$, respectively. The 24-hour PM_{10} is 150 $\mu g/m^3$.

Ozone exposure has been associated with increased susceptibility to respiratory infections, reduced lung function, increased frequency of asthma attacks, cardiac-related effects, and aggravation of chronic lung diseases, such as asthma, emphysema and bronchitis. These effects can lead to mortality, increased asthma medication use, school absenteeism and more frequent doctors visits (US EPA, 2008). The eight-hour primary and secondary ozone standard is 0.075 parts per million (ppm).

Emissions of NO_x, VOC and CO from fires can impact the NAAQS for NO_2, O_3, PM and CO. This guidance focuses on PM as the pollutant most significantly impacted by fire. The actions required to reduce VOC and CO emissions are the same as those recommended in this document to mitigate impacts on the PM NAAQS.

2.3 Regional Haze

Visibility is an important public welfare consideration because of its significance to enjoyment of daily activities in all parts of the country. Section 169A of the CAA sets forth a national goal for visibility which is the “prevention of any future, and the remedying of any existing, impairment of visibility in federal Class I areas which impairment results from man-made air pollution.” Protection of visibility as a public resource in the 156 federal Class I national parks and wilderness areas is addressed nationally through the Regional Haze Rule (40 CFR 51.308 – 51.309).

As part of the Regional Haze Rule, states/tribes must address the impacts of fires and other contributing sources on meeting reasonable progress in their control strategy analyses, as well as during periodic progress assessments. In developing the long-term strategy for controlling regional haze, states subject to 40 CFR 51.308 must consider smoke management techniques when fire is used for resource management purposes. For states subject to 40 CFR Part 51.309, more detailed and specific information regarding SMPs is required. SMPs can play an important role in addressing the requirements of the Regional Haze Rule. The rule and associated guidance can be found at http://www.epa.gov/air/visibility/index.html.

2.4 Prevention of Significant Deterioration

Title I, part C of the CAA requires SIPs/TIPs to include provisions to prevent the significant deterioration of air quality in areas designated as attainment or unclassifiable for any NAAQS. “Significant deterioration” for any pollutant is an unacceptable change in air quality measured as an incremental increase in ambient pollutant concentrations above the baseline concentration for that pollutant in an area. Thus, PSD “increments” define the maximum allowable increase in an ambient pollutant concentration above the baseline concentration existing in a particular area. Increments are currently defined for SO_2, NO_2, and PM_{10} (see, e.g., 40 CFR 52.21 (c)). In addition, EPA proposed increments for $PM_{2.5}$ in the *Federal Register* (72 FR 54112) on September 11, 2007, that have not yet been finalized as of the date of this guidance document.

The SIPs/TIPs are required to contain emission limits and such other measures as may be necessary to prevent significant deterioration of air quality (see section 161 of the CAA). In addition, SIPs/TIPs are required to include a preconstruction review permit program for new and modified major stationary sources (see Section 165 of the CAA). The SIPs/TIPs must ensure that increases in actual emissions from all types of air pollution sources do not cause changes in air quality that exceed the increment for a particular pollutant.[2]

While fires managed for resource benefits generally are not subject to a preconstruction review and the issuance of a PSD permit, the emissions from such activities may affect the air quality in a PSD area. Under adverse conditions, the combined PM emissions from increased

[2] Any increase in actual emissions from sources in an area is considered to consume the available increment after the date when the first application for a PSD permit is submitted in an attainment or unclassifiable area for that pollutant. Prior to that date, increment is consumed only by construction-related increases in actual emissions from major sources. 40 CFR § 51.166(b)(13)-(14); 40 CFR § 52.21(b)(13)-(14).

fire activities and from other sources could possibly result in ambient concentrations that exceed the allowable PSD increments for PM. Historically, however, EPA has often regarded fires managed for resource benefits as temporary activities. In addition, the PM emissions resulting from fire activities differ from the PM emissions generated by most other sources because they are generally short-lived. That is, the burning generally is carried out infrequently at a specific location (once every five to 20 years) and the duration tends to be short (approximately one to two days).

Section 163(c)(1)(C) of the CAA authorizes states with approved PSD programs to exclude (with the Administrator's approval) concentrations of PM caused by "construction or other temporary emission-related activities" when determining compliance with the PSD increments (see 40 CFR51.166(f)(1)(iii)). The EPA generally supports the concept of allowing states/tribes with approved SIPs/TIPs to exclude emissions caused by temporary managed fire activities from increment analyses, provided the exclusion does not result in permanent or long-term air quality deterioration. Nevertheless, the decision as to whether PM emissions from fire activities should be counted against the PSD increments for PM is a decision to be made by individual states/tribes. The EPA expects states/tribes to consider the extent to which a particular type of prescribed burn activity is truly temporary, as opposed to those activities which can be expected to occur in a particular area with some regularity over a period of time.

2.5 Conformity

Actions undertaken, permitted or funded by federal agencies, including DoD, must meet the requirements of the CAA, including the provisions of section 176(c), which requires that such activities "conform" to the purpose of the applicable SIP to eliminate or reduce the severity and numbers of NAAQS violations and achieve expeditious attainment of those standards. The

EPA's Conformity rules, implementing the provisions of section 176(c), only apply to federal actions taken within a designated nonattainment or maintenance area. The Transportation Conformity rules govern transit-related activities, and all other activities are governed by the General Conformity rules. The Conformity rules require a federal agency to demonstrate, prior to initiating a project, that an action conforms to all applicable requirements in a SIP and will not cause or contribute to NAAQS violations. The General Conformity rules provide federal agencies with several options for demonstrating conformity. The following methods are most typically followed: (1) a modeling demonstration to show that emissions from the project will not increase the frequency or severity of a NAAQS violation, (2) obtaining emission reductions that offset the new project emissions, or (3) showing that the project's emissions are already included in, or accommodated by, the emissions inventory of an EPA-approved SIP that assures attainment or maintenance of the NAAQS. In addition, where an action is designated as presumed to conform, federal agencies do not have to conduct a conformity determination, unless it is demonstrated that the emissions from a specific action would in fact cause or contribute to NAAQS violations, interfere with maintenance of a NAAQS, increase the frequency or severity of an existing NAAQS violation, or delay achievement of NAAQS attainment or milestones. Federal activities occurring in Indian country will be addressed by EPA consistent with its Tribal Authority Rule (40 CFR Part 49) and the requirements of the CAA.

When addressing emissions from fire projects, a federal agency can make a conformity demonstration on an annual basis for all burns within the airshed of a specific nonattainment or maintenance area. Alternatively, a federal agency should make the demonstration for each individual fire project conducted at the administrative unit. In addition, EPA has finalized revisions to the General Conformity rules that add an alternative compliance method for some federal fire actions [cite to final conformity revision rule]. As explained in the final revisions to the General Conformity rules, EPA believes that it is reasonable to presume that any fire action taken in compliance with a SMP would conform to the applicable SIP . Therefore, under 40 C.F.R. § 93.153(i)(2), wildland fire use and prescribed burn actions are presumed to conform when conducted in compliance with approved SMPs, and federal agencies would not have to conduct a conformity determination for those actions. While the final revisions to the General Conformity rules do not include a presumption of conformity for wildland fire use and prescribed burn actions employing basic smoke management practices, the preamble explains that such fires may be able to meet a presumption of conformity if the required actions to establish such a presumption have been taken by an agency under 40 C.F.R. § 93.153(g) or by a state under 40 C.F.R. § 51.851(f).

2.6 Exceptional Events Rule

On March 22, 2007, EPA published its final rule on the *Treatment of Data Influenced by Exceptional Events* 72 FR 13560. The EER establishes procedures and criteria for identifying, evaluating, interpreting and using air quality monitoring data affected by exceptional events. Section 50.1(j) of the rule defines an exceptional event as an event that:

- affects air quality;
- is not reasonably controllable or preventable;
- is an event that is caused by human activity that is unlikely to recur at a particular location, or is a natural event; and
- is determined by the EPA Administrator through the process established in the rule to be an exceptional event.

It excludes stagnation of air masses or meteorological inversions, meteorological events involving high temperatures or a lack of precipitation or air pollution relating to source noncompliance. While not specifically excluded from the definition of exceptional events, EPA anticipates that fire used to manage non-forestry resources (e.g., crops) are not likely to satisfy the statutory definition of exceptional events.

In addition to meeting the required procedures and criteria specified in the rule for qualifying as an exceptional event, the rule at 40 CFR 50.14(b)(3) requires that states must certify that they have either (1) adopted and implemented a SMP, or (2) they have ensured that the burner employed basic smoke management practices. This rule provision further specifies that if a prescribed burn managed by employing basic smoke management practices nonetheless causes or contributes to an exceptional event, the state must consider whether it is necessary to develop a SMP (if one is not already in place) to ensure that public health is protected.

Additionally, the EER at 40 CFR 51.930 contains mitigation requirements for states, including public notification, public education, and appropriate measures to protect public health from exceedances or violations of the NAAQS caused by exceptional events (including burns). These mitigation requirements apply to all states experiencing exceptional events, and are not preconditions for EPA approval to exclude data affected by specific exceptional events. The inclusion of public notification, public education, and appropriate measures to protect public health in 40 CFR 51.930 is consistent with several of the EPA recommendations for "Smoke Management Components of Burn Plans" listed in section 3.3.2 of this guidance.

Although a general rule, the EER currently applies to PM_{10}, $PM_{2.5}$, ozone and lead (Pb) NAAQS and provides for the discounting or exclusion of air quality data because these NAAQS contain provisions that allow for the special handling of data affected by exceptional events (40

CFR 50 Appendices I, K, N and R). During the NAAQS reviews for the other pollutants EPA will consider, as appropriate, including provisions for the rule to apply to those pollutants. In the meantime, if exceptional events cause violations of NAAQS for pollutants other than PM_{10}, $PM_{2.5}$, ozone or Pb, EPA will exercise its discretion in determining the impact of these events on an area's attainment status.

3.0 SMOKE MANAGEMENT

A SMP establishes a basic framework of procedures and requirements for planning and managing smoke from resource management fires. A SMP is typically developed by a state/tribal agency with cooperation and participation by various stakeholders (e.g., public/private land owners/managers, and the public). The primary purpose of a SMP is to reduce emissions from resource management fires, thus protecting public health by preventing deterioration of air quality and NAAQS violations, mitigating visibility impacts in mandatory Class I federal areas, and mitigating the nuisance and public safety hazards (e.g., on roadways and at airports) posed by smoke intrusions into populated areas.

Some strong indications that an area needs a SMP are: (1) resource management fires cause or significantly contribute to air quality in excess of a NAAQS; (2) smoke from resource management fires cause short term (i.e., one to three hour) spikes of PM or O_3 levels above the level of the NAAQS in populated areas; (3) resource management fires contribute to visibility impairment in mandatory Class I federal areas; (4) the trend of monitored air quality values is increasing (approaching the NAAQS for $PM_{2.5}$, PM_{10}, or O_3) because of contributions from smoke emitted by resource management fires; (5) citizens increasingly complain of smoke intrusions resulting from resource management fires; or (6) basic smoke management practices alone do not prevent resource management fires from causing or contributing to exceedances or violations of the NAAQS.

If a state/tribe determines that a SMP is needed, they may choose to develop a program using an array of smoke management practices that they believe will prevent NAAQS violations, address visibility impairment and meet their constituents' needs. Thus, a SMP can range from a purely voluntary program all the way to a program where resource management fires are regulated by a permitting authority that analyzes meteorological conditions and authorizes burning by time of day, fire location, size and anticipated duration. States/tribes may develop general fire regulations that establish basic parameters and conditions, such as wind speed, direction, ventilation, mixing height, location and distance to sensitive receptors, etc., within which, fires can be ignited or naturally ignited fire can be allowed to continue to burn. States/tribes may allow land owners/managers to voluntarily notify them of their intent to ignite a prescribed burn or they may require the burner to obtain a permit and authorization prior to ignition. States/tribes may also exempt de minimis fires (fires that will cover less than a specified number of acres or consume less than specified tons of fuel, as established by the state/tribe) from complying with a SMP. States/tribes retain the authority to exercise enforcement action when land owners/managers violate a SMP.

Voluntary programs or programs implemented through state/tribal general fire regulations may be adequate for areas where prescribed burns rarely cause or contribute to air quality problems. However, for areas where a significant amount of burning occurs on a large scale that could cause significant air quality impacts, or when several land owners/managers within an airshed are expected to burn concurrently, a more structured SMP requiring cooperation and coordination of fire activities may be required. This more-structured program may include enforceable requirements on who may burn and when burning may occur. A discussion of what a SMP may include is presented in section 3.3.

Air quality, agriculture and forestry agencies, public and private land owners/managers, the general public and EPA regional offices should collaborate in the development and implementation of state/tribal SMPs. The EPA provides states/tribes flexibility in their approach to regulating resource management fires. States/tribes are not required to change their existing fire regulations if those regulations adequately protect air quality. However, states/tribes must, where applicable, adopt enhanced SMPs to meet air quality goals, such as required by regional haze SIPs submitted under 40 CFR 51.309, or adopt smoke management techniques to address smoke effects for regional haze SIPs submitted under 40 CRF 51.308. Examples of enhanced SMPs can be found at the Western Regional Air Partnership (WRAP) web site.[3]

3.1 Implementing Principles

The following are guiding principles for implementing this guidance:

- Public health, welfare and safety should be the most important considerations in all resource management fire decisions;
- Air quality impacts on public health and visibility protection should be evaluated when determining which land and vegetation management practices to implement;
- Air quality, agriculture and forestry agencies should foster collaborative relationships among public and private land owners/managers, EPA regional offices and the public to develop and implement SMPs;
- Prior to measuring NAAQS violations, states/tribes have the flexibility to decide when a SMP is needed and how the program will be designed to prevent adverse air quality impacts. This does not preclude public and private land owners/managers from including

[3] http://www.wrapair.org/forums/fejf/tasks/FEJFtask6.html

smoke management components in burn plans for fires they conduct in the absence of an applicable state/tribal program; and

- All parties (public and private land owners/managers, air quality, agriculture and forestry agencies, and the public) should act in good faith and be held accountable for implementing their respective parts of the SMP.
- The development of smoke management programs should include public review and comment.

3.2 Basic Smoke Management Practices

States choosing to address the potential adverse impacts of smoke have the flexibility to develop a SMP or identify basic smoke management practices for minimizing emissions and controlling impacts from resource management fires. If a SMP is developed, EPA recommends that, at a minimum, basic smoke management practices be included in the SMP. Section 3.3 provides a detailed discussion of the elements of a SMP. However, when a SMP has not been developed or adopted, EPA strongly recommends that all of the following practices be implemented:

- Do not conduct burns on days in which the air quality is expected to be exceeding, or close to exceeding, the NAAQS for PM or ozone;
- Use an appropriately trained burn manager;
- Evaluate alternatives to burning and implement them where relevant;
- Identify smoke sensitive areas downwind of the burn (e.g., highways, communities, hospitals and medical clinics, schools, airports, scenic vistas, Class I federal areas, nonattainment areas);
- Determine/predict future meteorological conditions (e.g., wind speed and direction) that

will promote smoke plume rise and transport away from sensitive areas and prevent ground level accumulation of smoke. There are a number of models that predict meteorology up to 72 hours in the future. If the models all give the same end result then that result is a good indication of future meteorological conditions. If, however, they give different results, experience in observing plume characteristics for your local conditions would have to be developed. Consider use of smoke dispersion models such as VSMOKE and meteorological tools to aid in this determination. For larger burns, consider use of smoke forecasting models such as BlueSkyRAINS. Section 5 provides more information on tools that are available for evaluating meteorological conditions and smoke dispersion;

- Use emission reduction techniques (e.g., reducing fuel load with pre-burn treatments such as grazing, thinning, mastication or other mechanical treatment; limiting the amount of burning conducted during any one time; selecting fuel preparation methods that minimize dirt and moisture; and promoting fuel configurations that create an optimal air-to-fuel ratio);
- Establish contingency measures (see section 3.3.2.4 for further details) in case of excessive smoke impacts, which should include pre-coordinated public notification procedures. Ensure that adequate resources are on-site to implement the contingency measures. If necessary, implement the contingency measures and notify the public and air regulatory agencies of air quality problems;
- Monitor the smoke plume’s impact on sensitive receptors;
- Monitor the effects of the burn on air quality;
- Do not ignite a burn on a day with a burn ban or unfavorable meteorology;

- Provide adequate notice to potentially affected members of the public and agencies, and resolve any smoke-related health concerns; and
- Coordinate the ignition of multiple burns such that the cumulative impact is mitigated.

3.3 Elements of a Smoke Management Program

The EPA believes a SMP is an essential component in successfully balancing the use of resource management fires and protecting air quality. The EPA recognizes that the requirements and complexity of a SMP will vary by state/tribe due to differences in ambient air quality issues and the frequency and quantity of acreage burned. Thus, a SMP may form the framework for a state/tribe program which applies to all resource management fires or the administering authority may decide that only burns over some de minimis level should be subject to such a program.

The EPA believes that an effective SMP should contain the following components, described in more detail in the following sections:

3.3.1 Authorization to Burn

To effectively protect air quality and public health, a SMP should include a process for authorizing resource management fires within a region, state, or in Indian country and identify the appropriate authority responsible for issuing that authorization. Although EPA believes that an authorization process is an essential component of a SMP, we recognize that the process will vary depending on a variety of factors (e.g., air quality, visibility issues and the frequency of fires). For example, in areas where resource management fires do not contribute to ambient air quality violations or impact visibility, the process may be as simple as receiving and approving burn applications via telephone, e-mail or facsimile. However, in areas where resource management fires may adversely impact ambient air quality or visibility, the approval process may be more involved and require submitting a formal burn request, obtaining a permit to burn, and receiving a burn authorization under that permit. Also, a fire safety permit may be required from a local "Fire District" or fire department. The fire safety permit may contain constraints not related to air quality concerns. While air quality conditions may allow burning, there may be a burn ban due to high fire hazard levels. Coordination of burn decisions between fire departments and air quality regulators may be needed.

Examples of various ways of establishing conditions under which an approving authority issues a burn authorization are:

- A general statement that burning may occur only between certain hours of the day;
- Daily notification through the media and toll free phone number whether burning may occur and when (e.g., Today is a burn day in King County between the hours of 10:00AM and 3:00 PM. All fires should be out by 3:00 PM); or
- Daily communication with the burner providing them with a daily burn decision when ignition must take place and the field or location of the burn. (In this case, burning could not occur without verbal authorization. Such authorization could be rescinded at the last minute should conditions warrant.)

The approving authority may require a land owner/manager to submit a burn plan for an individual fire that will burn more than an established minimum acreage (also known as a de minimis fire). Persons responsible for managing greater than de minimis fires should be adequately trained in fire and smoke management. See section 3.3.2 for additional information on burn plan components.

The approving authority's review process of fire applications should incorporate the coordination and scheduling of resource management fire applications, an assessment of existing air quality and a determination of the ability of the airshed to disperse emissions (e.g., meteorological conditions) from all burning activities on the day of the burn. States/tribes should educate burners on proper burn practices and procedures, burn approvals and how that authority will be provided to the burner. The approving authority should strive to make prompt burn/no burn decisions and treat public and private land owners/managers equitably when authorizing fires. Persons receiving authorization to ignite fires must comply with all applicable state, local, tribal and federal requirements. Fire managers should be required to follow the authorized burn plan or explain the necessity of any deviations.

3.3.1.1 Coordination and Scheduling

The coordination and scheduling of multiple resource management fires within a specific area during the same timeframe (i.e., igniting multiple fires on the same day) is an essential component within the approval process. The EPA recognizes that air quality and visibility issues, as well as resource management fire frequency are factors that impact the extent of coordination when scheduling this type of fire. For example, when approving and scheduling a resource management fire, the approving authority should consider all previously approved burn requests for similar fires plus all open burning activities (e.g., land clearing and construction wastes) allowed within an airshed. The approving authority should strive to treat public and private land owners/managers equitably (e.g., similar requirements, evaluation of burn plans, acreage authorization, timely response) when authorizing fires. Neighboring states/tribes are encouraged to create partnerships to coordinate fire projects when inter-jurisdictional impacts are expected, so as to meet air quality and fire management objectives. Fire emissions should be minimized and the air quality impacts should be mitigated regardless of political boundaries.

3.3.1.2 Air Quality Assessment

Existing air quality in the area must be considered before burn authorizations are granted.

The EPA recognizes that there are various methods that an approving authority can use to determine air quality. One option is to use the Air Quality Index (AQI) which is an index for reporting daily air quality. The AQI is an indicator of how clean or polluted the ambient air is in a given area and the associated health effects. Thus, for areas that have minimal air quality and visibility issues, the approving authority may use the AQI as an indicator of air quality. If the AQI is not available for the area in which a resource management fire is proposed, the approving authority may use data from nearby ambient air monitors to determine air quality. Maps displaying current information regarding AQI are available at http://airnow.gov.

3.3.2 Smoke Management Components of Burn Plans

When burn plans are required, especially for fires on publicly owned lands, they should include:

- location and description of the area to be burned;
- resource management objectives of the burn;
- personnel responsible for managing the fire, including their training and contact information;
- type of vegetation to be burned;
- area (acres) to be burned;
- amount of fuel to be consumed (tons/acre);
- fire prescription information including actions taken to minimize fire emissions (section 3.3.2.1), evaluation of smoke dispersion (section 3.3.2.2), public notification (section 3.3.2.3), contingency measures (section 3.3.2.4) and air quality monitoring (section 3.3.2.5); and

- the distance and direction from the burn site to local sensitive receptor areas (e.g., nonattainment areas, hospitals and medical clinics, schools, Class I areas) and to regional/interstate areas where appropriate.

3.3.2.1 Actions to Minimize Air Pollutant Emissions

An overarching goal of a SMP is to minimize emissions from resource management fires. One way of accomplishing this goal is to ensure the judicious use of fire as a resource management tool. An essential component of a SMP is the consideration of alternative treatments to fire (e.g., biomass utilization and mechanical and chemical treatments) when addressing options for managing resources. (A discussion of alternative treatments is provided in Appendix A.) An alternatives analysis can be conducted by either the appropriate state agency or public and private land owners/managers and included in the burn plan. The analysis should provide a substantive evaluation of alternative treatments that may achieve the desired management objectives, while taking into consideration associated costs and the environmental impacts (e.g., air and water quality, soils, wildlife, etc.) of each alternative treatment. States/tribes should assist private land owners in identifying alternative treatments that will meet their objectives with minimum air pollutant emissions.

When the use of fire is selected as the best means to accomplish management objectives, there are several ways to reduce emissions from a single fire. The approaches fall into four categories and their applicability varies by fuel type: (1) minimize the area burned, (2) reduce the fuel loading in the area to be burned, (3) reduce the amount of fuel consumed by the fire, and (4) minimize emissions per ton of fuel consumed.

The burn plan should document the actions taken prior to and after the burn to reduce air pollutant emissions. Examples of emission reduction techniques include: using alternatives to burning to meet management objectives (e.g. mechanical treatments); reducing fuel load with pre-burn treatments (e.g., whole tree harvesting, firewood collection, grazing, thinning, piling, biomass removal, and mastication); burning smaller concentrations of fuels; minimizing consumption of non-target fuels; limiting acres ignited per day; ensuring optimal fuels moisture content and meteorology; and rapid mop-up to reduce residual smoke.

An important factor to minimizing emissions is combustion efficiency. Combustion efficiency is increased when the fire spends more time in flaming combustion than in smoldering combustion and can be achieved through various techniques. One is to ensure dry conditions are present during the burn while balancing the possibility of an increased risk that materials not intended as part of the prescribed burn will become part of the fire and increase the amount of emissions produced. Another technique is to burn the combustible materials in piles or windrows. This technique generates more heat and thus the material burns more efficiently.

Backing fires, or fires that move against the wind, move more slowly through the fuelbed so by the time the fire passes, much of the burn material has already been consumed so the fire dies out quickly with very little smoldering. Additional information on emission reduction and combustion efficiency techniques can be found in Chapter 8 of the *Smoke Management Guide for Prescribed and Wildland Fire*, 2001 Edition (Hardy et al., 2001).

3.3.2.2 Evaluation of Predicted Smoke Dispersion

Burn plans should include provisions for evaluating potential smoke impacts at sensitive receptors and time ignition of fires to minimize exposure of sensitive populations and avoid visibility impacts in Class I federal areas. The approving authority should evaluate dispersion conditions when authorizing a burn. The EPA recognizes that both the need for and complexity of a dispersion evaluation will vary depending on several factors (e.g., air quality, proposed acreage to be burned, anticipated emissions from fire, proximity of sensitive receptors to fire, and number of resource management fires within the airshed for the day and wildfires impacting the airshed). An approving authority can satisfy the need to conduct a dispersion analysis by requiring that a resource management fire be ignited only under certain conditions (e.g., minimum surface and upper level wind speeds, wind direction, minimum mixing height, and dispersion index). The limiting conditions established by the approving authority should be based on either modeled emissions or experience with a previous prototypical resource management fire. However, the EPA believes that a more extensive dispersion evaluation (i.e., use of a smoke dispersion forecasting model and forecasted local meteorological data) is warranted under certain conditions, especially in the evaluation of large burns, when multiple burns are scheduled, or under unusual meteorological conditions. Section 5 provides information on tools that are available for conducting dispersion evaluations.

3.3.2.3 Public Notification

Protecting public health is one of the primary goals of this guidance. Thus, a SMP should establish criteria for issuing health advisories when necessary, and procedures for notifying potentially affected populations or individuals, including those in adjacent jurisdictions, of planned fires. To ensure that this goal is achieved, a SMP should require a fire manager to provide adequate public notice and resolve any individual's smoke-related health concerns prior to igniting a fire. The public notice should include actions to be taken by sensitive people to minimize their exposure (e.g., remain indoors, avoid vigorous outdoor activity, avoid exposure to tobacco smoke and other respiratory irritants, and in extreme cases, provide evacuation procedures).

The SMP should also outline when the notification will occur in relationship to the burn, and what media will be used (e.g., radio, television, newspapers, posters or flyers, door to door, signage, personal phone calls). Special attention should be given to how sensitive populations, such as children, older adults and people with heart or lung disease, are notified of resource management fires. Once the burn has commenced, the AQI is a useful tool to inform the public about changes in air quality. If air quality becomes unhealthy, the AQI will provide information about what actions should be taken to reduce exposure and who should take them. More information about the use of the AQI in smoke events may be found in the multi-agency document *Wildfire Smoke - A Guide for Public Health Officials*, at: http://www.arb.ca.gov/smp/progdev/pubeduc/wfgv8.pdf .

3.3.2.4 Contingency Measures to Reduce Exposure

The burn plan should identify actions to be taken by the land owners/managers to reduce smoke exposure to the public and address safety issues that may arise if smoke does not disperse as anticipated. The approving authority can perform these functions, if needed and under certain circumstances, for some private land owners/managers. These measures are especially important when burning next to populated areas.

Appropriate short-term (i.e., less than 24-hour) contingency actions may, among other things, include:

- notifying the affected public (especially sensitive populations) of elevated pollutant concentrations using the AQI;
- consulting with appropriate health department personnel for issuing health advisories;
- Suggesting actions to be taken by sensitive people to minimize their exposure (e.g., remain indoors, avoid vigorous outdoor activity, avoid exposure to tobacco smoke and

other respiratory irritants, and in extreme cases, provide evacuation procedures);

- postponing athletic events;
- providing clean-air facilities for sensitive people;
- halting ignitions of any new open burning that could impact the same area;
- analyzing the fire situation and identifying alternative management responses upon becoming aware that a fire is out of air quality prescription with regard to the air quality criteria;
- consulting state/tribal air quality managers regarding the appropriate short-term fire management responses to abate verified impacts;
- implementing management responses that will mitigate the adverse impacts to public health;
- reporting the steps taken to mitigate adverse impacts to the public and appropriate state/tribal agencies after they have been completed;
- ceasing ignition except as needed to maintain control of the fire;
- delaying new ignitions that could impact the area;
- posting signs or traffic control personnel when smoke affects roadways; and/or
- beginning mop-up (i.e., actions to reduce smoke).

It is important that adequate resources be on-site to implement the contingency measures. If relevant, the burner implements the contingency measures and notifies the public and appropriate regulatory agencies that contingency measures have been implemented.

3.3.2.5 Fire Monitoring and Plume Dispersion Characteristics

The burn plan should identify how land owners/managers will monitor the impacts resulting from a prescribed burn on air quality at sensitive receptors and on visibility in mandatory Class I federal areas. The EPA recognizes that there are various ways to monitor a fire; however, the chosen method should match the size of the fire and its proximity to sensitive receptors. Monitoring techniques include, but are not limited to: using personnel either on the ground or in an airplane to conduct visual monitoring, using satellite imagery to observe the fire, and using ambient air quality samplers and tracking meteorological conditions during the fire. For small fires, visual monitoring of the direction of the smoke plume and monitoring nuisance complaints by the public may be sufficient. The best way to learn plume behavior in an area is through visual observation to determine whether the prediction of plume behavior based on results of the technical tools (MM5, BlueSkyRains, on-site PiBals, etc.) is accurate. If the plume does not behave as predicted, try to determine why and learn from experience.

Also, the SMP can require that personnel are posted at roadways to look for visibility impairment and initiate safety measures for motorists (highway flaggers), that personnel at other sensitive receptors look for smoke intrusions, or that aircraft be used to track the progress of smoke plumes. For large fires expected to last more than one day, locating real-time PM monitors at sensitive receptors may be warranted to facilitate timely response to smoke impacts. There are several different commercially-available continuous PM monitoring methods that can provide near real-time PM data for use in decision making and/or public awareness.

3.3.3 Recordkeeping and Reporting

Collecting and maintaining data pertinent to a resource management fire, whether on public or private land, is another important issue that should be addressed in a SMP. A SMP should identify the data to be collected; the party responsible for collecting and maintaining the data; and when, how and to whom the data will be reported. The EPA believes that, at a minimum, the data collected should include the agency/individual responsible for the burn;

acreage burned; location, date, time and duration of burn; and type of burn (e.g., wildland fire use fire or prescribed burn); fuel type and pre-burn fuel loading.

3.3.4 Public Education and Awareness

State/tribal air, agriculture and forestry agencies should implement a program explaining the use and importance of fire for ecosystem management, the implications to public health and safety and the goals of the SMP to both land managers and the public. Both public and private land managers and air quality, agriculture and forestry agencies should work with the media to announce pre-fire health advisories and post-fire results including management objectives met, smoke intrusions observed and/or successful minimization of air quality impacts. A significant allocation of resources should be dedicated to outreach activities to both land owners/managers as well as the general public.

3.3.5 Surveillance and Enforcement

The SMP should include procedures to ensure that public and private land owners/managers comply with the requirements of the SMP. Land owners/managers must follow their burn plan, including the fire prescription and smoke management components, or explain any deviations from the plan. Land owners/managers should conduct post-burn reviews to determine the effectiveness of the burn plan and define areas that can be improved for future burns. A SMP should require post-burn reports for resource management fires that cause either air quality problems or smoke impacts at sensitive receptors. Post-burn reports should describe the incident, the contingency plan implemented and provide recommendations to prevent air quality and smoke related problems in the future.

An essential component of implementing a SMP is the oversight role provided by state/tribal agencies. When multiple state/tribal agencies (e.g., air quality, agriculture and forestry) are responsible for implementing a SMP, EPA encourages these agencies to develop a Memorandum of Understanding (MOU) identifying their respective roles and responsibilities.

3.3.6 Program Evaluation

The SMP should provide for annual review and evaluation by all stakeholders (e.g., public and private land owners/managers, air quality, agriculture and forestry agencies, and the public) of its effectiveness. The review should include:

- reports of smoke intrusions;
- nuisance complaints;
- monitored air quality impacts;
- post-burn reports;
- acres of fires managed (historically and projected to account for program growth or shrinkage);
- need for expansion of the program to include authorization of other open burning;
- communications to the public, growers and land owners/managers; and
- availability of improved technical tools.

All participants should discuss lessons learned and revisions to practices and procedures to improve performance.

3.3.7 Additional Air Quality Protection Measures

States/tribes may adopt additional smoke management practices to provide better protection against smoke impacts. For example, “special protection zones,” or buffers (e.g., 10 to 25 miles), may be established to provide better protection against smoke impacts around wildland/urban interface areas, nonattainment areas or mandatory Class I federal areas. Requirements within a special protection zone may include no burning if high pollution levels already exist in the area, may apply only to multi-day burns or burns during specific seasons or could prohibit open burning altogether.

States/tribes may also establish "performance standards" that could set limits on the frequency and intensity (e.g., hours/day, PM concentration, visibility impairment) of smoke intrusions. These performance standards could trigger implementation of additional smoke management requirements if air quality levels begin to approach the NAAQS. Additional requirements may include banning additional fires until dispersion parameters (e.g., increased wind speed, mixing height, dispersion index, etc.) improve. Implementation of performance standards may require real-time monitoring of air quality.

3.4 Interstate Transport of Smoke

Fire emissions can cause detrimental effects in small geographical areas as well as large regions. For example, the large number and size of wildfires in central and Northern California in July 2008 contributed to elevated PM levels as far north as Oregon and Washington. Several key provisions of the CAA address interstate pollutant transport. Section 110(a)(2)(D) provides that a SIP/TIP must contain provisions preventing emissions from one state from contributing significantly to nonattainment problems or interfering with maintenance of air quality standards in any other state. That section also requires SIPs to contain provisions to prevent interference with any SIP required measures under Part C to prevent significant deterioration or to protect visibility. Section 169A authorizes EPA to promulgate regulations requiring states that "may reasonably be anticipated to cause or contribute to" visibility impairment in mandatory Class I federal areas to include in their SIPs, measures necessary to eliminate or reduce such impairment. Also, sections 169B, 176A and 184 contain provisions for cooperatively addressing interstate pollution problems by establishing interstate transport regions and commissions to address regional pollution and visibility concerns. The EPA promulgated a final rule, pursuant to the requirements of section 301(d) of the CAA that authorizes eligible Indian tribes to also implement these provisions (40 CFR Part 49).

If resource management fires in one state (or in Indian country) cause or significantly contribute to NAAQS violations in another state (or in Indian country), EPA is authorized to take action under section 110(k)(5) of the CAA to address the problem. If EPA finds that a SIP/TIP is substantially inadequate to attain or maintain the NAAQS, to prevent interstate transport or to meet any other requirements of the CAA, EPA may require the SIP/TIP to be revised to correct the inadequacy. As discussed in section 1.4.3, collaboration and cooperation between public and private land owners/managers, air quality and agriculture and forestry agencies are encouraged. Focused collaboration and cooperation between stakeholders in affected states can be useful for resolving issues associated with interstate transport of smoke.

3.5 Coordination on Wildfires and Wildland Fire Use Fires

Wildland fires present unique challenges to protecting both air quality and public health. As reflected in the EER preamble, there are two types of wildland fires, a wild fire and a wildland fire use fire. Although both types of fires are unplanned, a wildland fire use fire is, by definition, a resource management fire. The distinction between a wildfire and wildland fire use fire is reflected in the fact that a land owner/manager makes a conscious decision to allow a wildfire to burn, instead of actively seeking to extinguish the fire, on land that has been identified through a planning process that would benefit from the use of fire. Because these two types of fire are unplanned, the EPA believes that they do not easily conform to a SMP designed for planned prescribed burns. However, the EPA believes that certain components of a SMP are applicable when confronted with wildfires and wildland fire use fires.

The EPA believes that a wildfire's impact to air quality should be monitored and evaluated. In addition, the public should be kept informed of the fire's impact on air quality and options for avoiding health impacts. The EPA recommends that the AQI be used as the metric for determining health impacts. The process for informing the public about a wildfire's impact on air quality can vary. However, the EPA believes that a specific procedure (e.g., responsible party, timing and frequency of issuing notices, and notice contents, etc…) should be established jointly by the air quality and forestry agencies, land owners/managers, and the public.

A wildland fire use fire is by definition a resource management fire. The EPA recognizes that land owners/managers have the initial responsibility of determining whether a wildland fire should be reclassified as a wildland fire use fire. However, the EPA believes that the final decision regarding this type of reclassification should be determined jointly by air quality and forestry agencies. Existing air quality, an area's air quality classification (i.e., attainment, maintenance or nonattainment) for criteria pollutants, especially particulate matter and ozone, and the potential impact of a fire's emissions on air quality and public health should be included in the list of factors utilized in making the final decision. The EPA recommends that air quality and forestry agencies not conduct wildland fire use fires when the AQI indicates unhealthy ambient air or if the fire, either by itself or in conjunction with emissions from other sources would cause an area to exceed a NAAQS. In addition, the EPA believes that land owners/managers or air quality and forestry agencies should develop a generic burn plan that can be used for a wildland fire use fire. At a minimum, a generic burn plan should address the following: evaluation of predicted smoke dispersion, public notification, contingency measures to reduce exposure, and fire monitoring and plume dispersion characteristics.

4.0 DATA ON WILDLAND FIRES AND PRESCRIBED BURNS

Most of a state/tribal program to protect air quality is contained in a FIP, SIP or TIP. As the use of resource management fires increase, state/tribal air quality managers will need information to develop potential annual or seasonal air pollutant emission estimates for FIP/SIP/TIP planning purposes. Thus, state/tribal agencies will need to obtain and maintain the necessary information needed to compute emissions from resource management fires.

Emissions from fires can be estimated by multiplying the estimated level of activity by an emission factor. The level of activity for fire is the mass of biomass (fuel) consumed, usually expressed in tons. Emission factors and fuel loading information expressed in pounds per ton of fuel consumed are available in EPA's publication AP-42, which is periodically updated. Emission factors are derived from an estimate of overall combustion efficiency. The mass of fuel consumed is the product of fire size (acres), pre-burn fuel loading (tons per acre), and fuel consumption (percent of pre-burn loading). An emission inventory can be compiled by the affected air agency for an individual fire, a statistical class of fires, a burn program, or a population of fires in a given area over a period of time based on this information.

Federal land management agencies currently collect data on wildland fires and prescribed burns; however, no standard reporting format is followed. These raw data are usually limited to the time and approximate location of the fire, fire perimeter area, weather (occasionally) and a qualitative description of fuels at the point of ignition. The data are not collected for the purpose of calculating air pollutant emissions and are probably inadequate for that purpose.

A National Interagency Fire Statistics Information Project has been initiated to develop an easily accessible system for storing a set of commonly agreed upon fire data. Post-burn data, such as that described above, on future wildland fires and prescribed burns will be stored in this database. The database will be accessible by air quality managers to estimate past, current and future emission trends from this source category.

The EPA encourages the FLM agencies to develop the fire statistics database and FLMs to report fire data to the system. These fire data will be needed by air quality managers in regions where most wildland fires and prescribed burns occur on federal lands. Air quality managers should request similar fire data for wildland fires and prescribed burns on state, private and Indian wildlands as well as information on other types of open burning to complete their emission inventories.

Statewide emissions from fire use in all 50 states were first estimated in 1989 based on a survey of land owners/managers (Peterson and Ward, 1993). More recent inventories have been developed by Regional Planning Organizations (RPOs) established to provide technical support to states developing regional haze SIPs (Air Sciences and EC/R Incorporated, 2007; E.H. Pechan, 2003; Boyer et al., 2004; Reid et al., 2004). The emission estimates are based on fuel models derived from 14 types of vegetative cover spatially mapped throughout the area and estimates of fuel loadings as either low, medium or high. The procedures followed by Peterson and Lahm (1994) to estimate emissions for the western states provide a good model for developing emissions estimates for other areas.

Note that states and RPOs have updated fire emission estimates and emissions inventories that are being used for the regional haze SIPs. A fire emissions inventory and tracking system is required for the regional haze SIPs submitted under section 51.309 of the CAA.

5.0 TECHNICAL TOOLS

There are several tools available to help manage the impact of fire activity on air quality. These include modeling tools, data sources, and data collection tools. While EPA does not endorse any particular tool, several are discussed for informational purposes.

VSmoke - The VSmoke Model is a meteorologically-oriented dispersion model used to predict the smoke and dry weather visibility impact of a single prescribed burn at several downwind locations. The model allows the user to control what percentage of smoke is dispersed at the ground level and how the remaining smoke plume will rise to its maximum height into the atmosphere at 31 fixed distances. VSMOKE can be used either on its own or as part of a system of prescribed fire management programming tools.

VSmoke consists of six different computational components: (1) modeling of pollutant constituents, heat emissions, and vertical and horizontal distribution of smoke; (2) a plume rise model; (3) a plume atmospheric dispersion model to estimate smoke concentrations at specified distances downwind from the fire; (4) a crossplume sightline characteristics model that estimates the visibility and contrast ratio for the plume at specific downwind distances; (5) a dispersion rate model; and (6) a statistical model that estimates a Low Visibility Occurrence Risk Index (LVORI).

VSmoke provides conservative estimates and can be used as a screening system to determine the potential for smoke-related hazards. Once those potential hazards are identified with this model, other models, such as INPUFF or PLUVUE, can be used to more completely determine the nature and impacts of the hazard (Lavdas, 1996).

BlueSky – The BlueSky Smoke Modeling Framework is a web-based system that provides real-time smoke concentration predictions. The framework is designed to determine cumulative impacts from forest, agricultural and range fires using emissions, meteorology and dispersion models. BlueSky also uses fire information and predictions developed from a weather forecast model to estimate forecasts of ground concentrations of smoke. BlueSky is an open source modeling platform – there are various models that can be used in each step in determining impacts. Currently, most BlueSky implementations use the Fuelbed Characteristic Classification System (FCCS) fuel loading map and Emissions Production Model, CALPUFF, and HYSPLIT (discussed below). (http://www.airfire.org/projects/bluesky/bluesky-modeling-framework)

HYSPLIT - The HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model is the newest version of a complete system. It can be used for tasks as simple as computing simple air parcel trajectories, or as complex as dispersion and deposition simulations. The model can be run interactively on the Web through the READY (Real-time Environmental Applications and Display) system on the National Oceanic and Atmospheric Administration (NOAA) website or the executable code and meteorological data can be downloaded to a Windows PC. The model can simulate the transport of smoke utilizing the archived meteorological data on the READY web site. Through this site, the model is most appropriate for long range transport of smoke due to the 40 km horizontal grid spacing of the archived meteorology. For more information on this model, go to http://www.arl.noaa.gov/ready/hysplit4.html.

The HYSPLIT model can be used retrospectively: (1) to help determine the forward path of smoke plumes from past known fires, and (2) to investigate whether a monitored PM concentration may have been affected by known fire(s) in another area. While retrospective analysis obviously has limited or no direct use in smoke management, there may be an indirect benefit in that understanding the transport of smoke during past fire events may improve predictions of where smoke will travel in future fires. Satellite photographs (and satellite measurements of aerosol optical depth) are another way to look at past smoke transport. However, satellite photographs do not automatically tell whether smoke was present at the surface at points below what appears to be the smoke trajectory, because satellite photographs indicate all the smoke in a vertical column of air. If a smoke plume rises quickly past the mixed layer height (or boundary layer) height, a satellite photograph may indicate the path of a smoke plume that is not affecting concentrations at the surface. However, if HYSPLIT modeling of trajectories within the mixed layer match the trajectory suggested by the satellite photograph, or if it is known that the smoke stayed low to the ground, it is more likely that the satellite photograph indicates the presence of smoke at ground level.

HYSPLIT can also be used prospectively, to generate forward trajectories to predict the path of an ongoing fire or a contemplated future fire. The READY website can be used to do these predictive trajectories, but an additional user registration step will need to be completed.

ClearSky - ClearSky (http://www.clearsky.wsu.edu/) is a plume dispersion model housed at Washington State University that uses meteorological forecasts and emissions estimates to determine surface level smoke concentrations and dispersion. ClearSky uses a web-based application to allow burn managers to input data specific to the area of concern to create realistic simulations. These data are combined with meteorological forecasts developed from the Mesoscale Modeling Group MM5 (discussed below) and CALPUFF dispersion calculations to generate dispersion scenarios. Hourly $PM_{2.5}$ predictions at specific receptor locations (i.e., these locations have the necessary instrumentation to measure $PM_{2.5}$) are also provided to the burn manager. This tool allows local burn managers to generate multiple field-burning scenarios and view animations of the simulation results to help shape their burn decisions.

Local temperature soundings – Localized atmospheric conditions, including current weather and upper air data, are available through the National Weather Service (NWS) and associated federal agencies. Local surface data may be easily obtained via the NWS website at www.weather.gov. These surface data are typically collected at Automated Surface Observing Systems (ASOS) or Automated Weather Observation Systems (AWOS) sites, many of which are located at airports. Upper air data, including temperature, dewpoint and winds are able to be measured through multiple different methods including Radiosondes, Rawinsondes, Radio Acoustic Sounding Systems (RASS), microwave radiometers, Light Detection and Ranging (LIDAR) and aircraft measurements. Radiosondes and Rawinsondes are more widely-used worldwide, in concert, and have a predictable schedule with more easily accessible data. Radiosondes or Rawinsondes (which include wind data) are balloon-borne sensors released by NWS from 92 sites in North America and select Pacific Islands at 0000 and 1200 UTC (coordinated universal time) daily. They collect temperature and dewpoint, and often wind data as well, as they ascend through the atmosphere. The data are available at: http://rap.ucar.edu/weather/upper/ in the form of Skew-T diagrams which can be used to determine mixing heights and, if a rawinsonde is used, winds at given pressure level.

Pilot weather balloons (Pibals) - Pibals allow observers on the ground to project where an object or smoke plume will likely travel in the horizontal as it ascends vertically through the atmosphere. Pibals are usually a natural or synthetic rubber balloon filled with either hydrogen or helium. They come in varying 'weights' which correspond to varying maximum ascent altitudes. They are limited in use today due to the growing availability of other vertical profiling instrumentation, but are still used occasionally in rural areas where more modern vertical profilers or model estimates are unavailable. The use of a pibal is typically accompanied by the use of a theodolite, which allows the ground observer to mechanically keep track of the pibal height and bearing during its ascent.

Satellite images/maps, remote sensing (e.g. MODIS, GOES) - An extensive array of satellite-based systems (see Table 3) with the capability of covering broad spatial areas and measuring atmospheric column total species has been established by United States and European Satellite programs lead by the U.S. National Aeronautics and Space Administration (NASA) and NOAA in the United States and the European Space Agency (ESA). A suite of satellites

Table 3. Satellite-based Air Quality Observing Systems[1,4]

Instrument	Satellite Platform[3]	Lead Federal Agency	Initiated	Measurement Parameters	Orbit & Horizontal Resolution	Location of Information and/or Data
OLS (Operational Linescan System)	DMSP satellites	DOD	1962?	Identify fires and smoke plumes	Polar Imagery only	http://www.af.mil/factsheets/factsheet.asp?fsID=94
BUV (Backscatter Ultraviolet Spectrometer)	Nimbus 4	NASA	1970-1980	O3, CO2, SO2	Sun synchronous	http://nssdc.gsfc.nasa.gov/database/MasterCatalog?sc=1970-025A
SBUV (Solar Backscatter Ultraviolet Spectrometer)	Nimbus 7	NASA	1978-1993	O3, SO2	Polar	http://jwocky.gsfc.nasa.gov/n7toms/nimbus7tech.html
TOMS (Total Ozone Mapping Spectrometer)	Nimbus 7 Meteor 3 Earth-Probe	NASA	1978-1993 1991-1994 1996	O3, SO2, Aerosols	Polar ~100km	http://toms.gsfc.nasa.gov/fltmodel/spacecr.html
LIMS (Limb Infrared Monitor of the Stratosphere	Nimbus 7	NASA	1978-1979	O3, HNO3, NO2,	Polar	http://lims.gats-inc.com/about_lims.html
ATMOS (Atmospheric Trace Molecule Spectroscopy)	Spacelab 3 ATLAS -- 1,2,3	NASA	1985, 1992, 1993, 1994	O3, CFCl3, CF2Cl2, ClONO2, HCl, HF, CO, CH4, HCN, HNO3, NO, NO2, N2O, N2O5, Aerosols		http://remus.jpl.nasa.gov/atmos/sl3.html
CLAES (Cryogenic Limb Array Etalon Spectrometer)	UARS	NASA	1991-1993	O3, CFCl3, CF2Cl2 ClONO2, CH4, HNO3, NO, NO2, N2O, N2O5, Aerosols		http://umpgal.gsfc.nasa.gov/
HALOE (Halogen Occultation Experiment)	UARS	NASA	1991-2005	O3, HCl, HF, CH4, NO, NO2, Aerosols		http://umpgal.gsfc.nasa.gov/

ISAMS (Improved Stratospheric and Mesospheric Sounder)	UARS	NASA	1991-1992	O3, CO, CH4, NO2, N2O, N2O5, Aerosols		http://umpgal.gsfc.nasa.gov/
MLS (Microwave Limb Sounder)	UARS	NASA	1991-1999	O3, ClO, CH3CN, HNO3, SO2		http://umpgal.gsfc.nasa.gov/
GOES Imager (Geostationary Operational Environmental Satellites)	GOES-10 GOES-12	NOAA	1994	Fire products for WF_ABBA (imagery) and GASP (aerosol optical depth)	Geostationary	http://www.nesdis.noaa.gov/
GOES Sounder (Geostationary Operational Environmental Satellites)	GOES-10 GOES-12	NOAA	1994	Total column O3	Geostationary	http://cimss.ssec.wisc.edu/goes/goesmain.html#sndrinfo

Table 3. Satellite-based Air Quality Observing Systems[1,4] (Continued)

Instrument	Satellite Platform[3]	Lead Federal Agency	Initiated	Measurement Parameters	Orbit & Horizontal Resolution	Location of Information and/or Data
AVHRR (Advanced Very High Resolution Radiometer)	NOAA-15 NOAA-16 NOAA-17[2]	NOAA	1998	Aerosol optical depth, particle size information and vegetation/drought index products related to air quality through fires	Polar 4km	http://noaasis.noaa.gov/NOAASIS/ml/avhrr.html
SBUV/2 (Solar Backscattered Ultraviolet Radiometer Model 2)	NOAA-16 NOAA-17[2]	NOAA	2000	Total and profile O3 from surface to top of atmosphere in ~5 km thick Umkehr layers	Polar	http://www2.ncdc.noaa.gov/docs/podug/html/c4/sec4-4.htm
MOPITT (Measurement of Pollution in the Troposphere)	EOS Terra	NASA	1999	CO, CH4	Polar 22 x 22 km^2	http://www.eos.ucar.edu/mopitt/
MISR (Multi-angle Imaging SpectroRadiomenter)	EOS Terra	NASA	1999	Aerosol properties and plume height information near the vicinity of fires	Polar ~1km	http://www-misr.jpl.nasa.gov/mission/introduction/welcome.html
MODIS (Moderate Resolution Imaging Spectroradiometer)	EOS Terra EOS Aqua	NASA	1999 2002	O3, Aerosol optical depth, particle size information, fine particle fraction, and forest fires	Polar 1km	http://modarch.gsfc.nasa.gov/index.php
AIRS (Atmospheric Infrared Sounder)	EOS Aqua	NASA	2002	Total column ozone, surface temperature, temperature and moisture vertical profiles, (plus under development are CO and CO2 total column, O3 vertical distribution, and CH4 distribution)	Polar 50km	http://www-airs.jpl.nasa.gov/
HIRDLS (High Resolution Dynamics Limb Sounder)	EOS Aura	NASA	2004	O3, CFCl3, CF2Cl2, ClONO2, CH4, HNO3, NO2, N2O, N2O5, Aerosols	Polar	http://aura.gsfc.nasa.gov/index.html
MLS (Microwave Limb Sounder)	EOS Aura	NASA	2004	O3, BrO, ClO, HOCl, HCl, CO, HCN, CH3CN, HNO3, N2O, OH, HO2, SO2	Polar	http://aura.gsfc.nasa.gov/index.html
OMI (Ozone Monitoring Instrument)	EOS Aura	NASA	2004	O3, BrO, OClO, HCHO, NO2, SO2 and aerosol	Polar 12 x 24 km^2	http://aura.gsfc.nasa.gov/index.html

TES (Total Emission Spectrometer)	EOS Aura	NASA	2004	O3, NOy, CO, SO2, CH4	Polar 26 x 42 km^2	http://aura.gsfc.nasa.gov/index.html
CALIPSO (Cloud-Aerosol Lidar & Infrared Pathfinder Satellite Observations)	CALIPSO	NASA	2005	Aerosol optical depth, backscatter, extinction	Polar 0.3 x 0.3 km^2	http://www-calipso.larc.nasa.gov/about/
OMPS (Ozone Mapping and Profiling Suite)	NPOESS - Preparatory Project	NOAA	2006	Total column and vertical profile ozone data	Polar	http://www.ipo.noaa.gov/Projects/npp.html
VIIRS (Visible Infrared Imaging Radiometer Suite)	NPOESS - Preparatory Project	NOAA	2006	Aerosol optical depth	Polar	http://www.ipo.noaa.gov/Projects/npp.html
Orbiting Carbon Observatory	OCO	NASA	2008	CO2	Polar	http://oco.jpl.nasa.gov/

Table 3. Satellite-based Air Quality Observing Systems[1,4] (Concluded)

Instrument	Satellite Platform[3]	Lead Federal Agency	Initiated	Measurement Parameters	Orbit & Horizontal Resolution	Location of Information and/or Data
APS & TIM (Aerosol Polarimetry Sensor & Total Irradiance Monitor)	Glory	NASA	2008	Black carbon soot, other aerosols, total solar irradiance, cloud images	Sun-synchronous, circular, Low Earth Orbit	http://glory.gsfc.nasa.gov/

Notes:
1. Non-U.S. satellite systems are not included in table at this time.
2. As of 3/15/06 the operational satellite platforms may need to include NOAA-18.
3. CALIPSO -- Cloud-Aerosol Lidar & Infrared Pathfinder Satellite Observations
   DMSP -- Defense Meteorological Satellite Program
   EOS -- Earth Observing System
   GOES -- Geostationary Operational Environmental Satellites
   NOAA -- National Oceanic and Atmospheric Administration
   NPOESS -- National Polar-orbiting Operational Environmental Satellite System
   OCO -- Orbiting Carbon Observatory
   UARS -- Upper Atmosphere Research Satellite
4. See the following table for additional information on NASA satellites, instrument systems, pollutants measured, and data availability:

including Aqua, Aura, Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO), Glory, as well as NOAA-17, NOAA-18 and NPOESS, have either been launched since about the year 2000 or have other near-term proposed launch dates. Collectively, the remote sensing techniques can measure spatial distributions, as well as columns and/or profiles of aerosols (AOD – aerosol optical depth), other pollutants, and atmospheric parameters such as temperature and water. Most of these satellites have a near-polar orbit allowing for two passes per day over a given location. When taken together, a group of five satellites (Aqua, Aura, CALIPSO, as well as CloudSat and PARASOL -- coined the A-Train) fly in a formation that crosses the equator a few minutes apart at around 1:30 local time to give a comprehensive picture of atmospheric conditions. On the other hand, the NOAA Geostationary Operational Environmental Satellites (GOES) provide continuous monitoring, over portions of the globe, by circling the Earth in a geosynchronous orbit that allows them to hover continuously over one position on the surface. The geosynchronous plane is about 22,300 miles above the Earth, high enough to allow the satellites a full-disc view of the Earth. Because they stay above a fixed spot on the surface, they provide continuous measurements for that area of the Earth so as to monitor pollutant emissions and track their movements.

Temporal characterization

The polar orbiting satellite tracks provide wide spatial coverage of reasonable horizontal (10-50 km) resolution, but deliver only twice daily snapshots of a pollutant species. Consequently, temporal patterns of pollutants as well as a time-integrated measure of pollutant concentrations cannot be delineated explicitly through these satellite measurements alone. However, geostationary satellite platforms, such as the GOES for fire products (imagery and AOD), provide near continuous coverage. There also are proposed campaigns within NASA and across partnership federal agencies to deploy geostationary platforms with measurement capabilities for aerosols and trace gases to enhance space-based characterization of tropospheric air quality.

Spatial characterization

Polar orbiting satellites typically provide horizontal spatial resolution between 10 and 100km, depending on the angle of a particular swath segment. Spatial resolution less than 10 km is possible with geostationary platforms. With few exceptions, satellite data typically represents a total atmospheric column estimate. However, for aerosols and certain important trace gases (e.g., NO_2, SO_2, HCHO (formaldehyde)), the majority of mass resides in the boundary layer of the lower troposphere, enabling associations linking column data to surface concentrations or emissions fields. For example, reasonable correlations, especially in the Eastern United States, have been developed between concentrations from ground level $PM_{2.5}$ stations and AOD from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Aqua and Terra satellites. Correlations between AOD and surface aerosols generally are better in the Eastern United States, relative to the West, due to excessive surface light scattering from relatively barren land surfaces. The Infusing Satellite Data into Environmental Applications (IDEA, http://www.star.nesdis.noaa.gov/smcd/spb/aq/) Internet site provides daily displays and interpretations of MODIS and surface air quality data. The CALIPSO satellite provides some ability to resolve aerosol vertical gradients.

Use of Satellite data in air quality management assessments

Satellite data, particularly fire and smoke plume observations and GOES meteorological data, support various air quality analysis efforts. Satellite products complement existing observational platforms and support the air quality assessment process through:

- Direct observational evidence of regional and long range intercontinental transport;
- Direct evidence of the occurrence of biomass burning;
- Emission inventory improvements through inverse modeling;
- Evaluation of Air Quality Models;
- Tracking emissions trends (accountability); and
- Complementing surface networks through filling of spatial gaps.

As air quality assessments, including those related to the transport and dispersion of pollutant emissions from wildland fires and prescribed burns, evolve toward embracing more pollutant categories, an attendant need to characterize a variety of spatial (and temporal) scales places demands on developing more compositionally rich characterizations of air pollutants. Satellite technologies combined with federal agency partnerships, such as NASA and NOAA, are assisting the air quality community by providing data that covers broad spatial regimes in areas lacking ground based monitors and/or detailed data for calculating fire-related emissions.

NASA's Aura satellite (http://www.nasa.gov/mission_pages/aura/spacecraft/index.html) mission, launched in 2004, deploys sensors theoretically capable of measuring aerosols, all criteria gases and many other pollutants – a multiple pollutant space-based complement to the NCore multiple pollutant ground based network and intensive field campaigns. The Aqua, Terra and Aura all are part of NASA's Earth Observation System (EOS). When used in combination with air quality models, satellite data can be used as an observation driven top-down check and modification through inverse modeling of emission inventories. Satellite data for CO, NO_2 and HCHO, as an indicator for biogenic isoprene, have been used for improving emission inventories. As longer term records are developed, satellite imagery offers another means of checking progress of major emission strategy plans.

CALIPSO builds on the ongoing success of MODIS instrument aboard NASA's Terra (EOS AM) and Aqua (EOS PM) satellites which has provided total aerosol column optical depths (AOD) for use in:

- Supporting development of wildfire and prescribed burning emission inventories (the 2005 NEI will include emissions from fires utilizing MODIS);
- Evaluating ability of air quality models such as the Community Multiscale Air Quality

(CMAQ) model to characterize total column aerosol loadings, and

- Complimenting ground based $PM_{2.5}$ monitors by filling in spatial gaps and adding intelligence to conceptualize our understanding of aerosol episodes (see http://www.star.nesdis.noaa.gov/smcd/spb/aq/).

More specifically with regard to wildland fires and prescribed burns, GOES WF_ABBA (Wildfire Automated Biomass Burning Algorithm) and other satellite measurements and products can be especially useful. Emission estimates obtained through modeling of biomass burning using satellite-derived vegetative fuel loadings, fuel moisture, and fire sizes can be supported across the United States. For example, fuel loading can be developed from MODIS data including land cover type, vegetation continuous field and monthly leaf-area index. The weekly fuel moisture category can be retrieved from (Advanced Very High Resolution Radiometer (AVHRR) data for the determination of fuel combustion efficiency and emission factor. The burned area can be simulated from GOES by identifying burned areas in individual "fire pixels." This is critical input to calculation of the diurnal, seasonal, and inter-annual biomass burning emissions. The burned areas can also be used to exhibit diurnal variability with a temporal scale of half hours; burned areas from detections of GOES active fires can be at near real time and data.

MM5 - The Department of Atmospheric Sciences at the University of Washington Mesoscale Model produces high resolution meteorological forecast for the Pacific Northwest twice a day (http://www.atmos.washington.edu/mm5rt/). The MM5 uses an outer grid of 36 km horizontal resolution and a nested grid of 12 km resolution that covers Washington, Oregon and Idaho. These forecasts provide additional information to smoke management coordinators when deciding whether meteorological conditions are adequate for conducting a burn.

Monitoring equipment and data management systems - For response-oriented fire and smoke monitoring, air quality concerns are most closely linked to PM concentrations. In order to quantify the amount of PM in a fire impacted area, several PM monitoring methods are available. These methods are ideal because of the portability of the instrument and their near-real time measurement capabilities.

The more widely-used instrument for smoke monitoring is the Met One EBAM. It can give a concentration of PM in as quickly as 15 minute intervals. The EBAM detects PM by determining the attenuation of beta radiation of the collected ambient PM on a glass fiber filter tape to determine ambient PM concentrations. EBAMs use the same beta attenuation method as one of the current Federal Equivalent Method (FEM) instruments for both PM_{10} and $PM_{2.5}$. Therefore, it is fairly correlated to an FEM measurement over longer averaging periods (such as an hour averaging period). The EBAM is equipped to collect meteorological data (temperature, relative humidity, wind speed and direction) and also can run on battery power. The unit is capable of disseminating data (including associated met data if available) via AIRSIS satellite modems. The existing infrastructure established with AIRSIS just for the EBAM allows for easy web access to EBAM data.

The other instrument that can be deployed in a smoke monitoring situation is a nephelometer. Nephelometers use light scattering properties of passing ambient PM to determine a backscatter coefficient that may be translated into a PM concentration. Nephelometers have an advantage over the EBAM by essentially providing real-time data. In addition, these instruments are also quite portable and consume very little power. However, nephelometers are generally not as tightly correlated to Federal Reference Method (FRM) or FEMs as the EBAM might be in a dynamic environment such as response-oriented smoke monitoring. Nephelometers are also essentially only effective for looking at $PM_{2.5}$, and are much more easily biased by environmental conditions, especially by humidity. They are useful for at least providing "ballpark" representation of $PM_{2.5}$ concentrations, but are not necessarily recommended to be used to assign publicly recognized air quality indicators such as those used by the Air Quality Index.

6.0 DEFINITIONS

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: PM, SO_2, NO_2, O_3, CO and Pb, and by visibility in mandatory federal Class I areas. For the purposes of this guidance, concentrations of PM are taken as the primary indicators of ambient air quality.

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

Air Quality Related Values (AQRV) – Those special attributes of a mandatory Class I federal area that deterioration of air quality may adversely affect. Some examples of AQRV include: flora and fauna, water, visibility and odor among others.

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

Administrative Unit – A unit of land (forest, refuge, park, etc.) under the administration of a public land management agency.

AP-42 – The EPA's Compilation of Air Pollutant Emission Factors for stationary point, area, and mobile sources. An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Emission factors are then used to estimate the magnitude of a source's pollutant emissions.

Basic Smoke Management Practice – Practices that minimize smoke impacts to include: not burning on days with poor air quality, use of trained burn manager, evaluation/implementation of alternatives to burning, identification of downwind smoke sensitive areas, determination of meteorological conditions that promote plume rise and transport of smoke away from sensitive receptors, use of emission reduction techniques, identification of contingency measures, monitoring smoke impacts on sensitive receptors, monitoring air quality, public notification and coordination of multiple burns to minimize cumulative impacts.

Burn plan – Burn plans are operational plans for managing specific fires that should include best SMPs or smoke management components to minimize fire emissions and mitigate air quality impacts. The plan includes the project objective, fire prescription (including smoke management components), personnel, organization, equipment, etc.

Class I Area – An area set aside under the CAA to receive the most stringent protection from air quality degradation. Mandatory Class I federal 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 Class I federal area includes subsequent changes in boundaries, such as park expansions.

Conservation Practice Standard (CPS) – Practices (cultural, structural) that enhance the productive capacity while maintaining the long term sustainability of the natural resources.

De Minimis Fires – Fires that will cover fewer than X acres or consume less than Y tons of fuel, as established by a state or tribe.

Federal Implementation Plan (FIP) – A plan (or portion thereof) promulgated by the Administrator, as provided for under the CAA and any applicable EPA regulations, including regulations governing tribal air plans, to fill all or a portion of a gap or otherwise correct all or a portion of an inadequacy in a state or TIP, and which may include enforceable emission limitations or other control measures, means or techniques (including economic incentives, such as marketable permits or auctions of emissions allowances), and provides for attainment of the relevant NAAQS.

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. For example, the National Park Service (NPS) and the U.S. Fish and Wildlife Service (FWS) manage those areas under the authority of the Department of the Interior (DOI).

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.

Fire Management Plan (FMP) – A strategic plan that defines a program to manage wildland fires and prescribed burns, and documents the FMP 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.

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

Indian country – (a) All land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and, including rights-of-way running through the reservation, (b) all dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a state, and (c) all Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same.

Land Manager/Owner – Includes FLMs (including public lands and lands under the jurisdiction of the DOD, state/tribal/local land managers and private owners (including farmers and growers).

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.

National Ambient Air Quality Standards (NAAQS) – Standards for maximum acceptable concentrations of pollutants in the ambient air to protect public health with an adequate margin of safety, 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.

National Environmental Policy Act (NEPA) – The Act establishes national environmental policy and goals for the protection, maintenance and enhancement of the environment, and it provides a process for federal agencies to implement these goals. Procedures utilized by federal agencies include evaluation of environmental effects of proposed actions, and development of a range of alternatives to proposed actions; options for the public and cooperating agencies to be involved and clear rationale for the agency decision.

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

Particulate Matter (PM) – Any airborne finely divided material, except uncombined water, which exists as a solid or liquid at standard conditions (e.g., dust, smoke, mist, fumes or smog).

$PM_{2.5}$ – Particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

PM_{10} – Particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers (including $PM_{2.5}$).

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

. **Prescription –** Measurable criteria which 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.

Prevention of Significant Deterioration (PSD) – A pre-construction review permit program based on requirements set forth in the CAA. The PSD program regulates new and modified major stationary sources to prevent significant deterioration of air quality by means of air quality planning and control technology requirements which must be met by such new and modified sources. PSD increments, which define the maximum allowable increase in ambient air concentrations of selected air pollutants above baseline concentrations in an attainment or unclassifiable area, are an important component of the PSD program

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 up to hundreds of miles across a region and promoting noticeably hazy conditions; wide-spread visibility impairment, especially in mandatory Class I federal areas where visibility is an important value.

Sensitive Receptors – Population centers such as towns, scenic vistas, camp grounds and trails, hospitals, nursing homes, schools, roads/highways, airports, mandatory Class I federal areas, etc. where smoke and air pollutants can adversely affect public health, safety and welfare.

Smoke Management 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 (e.g., on roadways and at airports) posed by smoke intrusions into populated areas; to prevent deterioration of air quality and NAAQS violations; and to address visibility impacts in mandatory Class I federal areas in accordance with the regional haze rules.

State Implementation Plan (SIP) – A CAA required document in which states adopt emission reduction measures necessary to attain and maintain NAAQS, and meet other requirements of the CAA.

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

Tribal Implementation Plan (TIP) – A document authorized by the CAA in which eligible tribes adopt emission reduction measures necessary to attain and maintain NAAQS, and meet other requirements of the CAA for lands within Indian Country.

Volatile Organic Compounds (VOC) – Any organic compound which participates in atmospheric photochemical reactions, which are measured by a reference method, an equivalent method, or an alternative method. Some compounds are specifically listed as exempt due to their having negligible photochemical reactivity.[4] Photochemical reactions of VOCs with oxides of nitrogen and sulfur can produce O_3 and PM.

Wildfire – An unplanned, unwanted wildland fire (such as a fire caused by lightning), and include unauthorized human-caused fires (such as arson or acts of carelessness by campers), escaped prescribed burn projects (escaped control due to unforeseen circumstances), where the appropriate management response includes the objective to suppress the fire.

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 USDA 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.

Wildland Fire – Any non-structural fire, other than a prescribed burn, that occurs in the wildland. Wildland fires include unwanted (wild) fires and naturally ignited fires that are managed within a prescription to achieve resource benefits.

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[4] U.S. Environmental Protection Agency, "Definitions," 40 CFR 51.100.

Wildland/Urban Interface – The line, area or zone where structures and other human development meets or intermingles with the wildland.

Wildland fire use – The application of the appropriate management response to a naturally-ignited (e.g., as the result of lightning) wildland fire to accomplish specific resource management objectives in predefined and designated areas where fire is necessary and outlined in fire management or land management plans.

APPENDICES

Appendix A. Alternative Treatments

Land owners/managers have an array of tools, including fire, which can be used to accomplish land use plans, depending on the resource benefits to be achieved. Several factors should be considered when selecting appropriate treatments, including the costs of treatment, the environmental impacts (e.g., air and water quality, soils, wildlife, etc.), and whether fire must be used to meet management objectives. The best combination of treatments meets management goals with the most favorable environmental impacts at the most reasonable costs. The 2001 *Smoke Management Guide* is a good reference that provides several alternative management techniques (Hardy et al., 2001).

<u>Biomass Utilization</u>. Harvesting and selling or trading the biomass is one alternative to prescribed burn. Woody biomass can be used in various industries such as pulp and paper, methanol production and garden bedding. This alternative is most applicable in areas that have large diameter woody biomass and the biomass is plentiful and accessible so as to make biomass utilization economically viable. Small-diameter biomass can be used as posts, poles or tree stakes (Wynsma et al, 2007).

<u>Mechanical treatments.</u> Mechanical treatments may be appropriate tools when management objectives are to reduce fuel density to reduce a wildfire hazard, or to remove logging waste materials (slash) to prepare a site for replanting or natural regeneration. On-site chipping or crushing of woody material, removal of slash for off-site burning or biomass utilization, whole tree harvesting, and yarding (pulling out) of unmerchantable material may accomplish these goals. Air curtain incinerators offer a useful alternative to current fuel reduction and disposal methods, providing the benefits of producing lower smoke emissions

compared to pile or broadcast burning, burning a greater variety, amount, and size of materials from dead to green vegetation, reducing fire risk, operating with fewer restrictions in weather and burn conditions, and containing burn area to a specific site. Air curtain incinerators are large metal containers or pits with a powerful fan device to force additional oxygen into the fire, thus producing a very hot and efficient fire with very little smoke.

Mechanical treatments are normally limited to accessible areas, terrain that is not excessively rough, slopes of 40 percent or less, sites that are not wet, areas not designated as national parks or wilderness, areas not protected for threatened and endangered species and areas without cultural or paleological resources.

Chemical treatments. When the management objective is to preclude, reduce or remove live vegetation and/or specific plant species from a site, chemical treatments may be appropriate tools. However, other potential environmental impacts caused by applying chemicals must also be considered.

Fire treatments. Fire is one of the basic tools relied upon by land owners/managers to achieve a myriad of management objectives in fire dependent ecosystems. Most North American plant communities evolved with recurring fire and are dependent on recurring fire for maintenance. The natural fire return interval may vary from one to two years for prairies, three to seven years for some long-needle pine species, 30-50 years for species such as California chaparral, and over 100 years for species such as lodgepole pine and coastal Douglas-fir. When one management objective is to maintain a fire dependent ecosystem, the effects of fire cannot be duplicated by other tools. In such cases fire may be the preferred management tool even when other treatments may be equally effective for meeting other objectives. Fire can also be used to reduce heavy fuel loads and prevent catastrophic wildfires.

Appendix B. Federal Land Use and Fire Management Planning

Federal land use planning is an open process to establish land use and management goals and objectives. The planning process is designed for public participation and must comply with NEPA. State/tribal air quality managers are given the opportunity to participate in land use planning as part of normal intergovernmental consultation procedures. It is important for air quality managers to participate in public land use planning decisions to ensure that air quality concerns are adequately addressed. Through the public participation process, issues are identified and alternatives are discussed regarding methods for implementing land management activities such as trail building, improvement of wildlife habitat, timber harvesting, use of fire, etc. The environmental impacts of these activities are analyzed including, among other things, impacts on cultural resources, wildlife, vegetation, soils, riparian areas, wetlands, water quality, air quality and visibility. Consideration of the air quality impacts of land management activities is essential to arriving at the best choice of treatments and response to fire.

Two or more levels of land use planning are conducted by FLMs to achieve management goals. First, broad scale and long-range land use plans must be developed for administrative units (e.g., forests, parks, refuges, sanctuaries). The land use plan identifies the scope of actions and goals for the lands and resources administered, and typically covers a 10- to 15-year period.

In addition to land use plans, there are other, shorter term (typically one to five years) planning efforts where decisions are made concerning specific activities and programs, including the use of fire to achieve resource benefits. These may include programmatic plans, such as fire management plans, or specific project plans.

The FMPs are strategic plans that define how wildland fires and prescribed burns will be managed to meet land use objectives. The FMPs must contain prescriptive criteria which are measurable and will guide selection of appropriate management actions in response to fires. The criteria can relate to suppression actions or describe when fire can be managed to gain resource benefits. This allows the use of a full range of appropriate management responses to fire, which may include: full suppression of a wildland fire; suppression of part of a wildland fire while allowing another portion of the fire to continue playing a natural ecological role and achieve resource benefits; or the use of prescribed burn.

Project plans are strategic plans to accomplish specific actions and goals established in a land use plan. Project plans may involve decisions regarding trade-offs between using mechanical, chemical and fire treatments. When projects include fires treatments, burn plans are also required. Burn plans are operational plans for managing specific fires, and when prepared by FLMs, should include smoke management components to minimize fire emissions and mitigate air quality impacts.

Appendix C. Evaluating Environmental Impacts

Federal agencies are required to conduct the appropriate level of NEPA analysis for land and resource management plans and at the project level. The use of fire for resource management and its impact on plant and animal species, aquatic life, cultural resources, soil conditions, riparian areas, wetlands, water quality, air quality and visibility are considered in these environmental reviews. Moreover, impacts from federal actions, and particularly the use of fire as resource management tool on air quality varies greatly by region. Factors that contribute to this variability include meteorology; existing air quality; the size, timing and duration of the activity; and other actions, including non-federal activities occurring in an airshed at the same time. Coordination and communication with state/tribal air quality managers is integral in achieving the land manager’s goals, providing technical assistance, and forecasting potential environmental impacts and evaluating potential air quality impacts.

Air quality and visibility impact evaluations of fire activities on federal lands should:

- Include recent historic (e.g., 10 years) and projected (life of the plan) annual or seasonal emissions from wildland fires, and silvicultural and agricultural prescribed burns. Emission projections should be based on estimates provided by land owners/managers of acres burned, pre-burn fuel loading by vegetation type and consumption;
- Be related to analyses of aggregate impacts of fires on regional and sub-regional air quality, when possible;
- Identify applicable regulations, plans or policies (e.g. burn plans, authorization to burn, conformity);
- Identify sensitive receptors;
- Include description of planned measures to reduce smoke impacts;
- Identify the potential for smoke intrusions into sensitive areas, and model air quality and visibility impacts, when possible; and
- Describe ambient air monitoring plans, when appropriate.

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