MONTANA, IDAHO, DAKOTAS NATIONAL FORESTS & GRASSLANDS AIR QUALITY ASSESSMENT

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PURPOSE AND USE OF ASSESSMENT

The purpose of this assessment is to describe air quality for Forest Plan revisions in Region 1 and the National Forests of Idaho within Region 4. This assessment incorporates the Eastside National Forests air quality assessment written in 2000 by Mark Story, with additions of the National Forests and Grasslands of the Dakotas, Idaho, and western Montana.

A decision was issued on August 1, 2002 for the final EIS for the Dakota Prairie Grasslands Management Plan, including the Little Missouri Grasslands in western North Dakota and two smaller National Grasslands in North Dakota and South Dakota. The Dakota Prairie Grasslands Plan emphasizes livestock grazing and oil and gas development with standards for air quality compliancy for all federal, state, and local standards and regulations. The plan will meet requirements of the Prevention of Significant Deterioration (PSD), State Implementation Plans (SIP), and applicable Smoke Management Plans (SMP) to ensure protection of class I areas air quality and air quality related values, like visibility. The plan also requires cooperation with air regulatory authorities to prevent significant adverse effects of air pollutants and atmospheric deposition on forest and rangeland resources, and to control and minimize air pollution impacts from land management activities.

The Southwest Idaho Ecogroup's Air Quality and Smoke Management Technical Report Summary, written in 2002, by Deirdre Dether and Ann Acheson, for the FEIS revision of the Boise, Payette, and Sawtooth National Forest Plan, is a recommended prototype for upcoming Forest Plan air resources input. Maintaining and improving air quality for public health and visibility while managing Forests using fire is the focus of this report.

Smoke NEPA Guidance, written by Ann Acheson, Bob Hammer, and Mark Story in 2002, discusses air resource smoke impacts from prescribed fire on National Forests and Grasslands of Montana, Idaho, North Dakota, and South Dakota in Regions 1 and 4 on prescribed burning projects. Forest Plan scales of time are long, and of space are large, making estimates of fire use smoke effects on ambient air and visibility challenging. NEPA project estimation of smoke effects is of short time scales and small, site specific spatial scales wherein atmospheric dispersion modeling is possible and project burning is regulated within the framework of smoke management plans. North and South Dakota currently do not have a smoke management program, and may need to create one as Regional Haze Rule and PM2.5 standards are implemented. The current smoke management program of the Montana/Idaho Airshed Group is critical in coordinating and minimizing smoke impacts from prescribed fire.

This air quality assessment emphasizes the major atmospheric pollutant from National Forest activities, smoke emissions from prescribed burning of forests and rangelands. PSD permitting for new sources and modifications of sources is complex, requiring regional air program managers to work closely with State air quality regulators.

Mining and ore processing in Montana and Idaho has a history of forest ecosystem impacts by airborne sulfates, metals, and other air pollutants. At the turn of the last century, Butte, Montana's open burning of metal ores caused darkness during daylight hours. Other examples of air pollution impacts on forest ecosystems include fluoride emissions from aluminum plants at Columbia Falls, Montana, and sulfate and heavy metal impacts on forests from smelter emissions at Kellogg, Idaho, and Anaconda, Montana, where emissions damaged forest vegetation on nearby hill slopes.

Forest mountain snowpacks downwind of industrial facilities along the Columbia River, Snake River, and Clearwater River are showing accumulations of mercury which is toxic to life. Pulp and paper processing and other industrial processes may be the mercury emissions source.

Human health as well as forest ecosytems are affected by air pollutants. In Libby, Montana, vermiculite used in homes and streets is contaminated with asbestos minerals, causing human health problems years after the mines closed. More recently, smoke emissions from burning agriculture grass and grain fields in northern Idaho caused lawsuits from the death of one citizen. Smoke management for agriculture, as well as forestry will likely be more critical for implementing Regional Haze Rules. The major forest activity air quality issue relative to visibility and human health is smoke emissions from burning of forest and rangeland.

LEGAL FRAMEWORK

CLEAN AIR ACT

The framework for controlling air pollution in the United States is mandated by the 1970 Clean Air Act (CAA), as amended in 1977 and 1990. In 1999, changes were made to the act for visibility protection, published as the Regional Haze Rules. The CAA is designed to “protect and enhance” air quality. The CAA encourages “reasonable” Federal, State and local government actions for pollution prevention. State Implementation Plans (SIP’s) are developed by each state to implement the provisions of the CAA. The SIP’s describe the State’s actions to meet and maintain the National Ambient Air Quality Standards (NAAQS). Regional Haze Rule and PM2.5 implementation SIP’s are being created now, with the next decade being critical for accommodating the needs of fire use, smoke, human health, and visibility.

Section 160 of the CAA requires measures “to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreation, scenic, or historic value.” Stringent requirements are established for areas designated as “Class I” attainment areas. Class I areas include Forest Service and Fish and Wildlife Service wilderness areas over 5,000 acres in existence before August 1977, and National Parks in excess of 6,000 acres as of August 1977. Designation as a Class I area allows small increments of new pollution above existing air pollution levels. Class II areas are recent wilderness areas and all remaining National Forest lands wherein more air pollution is allowed.

The CAA requires that new major stationary sources, or major modifications of existing stationary sources, receive a Prevention of Significant Deterioration (PSD) permit from the appropriate air regulatory agency before construction or modification of these sources can be accomplished. A “major source” is one that emits over 100 to 250 tons/yr of a pollutant, depending on the type of source. PSD provisions are aimed at protecting and enhancing the air quality in wilderness areas and other locations of special scenic, recreational, historic, or natural value. Before the construction of certain new air pollution sources is approved, the new source proponents must apply for and receive a PSD permit for the appropriate air regulatory agency, the Montana Department of Environmental Quality, the Idaho Department of Environmental Quality, the North Dakota Department of Health, and the South Dakota Department of Environment and Natural Resources, with overview by the Environmental Protection Agency (EPA).

PSD permit applicants must demonstrate that the proposed facility will: (1) not violate national or state ambient air quality standards, (2) use Best Available Control Technology for sources subject to PSD, (3) not violate either Class I or II increments for sulfur dioxide, nitrogen oxides, or particulates, and (4) not cause or contribute to an adverse impact on AQRV’s in any Class I area.

Air quality regulatory policy and law are evolving for new source PSD review for existing air pollutant emitters, especially coal burning electrical power generating facilities, and for means of improving existing regional haze visibility impairment of class I areas, as well as implementation of PM2.5 standards.

PSD permit review by Forest Service land managers is done in Region 1 by Regional Air Program Manager Ann Acheson, and her assistant, Mark Story, in coordination with State air regulatory personnel, as well as with assistance and coordination with National Park Service Air Resource Division personnel, guided by a Forest Service, National Park Service, and US Fish and Wildlife Service reference document called Federal Land Managers AQRV Work Group (FLAG), published in 2000. The National Park Service employs a team of highly skilled PSD review experts in Denver, including air modelers and emission control engineers, while the Forest Service depends upon on a few scattered personnel, having broader resource management skills for PSD review work.

National Ambient Air Quality Standards

The Environmental Protection Agency established the National Ambient Air Quality Standards (NAAQS) for specific pollutants emitted in significant quantities to impact human health and welfare. Termed criteria pollutants, the NAAQS are designed to protect human health and public welfare, which includes effects to "…soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being."

The following table lists the National Ambient Air Quality Standards:

Pollutant	**Time Period**	**Standard**
PM2.5	Annual Arithmetic Mean 24-hour Average	15 ug/m3 65 ug/m3
PM10	Annual Arithmetic Mean 24-hour Average	50 ug/m3 150 ug/m3
Nitrogen Dioxide (NO2)	Annual Arithmetic Mean	0.053 ppm
Sulfur Dioxide (SO2)	Annual Arithmetic Mean 24-hour Average 3-hour Average	0.03 ppm 0.14 ppm 0.50 ppm
Ozone	8-hour Average 1-hour Average	0.08 ppm 0.12 ppm
Carbon Monoxide (CO)	8-hour Average 1-hour Average	9 ppm 35 ppm
Lead (Pb)	Quarterly Average	1.5 ug/m3

Forest fires emit carbon dioxide and water as well as carbon monoxide, hydrocarbons, nitrogen oxides, and particulate matter. Fine particulate matter, PM2.5, is emitted in large quantity from forest fires and can affect visibility and human health, and is a main air resource focus in Forest Plan revision. Other criteria pollutants, like ozone, sulfates, and nitrogen dioxides, are emitted by mobile sources, such as vehicles, stationary sources such as large industrial processing and power generating plants, and are of concern in protecting forest watershed ecosystems. In general, particulate matter is emitted from combustion, dust, and many other sources. Carbon monoxide comes from vehicles and many sources of combustion. Sulfur dioxide from coal and oil burning, metals smelting, and many other sources. Nitrogen dioxide comes from vehicles, power plants, and many other sources. Ozone results from combustion emissions' reactions with sunlight and oxygen. Particulate matter is a major emission from forest fires, with PM2.5 being regulated for protection of human health and regional haze reduction.

Non-attainment Areas

If a community does not meet or "attain" the NAAQS for one or more pollutants, EPA designates it as a "non-attainment" area. The states must demonstrate to the public and EPA how a non-attainment area will meet the ambient AQ standards in the future based upon controlling emission sources. This demonstration is done through a control plan that is part of the SIP. The emissions from prescribed fire may be considered part of this demonstration. Recently implemented NAAQS for PM2.5 of 15 micrograms per cubic meter, annually, will likely result in additional non-attainment areas being designated, such as Libby. Non-attainment areas currently designated for particulate matter, PM10, are concentrated mainly in mountain valleys and around communities, particularly in northern Idaho and northwestern Montana. North Dakota and South Dakota have no PM10 non-attainment areas.

Montana PM10 non-attainment areas include portions of the northwestern counties of Lincoln, Flathead, Sanders, Lake, and Missoula, Silverbow, and Rosebud. Rosebud includes both the Colstrip coal strip mining and mammoth coal burning electrical power generation facility area, and the Northern Cheyenne Indian Reservation, a Class I Area. Silverbow is the Butte mining area. Northwestern Montana counties and communities of Libby, Whitefish, Kalispell, and Missoula are influenced by forest fire smoke in mountain valleys, especially with atmospheric inversions that frequent these mountain valley basins in winter.

Idaho PM10 non-attainment areas include all of Bonner County and portions of Shoshone Country in northern Idaho, as well as the communities downwind of urban industrial emissions from Spokane, Washington, and Coeur d'Alene, Idaho. Agricultural burning of grain and grass fields is a large source of PM10 as well as forest fire smoke from the northern Idaho mountain valleys which are also subject to inversion conditions. Southwestern Idaho portions of Power and Bannock Counties are PM10 non-attainment, with urban industrial emissions from Pocatello, phosphate mining, fertilizer facilities, and sugar beet processing also contributing.

The Idaho Department of Environmental Quality has an air pollution emergency rule for conditions of atmospheric stagnation and/or degraded air quality to protect human health in all areas whether or not they're non-attainment. The air pollution emergency rule followed a human fatality attributed to smoke from agricultural burning in northern Idaho. When ambient air conditions for fine particulate matter, PM2.5, reach or exceed 80 micrograms per cubic meter for one-hour average, all open burning can be prohibited. If PM2.5 equals or exceeds 50 micrograms per cubic meter in 24 hours average, open burning can be prohibited.

The general conformity provisions of the CAA (Section 176(c)), prohibit federal agencies from taking any action within a non-attainment area that causes or contributes to a new violation of the

standards, increases frequency or severity of an existing violation, or delays the timely attainment of a standard defined in the area plan. Federal agencies are required to ensure their actions conform to applicable State Implementation Plans. Burning projects outside a non-attainment area are not subject to conformity. If prescribed burning is planned in a non-attainment area, local and state air quality regulatory managers as well as regional Forest Service air resources managers are involved. States with many non-attainment areas, such as California and the southeastern United States, may be creating burn emissions allowable within the State Implementation Plan to simplify conformity and NEPA documentation for burning.

Carbon monoxide non-attainment areas include: portions of Missoula and Cascade County, Great Falls in Montana; Boise County and the city of Boise, Idaho. North and South Dakota have none.

SO2 non-attainment areas include: the cities of Helena and Billings-Laurel and Lewis and Clark and Yellowstone counties in Montana. There are no non-attainment areas for SO2 in Idaho, North Dakota, and South Dakota.

NO2 and ozone non-attainment areas were not listed in Montana, Idaho, North and South Dakota, in 2002. East Helena, Montana, is non-attainment for lead (Pb). There are no non-attainment areas for lead in Idaho, and North and South Dakota in 2002.

Washington and Oregon are upwind of the Northern Region, and have no non-attainment areas for NO2, SO2, and lead. There are no non-attainment areas in Washington for ozone (O3), while Oregon has portions of Marion and Polk County as non-attainment for ozone in Oregon. Carbon monoxide is non-attainment in portions of Spokane and Yakima County in Washington, and portions of Marion, Polk, and Jackson County in Oregon. PM10 is non-attainment in portions of Spokane, Walla Walla, and Yakima County in Washington, and portions of Union, Lane, Josephine, Jackson, Klamath, and Lake County in Oregon.

Visibility and Regional Haze Rule (RHR)

The Clean Air Act establishes as a national goal “the prevention of any future, and the remedying of any existing impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution.” Visibility impairment is a basic indicator of pollution. Visibility variation occurs as a result of the scattering and absorption of light by particles and gases in the atmosphere from both natural and human caused pollution sources. The EPA created Regional Haze Regulations for Protection of Visibility in National Parks and Wilderness Areas in 1997. The Regional Haze regulations proposed “presumptive reasonable progress targets” for improving visibility in each Class I areas. These areas include many of the best-known national parks and wilderness areas, such as, the Grand Canyon, Yellowstone, and Yosemite. The Regional Haze regulations apply to all States, including those States that do not have any Class I areas. Pollution that occurs in those states may or may not contribute to impairment in other states or Class I areas, but must be accounted for. Plans in states without Class I areas must address the emissions from any sources that may reasonably be anticipated to cause or contribute to visibility impairment of any Class I area outside that state. The Regional Haze regulations require states to demonstrate reasonable progress for improving visibility to natural conditions in each Class I area over a 60-year period, to 2064.

The EPA and each state are creating Regional Haze Rule State Implementation Plans which are complex and may affect all emissions which diminish natural visibility. EPA and state creation of Regional Haze Rule SIP’s will be important for Forest Service fire managers and air resource managers to actively participate in development and implementation. Natural wildfire and ecosystem maintenance prescribed fire may contribute acceptably to the “natural “ background

regional haze, while prescribed burning for other purposes is regulated and considered a human caused source of regional pollution, subject to SIP regulation.

The Regional Haze Rule requires states to address visibility impairment in mandatory class I aeas due to emissions from fire activities. Fire is addressed in both sections 308 and 309 of the Regional Haze Rule as a source of potential visibility impairment, requiring smoke emissions management with progress toward natural visibility.

Montana has a control plan to address the first phase of the visibility regulations, plume blight from point sources. Regional haze is the second phase of visibility regulation to be implemented in the next decade. The "reasonably attributable" regulations primarily address industrial sources impacting Class I areas. Montana will consider emissions from prescribed wildland fire use as they evaluate progress toward national visibility standards. Montana's SIP for Regional Haze Rule implementation is due by 2008. Idaho and North and South Dakota are likely to implement visibility and regional haze rules in a manner and time frame similar to Montana. South Dakota intends to develop and implement a smoke management program within a year. North Dakota requires a burn permit, and will soon require an annual burn summary for estimated emissions.

Other Land Management Acts

Class I areas in Montana, Idaho, and the Dakotas managed by the National Park Service include Glacier National Park, Yellowstone National Park, Craters of the Moon National Monument, Theodore Roosevelt National Park, Badlands National Park, and Wind Cave National Park. Class I areas managed by the US Fish and Wildlife Service as Refuges include Red Rock Lakes, Medicine Lake, Lostwood, and UL Bend. Class I areas managed as American Indian Lands are the Flathead, Northern Cheyenne, and Fort Peck lands.

The Wilderness Act (1964) defines wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain . . . an area of undeveloped Federal Land retaining its primeval character and influence . . . protected and managed so as to preserve its natural conditions." The Act also states that wilderness areas will be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use. Forest Service wilderness' in R1 includes 9 Class I and 8 Class II areas:

Area	Acres	Class
Absaroka-Beartooth	930,584	2
Anaconda-Pintler	158,656	1
Bob Marshall	1,009,356	1
Frank Church River of No Return	2,373,331	2
Gates of the Mountains	28,562	1
Gospel Hump	206,000	2
Great Bear	286,700	2
Hells Canyon	215,233	1
Lee Metcalf	250,297	2
Mission Mountains	73,877	1
Rattlesnake	33,000	2
Sawtooth	217,000	1
Scapegoat	239,936	1
Selway Bitterroot	1,340,681	1
Theodore Roosevelt	29,920	2
Welcome Creek	28,135	2

Area	Acres	Class
TOTAL CLASS I ACREAGE	3,523,237	
TOTAL CLASS II ACREAGE	4,137,967	

The Bureau of Land Management manages leasing and development of minerals, including oil and gas, on National Forest lands - laws and rules outside the scope of this document.

POLICY

Forest Service air resource management responsibilities derive from the Clean Air Act and it's amendments, National Forest Management Act (NFMA), Wilderness Act, and National Environmental Policy Act (NEPA). Primary responsibilities include:

1. Protecting ecosystems from adverse air pollution impacts
2. Managing emissions in accordance with national, state, and local AQ standards
3. Protecting AQRVs, including visibility, in Class I areas

CURRENT AND POTENTIAL IMPACTS ON FORESTS AIR QUALITY

The pollution that often affects our National Forests comes from industry, wildfire, prescribed and agricultural burning, development, and vehicle emissions. Emissions are classed "stationary" "mobile", "point", and "area". Regulation prevents emissions whenever possible and stops them all together if necessary. Smoke management is the key to minimizing effects of forest and rangeland burning smoke emissions on health and visibility. The following discussion will reflect our current understanding of current and potential impacts on Forests air quality.

Industrial Emissions

The EPA National Emissions Trends (NET) database is an emission inventory that contains data about emissions sources that emit "criteria" pollutants and precursors of ozone - nitrogen oxides and organic compounds mediated by sunlight. NET is released every three years - 1996, 1999, 2001 (not yet ready) and 2004. A NET listing of all stationary sources in Montana, Idaho, North Dakota, and South Dakota in the vicinity of the National Forests, with permitted emissions of PM10 greater than 100 tons/yr, is contained in Appendix 1. Because particulate matter from forest fire is the major source of air pollution - and regional haze - in the northern Rocky Mountains and Dakota Prairie Grasslands, the listing of emission sources is ranked by tons of PM10. PM2.5 emissions inventories are currently being created as part of Regional Haze Rule and the new PM2.5 standards implementation. 1999 facility emission lists are likely to be inaccurate for current sources of PM2.5**.**

1999 EPA AirData emissions from stationary sources are summarized for PM10, SO2, and NOX by state, Montana, Idaho, North Dakota, and South Dakota, including upwind Washington and Oregon, and are shown in the following emissions summary table.

State	PM10 (tons)	SO2 (tons)	NOX (tons)
Montana	15744	49363	57515
Idaho	12492	23671	6051

State	PM10 (tons)	SO2 (tons)	NOX (tons)
North Dakota	4976	252899	87167
South Dakota	990	27596	28770
Washington	11817	129166	59071
Oregon	11177	26190	30908

Montana's largest source of PM10, SO2, and NOX is coal burning power generation at Colstrip, with lesser large sources of SO2 at Exxon in Billings, Cenex in Laurel, Holnam in Trident, and Asarco in East Helena, and Columbia Falls Aluminum. North Dakota's largest sources of PM10 and NOX are a cluster of large coal burning power plants north of Bismark. Idaho large sources of PM10 and SO2 are, Potlach Corp in Lewiston, Amalgamated Sugar in Nampa, FMC Corp and JR Simplot in Pocatello, and Monsanto in Soda Springs. South Dakota large sources of PM10, SO2, and NOX are scattered power generation. Oregon large sources of SO2 and NOX are Pacific Gas Transmission Corp and Portland General Electric in Morrow County, near the Columbia River and upwind of Idaho and Montana. Washington's largest source of SO2 and NOX is Pacifcorp in Centralia. Other upwind sources from Washington include Kaiser Aluminum in Spokane, for SO2, and Unocal Ag Products in Kennewick, and Boise Cascade in Wallula, for NOX.

Sulfur dioxide is a pollutant of concern in Montana. Four areas where SO_2 from industrial point sources is an issue are Billings/Laurel, East Helena, Colstrip, and Great Falls. In Great Falls, the primary source of SO_2 is the Montana Refining petroleum refinery. Seven major $S0_2$ sources in the Billings/Laurel area include the Exxon, Conoco, and Cenex oil refineries, Montana Power coal fired electric power generating facility, Western Sugar beet factory, Yellowstone Energy Limited Partnership coke fired cogeneration power plant, Montana Sulphur and the Chemical sulfur recovery facility. Sulfur dioxide emissions in the Billings/Laurel area have declined due to a number of factors including industrial controls added as part of SIP requirements, plants operating at less than full capacity, and industrial process changes to meet sulfur and diesel fuel regulations. Subsequent monitoring for SO_2 has shown the area to be in compliance with National Ambient Air Quality Standards (NAAQS). In 1997, the Montana Board of Health and DEQ negotiated new emission limits on all of the SO_2 emitting sources, requiring continuous emissions monitors on most stacks for compliance determinations. SO2 concentrations may increase throughout the eastern Montana and North Dakota if additional coal-fired power plants are built. If coal bed methane develops, the potential for long distance dispersion exists.

East Helena is a non-attainment area for SO_2 and lead, due primarily from the ASARCO lead smelter where an acid plant and modified stacks to reduce SO_2 emissions has been installed. Data from monitors in the immediate vicinity of the smelter shows exceedance but no violations of the NAAQS or MAAQS for $PM_{10,}$ while continuing to show violations of lead NAAQS.

Point sources of NO or NO_2 include coal fired power plants, natural gas compressor stations, and oil refineries (Appendix 1). Data submitted by the Colstrip Power Company has shown no violations of the NAAQS or MAAQS for NO_2. Huge NOX emissions occur in North Dakota, north of Bismark.

Hazardous air pollutants, also known as air toxics or toxic air pollutants, cause serious health problems. For example, Mercury from coal burning power plants, pulp mills and other sources, is transported through the atmosphere where it is deposited and accumulated in aquatic ecosystems. The EPA compiles hazardous air pollutant emissions in a National Toxics Inventory (NTI) with updates every three years. NTI is updated using a Toxics Release Inventory. The Toxics Release Inventory does not include most aircraft and airport emissions, even though airports are both large stationary and mobile sources of toxic air pollution.

The Montana, Idaho, North Dakota, and South Dakota 1999 Toxics Release Inventory lists air emissions in pounds for the top facilities ranked by total on-site air emissions. Total emissions for the top toxic release facilities by state are: the Potlach Corp. in Lewiston, Idaho - 1,528,230 pounds - and Stone Container of Missoula - 3,298,705 pounds. North Dakota and South Dakota facilities are not listed for toxic releases in the vicinity of class I Forest Service wilderness areas.

Hazardous air pollutants and toxic and persistent organic compounds often used as herbicides and pesticides, are globally airborne from third world countries. The National Park Service is planning monitoring in Glacier National Park and other western US parks - especially in colder and alpine climates - and near the west coast where many these pollutants bioaccumulate in prey animals like fish and birds. See the snow pack chemistry monitoring section, Western Airborne Contaminants Project.

Oil, Gas, Mineral Development

The Bureau of Land Management on National Forest lands manages mineral leasing and development, including oil and gas. The Montana Statewide Final Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans is available online as of January 10, 2003, at www.mt.blm.gov. This final environmental impact statement addresses coal bed methane, natural gas, development, and is a joint effort the BLM, Montana Board of Oil and Gas Conservation, and Montana Department of Environmental Quality. The Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois produced the coal bed methane FEIS AQ technical support document. There is potential for cumulative air impacts of existing coal mining, existing and proposed coal burning power generation, oil and gas development, and coal bed methane development to affect visibility in several class I areas like Gates of the Mountains and Scapegoat Wilderness Area.

Active oil and gas wells - about 600 - are found primarily on the Dakota Prairie Grasslands. The Dakota Prairie Grasslands EIS includes oil and gas leasing and was released last summer. There are less than half a dozen active oil and gas wells on the Custer National Forest, and none currently on the Rocky Mountain front, Flathead, Lewis and Clark, Helena, Gallatin, and Beaverhead-Deerlodge National Forests. Potential for occurrence of oil and gas development is low in Idaho and western Montana. Oil and gas leasing on the Custer National Forest and the Dakota Prairie National Grasslands is very active; the development of wells, roads, pipelines, and transmission stations contributing significantly to potential air emissions. Coal bed methane gas wells may be a large source of atmospheric emissions in eastern Montana if activity occurs as proposed, primarily on the Ashland Ranger District of the Custer National Forest as well as off the national forest on private lands in the Ashland area, and farther south in Wyoming, in the Powder River basin. NOX, SO2, and particulate matter will be released from coal bed methane wells. Visibility may be diminished in several class I areas, including Gates of the Mountains and Scapegoat Wilderness Area.

Coal strip mining and coal burning electrical power generation occur in eastern Montana with atmospheric pollutants, including emissions of fine particulate matter, sulfates, and nitrogen

oxides. Coal burning electrical power generation is a major air emission source for particulate matter, sulfates and nitrogen oxides in eastern Montana and in North Dakota.

In the Ashland, Montana area, about 150 coal bed methane gas wells are proposed in the vicinity of the Custer NF. And just south of there, 4000 to 5000 wells are planned. South of there, in Wyoming, up to 39000 coal bed methane wells are possible, primarily on BLM land. Coal bed methane potential is also high on the Northern Cheyenne Reservation, a class I area already surrounded by large coal strip mining, including the large coal burning power generation facility at Colstrip.

Scattered drilling - both productive and dry holes - occurred near the Lewis and Clark Forest island units, including the Highwoods, Big and Little Belts, Crazy, Castle, and Big Snowy Mountains. These areas are ranked low to moderate for potential petroleum occurrence.

Scattered well drilling occurs along the Rocky Mountain Front. Except for the gas production at Blackleaf Field, most have been dry holes. The area is rated high for the potential occurrence of petroleum, especially gas. Leasing is not currently allowed on the Lewis & Clark NF portion of the Rocky Mountain Front. (Information on the potential rankings is from Lewis & Clark NF Oil and Gas Leasing FEIS Appendix B and the Helena NF Oil and Gas Leasing FEIS Appendix E). There have been thousands of wells drilled since the early 1900's on the Sweetgrass arch which stretches from the Canadian border through Shelby and Conrad. The western most production from the fields associated with the arch is approximately 24 to 30 miles east of the Rocky Mountain Ranger District.

Mining various metals and other minerals in underground and open pits and strip mines, as well as metals and minerals processing are widespread sources of atmospheric emissions throughout Montana, especially in western and central areas, and throughout Idaho. Phosphate strip mining and phosphate processing are a major industry in southeastern and south central Idaho.

Wildfires and Prescribed Burning Emissions and Visibility

The 2002 NEPA Smoke Guidance summarizes the role of smoke management programs to meet both prescribed burning and air quality needs. Fire helps to form forest and rangeland ecosystems. The objectives of prescribed fire and smoke management programs are to cooperatively meet forest and rangeland management, human health and visibility objectives.

Emissions from wildfire and prescribed fire contribute to episodic visibility impairment, including organic carbon, elemental carbon, and fine particulate matter, PM2.5. Agricultural burning emissions and their effects are also a concern. All types of forest and rangeland prescribed fire and agricultural burning need to be addressed as part of human health and visibility protection.

The EPA website - http://www.epa.gov/ttn/chief/eiip/pm25inventory/invinfo.html - contains monitored and modeled estimates of PM2.5 emission density (tons per year per square mile) by county for the year 2000. Agricultural field burning in eastern Washington and Oregon, northern and southern Idaho, and parts of Montana shows from 0.01 to 5 tons per year per square mile PM2.5. Agricultural tilling fugitive dust in eastern Washington and Oregon, northern and southern Idaho, eastern Montana, and the Dakotas is estimated to be from 0.05 to over 5 tons per year per square mile PM2.5. Ammonia fertilizer application in wheat country of eastern Washington and Oregon, northern and southern Idaho, eastern Montana, and the Dakotas is estimated to contribute from 0.01 to 0.5 tons per year per square mile PM2.5. Residential open burning is estimated to produce PM2.5 from 0.05 to 0.5 tons per year per square mile PM2.5 in eastern Washington and Oregon, northern and southern Idaho, western Montana, and western

North Dakota. Mining and quarrying fugitive dust is estimated to produce PM2.5 from 0.05 to 0.5 tons per year per square mile in scattered parts of Washington, Oregon, Montana, Idaho, North Dakota, and South Dakota. Fugitive dust from paved and unpaved roads produces estimated PM2.5 from 0.05 to 5 tons per year per square mile from scattered parts of Washington, Oregon, Idaho, Montana, and the Dakotas, with particular concentrations in northern Idaho, southern Idaho, and western Montana. Wildfire PM2.5 emissions depend upon the year. Drought years like 2000 and 2002 produced huge amounts of PM2.5 in Montana and Idaho. Forest plans estimate both wildfire and prescribed fire emissions, using estimates of burn area and emission factors available in models like FOFEM 5 designed by Elizabeth Reinhardt and Bob Keane.

MONITORING EFFORTS AND SUMMARY OF KNOWN INFORMATION

NADP

The National Atmospheric Deposition Program (NADP) monitors geographic and temporal trends in the chemical composition of rain and snow (wet deposition), with the primary purpose of acid rain benchmark monitoring. The NADP program currently consists of 200 sites, including 6 sites in Montana - Lost Trail Pass, Glacier National Park, Clancy, Poplar River, Havre Experimental Station, and Little Bighorn Battlefield National Monument. Idaho has three sites, Craters of the Moon National Monument, Reynolds Creek, and Smiths Ferry. North Dakota has NADP sites near the Dakota Prairie Grasslands at Theodore Roosevelt National Park upwind and Woodworth downwind. South Dakota has NADP sites in area of Grasslands at Wind Cave National Park and Cottonwood. Washington has a NADP site at Palouse Conservation Farm upwind of our national forests. Oregon has Starkey Experimental Forest NADP also upwind of our national forests. There are a few inactive NADP sites not mentioned.

The National Atmospheric Deposition Program/National Trends Network website at http://nadp.sws.uiuc.edu, shows sulfate ion wet deposition for 2001, of 1 to 2 kg/ha as SO4 in Montana and Idaho, and 3 kg/ha as SO4 in western North and South Dakota. Sulfate ion wet deposition is very high in the eastern United States, up to 30 kg/ha in Ohio, in the vicinity of coal burning power plants. Inorganic nitrogen wet deposition from nitrate and ammonium, 2001, is 0.7 to 1.1 kg/ha in most of Montana and Idaho, 1.3 kg/ha in northeastern Montana, 1.7 kg/ha in western North Dakota, and 2.7 kg/ha in western South Dakota. Inorganic nitrogen wet deposition in the upper Midwestern United States reaches 7.2 kg/ha in Wisconsin and 7.3 kg/ha in Michigan. Chloride ion wet deposition in 2001, is from 0.1 to 0.3 kg/ha in Montana, Idaho, and the Dakotas. Chloride ion wet deposition reaches 35.4 kg/ha in the Olympic Peninsula of Washington, near the Pacific Ocean source.

Lost Trail Pass is the Forest Service NADP monitoring site in R1 and R4. Under natural conditions, the pH would average around 5.65 from the solubility of CO2 into carbonic acid in water vapor. Concentrations (mg/L) and deposition (kg/ha) of the primary acid deposition anions (NO3, nitrate, and SO4, sulfate) are relatively low. Elevated levels of SO4 and NO3 at the Clancy and Little Bighorn sites may be influenced by Helena area emissions and Billings-Laurel/Colstrip emissions. All of the NADP sites demonstrate a pronounced seasonal trend of lower pH and higher nitrate and sulfate concentrations in the summer. This is at least partially due to more efficient process of photochemical transformation of acid deposition precursors (NO2, SO2 to nitric and sulfuric acid) in the summer, when the atmosphere is warmer.

Snow pack Chemistry

Persistent bioaccumulative toxics like PCB, DDT, and mercury will be monitored by the National Park Service. These toxics are transported as gases and particulates from thousands of miles

away and are deposited most often at high latitudes and high elevations, where they accumulate in biologic systems. Monitoring for the northern Rocky Mountains will occur at Glacier National Park. Tamara Blett of the National Park Service Air Resources Division in Denver is the primary contact for information about the Western Airborne Contaminants Assessment Project - snowpack chemistry, as well as fish sampling, sediment coring, lichens, willow bark, and atmospheric modeling are included in this project.

US Geological Survey Rocky Mountain snowpack chemistry monitoring found high mercury in snow on the Montana and Idaho divide near Lolo Pass, at Granite Pass, as well as at Snowbowl Ski Area near Missoula. Mercury may originate near Lewiston, Idaho, and Missoula, with pulp and paper mills as possible sources. EPA National Toxics Inventory database shows Stone Container in Missoula producing mercury compounds emissions of 31.4 pounds in 1996 and Potlach Corporation in Lewiston, Idaho emitting 32.8 pounds. There are also hundreds and thousands of pounds of mercury compounds from sources upwind in Washington and Oregon. The Columbia River, Snake River, Clearwater River, Lochsa River, and Lolo Creek are an atmospheric pathway for upwind mercury emissions to be transported and deposited in western Montana.

The chemical composition of the annual snowpack has been shown to be a composite record of atmospheric deposition of airborne pollutants throughout winter and has also been used to identify nearby emission sources. US Geological Survey (USGS) has monitored the chemical composition of annual snowpacks in the Rocky Mountains for over a decade - and now includes about 75 sites. Elevated levels of pollutants from atmospheric deposition held in seasonal snowpacks indicate chemical concentrations of species associated with watershed acidification (including nitrate and sulfate) at alpine and subalpine sites. Snowmelt chemistries from this network of mountainous locations established normal, or background levels of acidic ions deposited in the seasonal snowpack. In addition to normal chemical concentrations present in the region, elevated levels of pollutants in a given area are readily identifiable. Thus, emissions of chemical compounds such as ammonium, nitrate, and sulfate from local anthropogenic sources are discernible from normal background levels.

Snowpack chemistry studies indicate slightly elevated ammonia levels near West Yellowstone downwind of the Snake River plain's agricultural use of ammonia fertilizer. Snowpack chemistry may also show slightly elevated sulfate levels downwind of the East Helena smelter emissions. The USGS monitored increased snowpack deposition of ammonium, nitrate, sulfate, benzene, and toluene in Yellowstone NP near snowmobile traffic. Deposition decreases with distance from their roadways.

Lakes

Water quality in lakes can be an indicator of air quality. Lake chemistry is sensitive to deposition of sulfates and nitrogen dioxide, particularly in lakes formed in granite and quartzite type rock basins. Granite and quartzite rocks don't dissolve in water, supporting lakes almost like distilled water, being very low in ions, very low in dissolved solids, and poorly buffered where minimal size and soil development do not allow much buildup of the dissolved bicarbonates which buffer acidic compounds. The Selway Bitterroot, Absaroka Beartooth, Sawtooth, and Cabinet Mountains Wilderness Areas have a large number of highly sensitive lakes from glaciated cirque basins formed in granitic or quartzitic rock. Limestone rock basins, like much of the Anaconda Pintler and Bob Marshall Wilderness Areas, have lakes with water well buffered from high levels of bicarbonate from easily dissolved limestone.

Forest Service Regions 1 and 4 have several thousand lakes. Lake chemistry sampling began in 1985 with the EPA Western Lakes Survey and continues today. Sampling in Region 4's Sawtooth was done with several reviews. Sampling in Region 1 employs a three-phase approach:

- Phase 1 includes measuring pH, alkalinity, conductivity, and documenting watershed factors (geology, vegetation, and drainage characteristics) to determine lake sensitivity to atmospheric induced chemical change.
- Phase 2 consists of a more comprehensive chemical analysis (major cations and anions).
- Phase 3 "benchmark monitoring" includes some additional chemical and biological parameters.

There is a wide range of lake sensitivities in R1, with water chemistry determined primarily by the surrounding rock sensitivity to weathering and dissolution into dissolved minerals, as well as the alkalinity generation potential of bedrock parent material. An indicator of lake chemistry sensitivity to acidic precipitation is the use of acid neutralizing capacity (ANC). ANC is the sum of base cations minus the sum of acid anions, and is comparable to alkalinity in calcium-dominated systems. ANC <200 ueq/L is a threshold for acid sensitivity. Lakes having ANC <25 ueq/L are defined as a threshold for extreme sensitivity (Stanford, et al 1997, "A Screening Procedure to Evaluate Air Pollution Effects in Region 1 Wilderness Areas, 1991," Rocky Mountain Forest & Range Experiment Station Gen. Tech. Rep. RM-GTR-294).

Upper and Lower Libby Lakes in the Cabinet Mountains Wilderness, North Kootenai and Shasta Lakes in the Selway Bitterroot Wilderness, and Twin Island and Stepping Stone lakes in the Absaroka Beartooth Wilderness were selected as the longer term monitoring phase 3 lakes. The phase 3 monitoring consists of intensive chemical monitoring to provide a long-term benchmark to evaluate trends in acid deposition and other atmospheric related changes in lake ecosystems. All of the phase 3 lakes are calibrated for acid deposition sensitivity with the MAGIC/WAND model (Model of Acidification of Groundwater in Catchments/with Aggregated Nitrogen Dynamics) The MAGIC model calibrates lake chemistry to atmospheric deposition and watershed, soil, vegetation, and hydrology factors, enabling a prediction of lake chemical response to potential upwind changes in emissions for use in air quality permitting analysis.

Refer to the Region 1 air website on the Gallatin National Forest, http://www.fs.fed.us/r1/gallatin/resources/air /index.shmtl for lake chemistry reports, and Mark Story, Gallatin National Forest for contact information. For Sawtooth lake chemistry, refer to Jay Dorr - long term monitoring lakes here are less than 50 ueq/L for ANC (some less than 10 ueq/L), are extremely sensitive to acid rain, with no discernable trends in chemistry over time, indicating acidic precipitation in this part of the country is neither prevalent nor causing lake chemistry changes within the last decade.

Lichens

All class I areas are being inventoried for lichen community species and diversity, with special emphasis on relative sensitivity to air pollutants, like sulfates, and accumulation of metals. Dr. Larry St. Clair, Brigham Young University, has inventoried and surveyed the lichen communities in the Rocky Mountains, with resurveys every 7 years to determine if there are trends in lichens as bio-indicators of air pollution. All class I wilderness areas of Montana show healthy lichen communities without adverse air pollutant impact. A lichen survey from the former Anaconda, Montana, ore smelter, to the Anaconda Pintler Wilderness, shows a less diverse lichen community outside the class I area as the former smelter site is approached since smelter operations damaged and altered forest communities easily visible from highways nearby, as well as the Anaconda community. The contacts for lichen surveys are Larry St Clair or Ann Acheson.

Visibility

Interagency Monitoring of Protected Visual Environments (IMPROVE) and scene photographic monitoring provide visibility data. The Clean Air Act requires visibility protection in class I areas, including wilderness areas and national parks or monuments established as of 1977. The Northern Cheyenne Reservation was designated class I in 1977, due to Colstrip area coal strip mining and concerns about coal burning power plant atmospheric emissions by the Northern Cheyenne people.

IMPROVE data affirm the following statement quoted from FLAG, Federal Land Manager's Air Quality Related Values Workgroup, Phase I Report, December, 2000, page 17, "At all class I areas where visibility has been monitored, visibility conditions have been found to be impaired (by human-caused pollution)." Scott Copeland produced an analysis of IMPROVE data for the Pacific Northwest Region certification of visibility impairment in class I wilderness areas (2580 file, letter of 2/7/02, from Regional Forester to Regional EPA director). Western United States natural background visibility fine mass particulate matter less than 2.5 microns, annual mean is 1.47 micrograms per cubic meter. Glacier National Park annual mean fine mass is 5.38, Yellowstone National Park annual fine mass is 3.09, Sawtooth Wilderness annual fine mass is 2.84, Anconda Pintler and Selway Bitterroot Wilderness annual fine mass is 3.00, and Craters of the Moon National Monument annual fine mass is 3.47 micrograms per cubic meter. Implementation of the Regional Haze Rule will require considerable reductions of the fine mass particulates from source emissions in Montana, Idaho, North and South Dakota. Wildfire smoke is a part of the natural background fine mass, and the challenge for federal land managers and air quality regulators is to determine how much of prescribed fire smoke will be natural background fine mass, like ecosystem maintenance burning, and how much will be regulated smoke.

Visibility is usually characterized by the visual range (the greatest distance that a large black object can be seen against a viewing background) expressed in kilometers (km) or light extinction (the sum of light scattering and absorption per unit distance) expressed in inverse megameters (Mm^{-1}). Natural Rayleigh scatter from air molecules and suspended atmospheric aerosol particles causes base light extinction of 10 Mm^{-1}. A visual range of 391 km signifies the best possible visibility, corresponding to a light extinction of 10 Mm^{-1}. These two characteristics are inversely related and neither is linear with respect to increases or decreases in perceived visual air quality. Therefore, a third visibility characterization, the deciview (dv) was derived and used to index a constant fractional change in extinction or visual range. Pristine visibility with maximum visual range is characterized by low deciview values. Extinction may be directly calculated from light transmittance measurements or derived as a "reconstructed extinction" from measured particle concentrations. Fine mass particulate matter less than 2.5 microns is a major determinant of visibility and component of IMPROVE.

IMPROVE monitoring is done at Glacier and Yellowstone National Parks, Craters of the Moon National Monument, Sula Peak on the Bitterroot NF, Green Mountain on the Kootenai NF, Hogback on the Helena NF, and the Monture Guard Station on the Lolo NF as well as the Flathead, Fort Peck, Medicine Lake, Northern Cheyenne, UL Bend, Sawtooth, Salmon, Scoville, Theodore Roosevelt, Lostwood, Badlands National Park, and Wind Cave. IMPROVE is a national network employing a set of aerosol samplers to measure atmospheric coarse and fine particulate matter, and it's chemical and physical composition. IMPROVE monitoring often includes transmissometers and digital or 35mm automated cameras for documenting scenes under various atmospheric conditions.

Visibility in the northern Rocky Mountains and Great Plains is excellent compared to other parts of the country, like the southeastern United States, where sulfates cause major reduction of visual range, and in southern Californian where NOX also diminishes visibility. Visibility reduction from natural levels in many rural western areas is largely due to sulfate, organics, and soil. Historically, visibility varies with patterns in weather, humidity, winds and smoke from fires. Current monitored visibility conditions are diminished from their "natural" condition, as monitored and modeled for the Regional Haze Rule. The cleanest 20% of the days in the northern Rockies and Great Plains approach natural conditions.

VIEWS (Visibility Information Exchange Web System, vista.cira.colostate.edu/views) provides the annual and seasonal spatial patterns of PM2.5, light extinction, and the contributions of major aerosol types at each IMPROVE site. The annual average standard visual range for the northern Rocky Mountains ranges from 90 km in northern Idaho and northwestern Montana, to over 150 km in southern Montana and southern Idaho. The annual average standard visual range for the northern Great Plains ranges from over 100 km in western North Dakota and South Dakota, to less than 90 km in the eastern Dakotas. Fine mass sulfates, organic matter, and carbon are common in summer, and often represent forestry or agricultural burning. Nitrates are more common in winter and spring. Seasonal dust from agricultural and other activities contribute to visibility impairment, especially in southern Idaho and western Idaho downwind of the wheat fields of eastern Washington.

Scott Copeland describes the range of visibility conditions at the Sawtooth IMPROVE, relating measured PM2.5 and fine mass species to scene conditions. Copeland will prepare similar visibility summaries for other IMPROVE sites, available on the VIEWS site. Pristine visibility at the Sawtooth site occurs a few percent of the days each month, with standard visual range of 350 km, 0 to 1 deciview (dv), light extinction coefficient of 10-11 inverse megameters (Mm-1), and less than 0.4 micrograms per cubic meter (ug/m3) of PM2.5. Clear day Sawtooth visibility occurs from no days in summer to 45% of days in winter months, with SVR of 210 to 260 km, 4 to 6 deciviews (dv), extinction of 15 to 18 Mm-1 and fine mass of 0.7 to 1.2 ug/m3. A median day at the Sawtooth site occurs about a third of the time, with SVR of 130 to 175 km, 8 to 11 dv, 12 to 30 Mm-1, and fine mass of 1.7 to 2.8 ug/m3. A hazy Sawtooth day occurs from a third of the time in summer to no days in winter months, with SVR of 52 to 85 km, 15-20 dv, 46 to 75 Mm-1, and fine mass of 5 to 10 ug/m3. An extreme event on the Sawtooth, like forest fire smoke, occurs a few percent of days in April, August, and September, with SVR of 25 to 30 km, 26-28 dv, 130 to 160 Mm-1, and fine mass over 15 ug/m3. In short, the greatest visual ranges and least particulate concentrations usually occur in winter with the pattern reversing in the summer. The range in particulate concentrations from best to worst, outside the infrequent extreme haze events, is about 10 micrograms of PM2.5, and the range in SVR can be about 300 km.

The 90 percentile annual SVR is about 250 kilometers - visibility is better (greater SVR) on 10 percent of the days, or worse (lower SVR) on 90 percent of the days. The 50 percentile median annual SVR is about 150 kilometers - visibility is better and worse on half the days. The 10-percentile annual SVR is about 80 kilometers that is; visibility is worse on 10 percent of the days, or better on 90 percent of the days. Compared to the rest of the country, visibility is good to excellent in the class I areas of the northern Rocky Mountains, represented by the Sawtooth IMPROVE site.

General Meteorology

Topography of the planning area ranges from flat grasslands to rolling prairie foothills to rugged glaciated mountain peaks. Prevailing westerly to southwesterly winds and two major climatic air masses, continental and maritime systems influences the climate. At lower elevations

precipitation may be as little as 10 inches annually, while at higher elevations precipitation can exceed 100 inches annually. Temperatures range from well below freezing to over 100 degrees.

The diverse nature of the terrain and climate can result in variable dispersion characteristics. Mountainous terrain affects surface wind speed and direction. Increased precipitation occurs as elevations increase relative to drier valley bottoms and plains areas. Temperature inversions, which trap pollutants, are common in the region throughout the year, but the depth, duration, and intensity vary widely from the mountains to the plains. Inversions on the plains seldom persist past noon and are usually shallow and weak. Inversions in the mountainous areas are often stronger and deeper and can persist for days, and even weeks, during the fall and winter.

Weather in eastern Montana and the Dakotas is typical of the Northern Great Plains, hot and dry summers and cold and dry winters. Precipitation totals are relatively low; thunderstorms produce significant precipitation. Wind patterns are usually westerly. Dispersion in eastern Montana and the Dakotas is usually excellent, and inversions are shallow and temporary.

Idaho and western Montana weather is influenced by Pacific Ocean maritime air masses; higher precipitation produces more forest vegetation than on the plains. Summers are cooler and winters are warmer than on the plains from oceanic air modification. Continental air masses may form cold and dry or hot and dry conditions in the mountainous areas, more typical of plains areas. Dispersion in western Montana and Idaho mountain valleys ranges from excellent to poor. Inversions are frequent and may linger during high pressure. Concentrations of human populations in growing communities in the mountain valleys add to the natural inversion conditions of stagnant air, impairing air quality and creating challenges for smoke management. Particulate air monitoring and AQ management is focused in western Montana and Idaho, within mountain valleys.

Pollution Exposure Index

The potential for pollutants from industrial sources to reach class I areas in the northwestern United States, including all Forest Service class I wilderness areas in Montana and Idaho, is approximated from monthly mean pollutant emissions, wind speeds, and directions. A simple pollution exposure index is derived to estimate downwind concentration. Maps of pollution potential were generated for each pollution component (particulates, PM, sulfur oxides, SOX, nitrogen oxides, NOX, and ammonia), months representing each season (January, April, July, and October), and each of the three vertical levels: surface, 850 millibars (mb) - about 5000 feet, and 700 mb - about 10,000 feet. Mixing heights were used to help determine which trajectory levels best represent each month (reference paper available in January, 2003 by Sue Ferguson and Miriam Rorig, Pacific Northwest Research Station, General Technical Report, Forest Service, Seattle, WA).

Pollution Exposure Index modeling results indicate January mixing heights are low, less than 1000 feet above ground level, with surface winds making trajectory potential for PM, NOX, and SOX impacts to the Cabinet Mountain Wilderness from sources at Lewiston, Idaho. Lewiston emission source trajectories in April have higher mixing heights - 5000 feet - with 850 mb steering winds showing potential impacts for PM and NOX to the Selway Bitterroot Wilderness. Emission sources from Spokane show potential impacts for SOX in the Cabinet Mountains Wilderness. Higher mixing heights - 10,000 feet - and 700 mb steering winds in July show trajectories of emission sources from Lewiston, Idaho potentially impacting the Mission Mountains, Scapegoat, and Bob Marshall Wilderness with PM, NOX, and SOX. Spokane emission source trajectories in spring show potential SOX impacts to the Cabinet Mountains Wilderness. October mixing heights are like spring or lower, with 850 mb steering winds showing emission sources at Lewiston having potential to impact the Mission Mountains, Scapegoat, and Bob Marshall Wilderness for PM and NOX. Puget

Sound and Willamette Valley sources of PM in the fall show potential to impact the Cabinet Mountains Wilderness. Ammonia source trajectories do not stand out as potential impacts to Montana and Idaho Forest Service class I wilderness areas.

The Pollution Exposure Index did not model eastern Montana and North and South Dakota. Large air emissions in eastern Montana at Colstrip, and in western North Dakota north of Bismark, are mostly downwind of class I wilderness areas managed by the Forest Service, although class I areas managed by other agencies, like the Theodore Roosevelt National Park, and the Northern Cheyenne Reservation are impacted.

Ventilation Index

An indicator of atmospheric dispersion conditions for air pollutants and smoke is provided by the ventilation index. Sue Ferguson of the Pacific Northwest Experiment Station created a ventilation climatology website - http://www.fs.fed.us/pnw/fera/vent/introduction.html - which provides maps of the product of mixing height and transport wind, called the ventilation index. The ventilation index is a useful tool in smoke management. Maps of the ventilation index as well as wind roses and mixing heights provide spatial and temporal indicators of atmospheric dispersion.

The ventilation index for Montana, Idaho, North and South Dakota for the month of September - the fall season prescribed burning time - is shown in Appendix 2 as an example of the ventilation climatology web site tool. The ventilation index for September shows morning inversions in mountain valleys of Montana and Idaho and the Snake River plain of southern Idaho, indicating poor atmospheric dispersion, while the afternoon mixing heights and transport winds represented by the ventilation index, indicates good dispersion over much of the area.

NEEDS AND RECOMMENDATIONS

1. Continue IMPROVE, lichens, lake chemistry, NADP, and snow chemistry monitoring; coordinate with and support NPS Western Airborne Contaminants Project. In general, air quality in the vicinity of the Forests and Grasslands of the northern Great Plains and Rocky Mountains is good, with some questions about regional haze effects on visibility in class I areas and airborne contaminants like mercury and persistent organic pesticides. Criteria pollutant emission sources, which are concentrated around Spokane, Coeur d'Alene, Boise, Pocatello, Lewiston, Missoula, Libby, Kalispell, Whitefish, Great Falls, Helena, Billings/Laurel, Colstrip, and north of Bismark, are dispersed by generally prevailing southwesterly airflow with periods of stagnant dispersion more common in mountains.

2. Localized areas of inversions, primarily in mountain valley locations, pose the greatest pollutant and health concerns. Non-attainment areas are counties with concentrated populations and industry, or counties with very large power generation facilities, agricultural product facilities, forest product facilities, or mining facilities.

3. Air resource monitoring in the vicinity of the Forests (visibility, lakes, acid deposition, lichens) documents healthy lake chemical conditions, healthy precipitation chemistries, and healthy lichen communities. Class I area visibility is vulnerable to degradation from

anthropogenic air pollution sources. Regional Haze Rule implementation SIP's will involve Forest managers because of visibility impairment to class I areas, requiring compromises between prescribed fire smoke emissions and emissions from industrial and mobile sources. Wildfire and prescribed fire ecosystem maintenance smoke is considered natural.

4. Increased use of fire activity, such as understory broadcast and pile burns, and wildfire in drought years, is the greatest source of potential change in forest emissions. Industrial emissions from oil and gas drilling and production, coal bed methane wells, and increased production from coal and gas fired power-generating facilities scattered around the region present new challenges to air quality.

Recommended Management Actions

1. Coordinate with the state air regulatory agencies to constrain oil and gas - including coal bed methane - and other cumulative industrial emissions to comply with NAAQS, PSD increments, and AQRV thresholds (visibility and lake chemistry) in the class I wilderness areas. Continue air quality and air quality related values monitoring and modeling for use in PSD permitting.

2. Continue to coordinate with the state environmental quality, health, and natural resource agencies and the EPA in meeting all air quality regulatory requirements in Forest projects or permitted emissions, such as from fire activity, road dust, or vehicle/equipment emissions. Smoke emissions from prescribed burning require a plan for smoke visibility impacts, the implementation of an emission tracking system for all fire activities, improved integrated assessment of emissions and established annual emission goals, enhanced smoke management programs, public education programs, and removal of administrative barriers to the use of alternatives to burning. Smoke management programs must be implemented in North and South Dakota. Smoke management programs must include agricultural burning. State Implementation Plans for PM2.5 and Regional Haze Rule must include Forest Service needs for the use of fire smoke emissions.

3. Continue to participate in the GYACAP (Greater Yellowstone Area Clean Air Partnership) group which functions primarily as a technical advisory group to the GYCC (Greater Yellowstone Coordinating Committee). The GYACAP is also a useful forum to collaborate with Montana, Idaho, and Wyoming DEQ's on air quality issues and regulations, exchange air quality information, and to coordinate air quality monitoring.

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Appendix 1

EPA AirData
NET Facility Emissions Report
Montana, Idaho, North Dakota, South Dakota
Air Pollution Sources (ranked by PM10 > 100 tons)
Pollutant Emissions in Tons Per Year (1999)

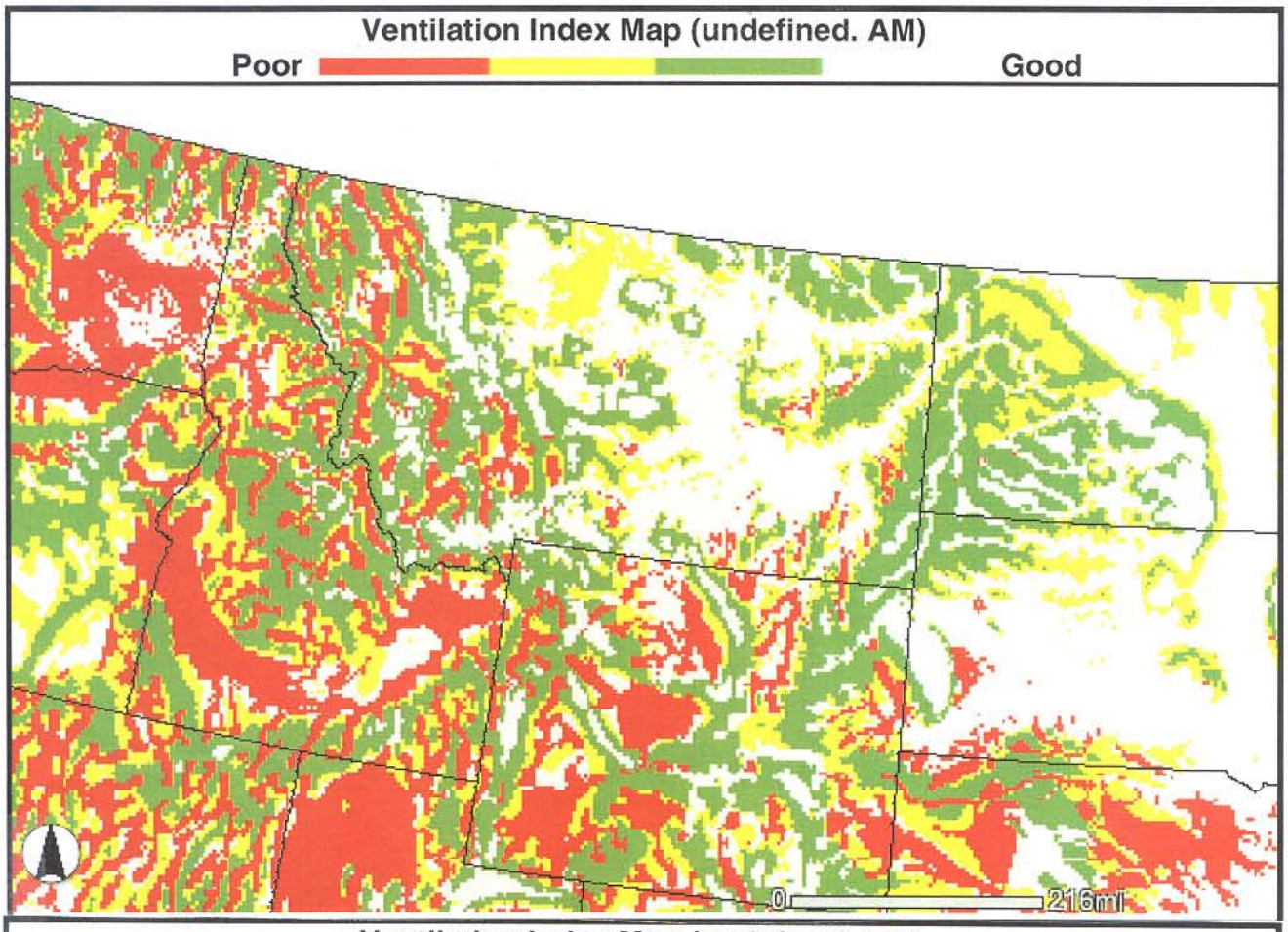
Facility	**City, State**	**PM10**	**PM2.5**	**SO2**	**NOX**	**CO**	**Industry Type**
MONTANA SOURCES RANKED BY PM10							
MPC - Colstrip Units #1 & #2	Colstrip, MT	5487	2699	17948	38375	2314	Electric Services
Montana Resources	Butte, MT	1559	980	45	406	534	Copper Ores
Golden Sunlight Mine	Whitehall, MT	1056	556	43	492	607	Gold Ores
Western Energy	Colstrip, MT	738	284	58	304	498	Bituminous Coal & Lignite
Decker Coal Company	Decker, MT	714	247	37	339	545	Bituminous Coal & Lignite
Columbia Falls Aluminum	Columbia Falls, MT	539	372	1320	9	30064	Primary Aluminum
Stone Container	Missoula, MT	450	305	160	1962	3649	Paperboard Mills
Big Sky Coal Company	Colstrip, Mt	418	185	25	224	265	Bituminous Coal & Lignite
Montana Tunnels Mine	Jefferson City, MT	398	289	56	515	482	Gold Ores
Spring Creek Coal	Decker, MT	312	124	20	232	263	Bituminous Coal & Lignite
Westmoreland Resources	Hardin, MT	294	91	20	184	263	Bituminous Coal

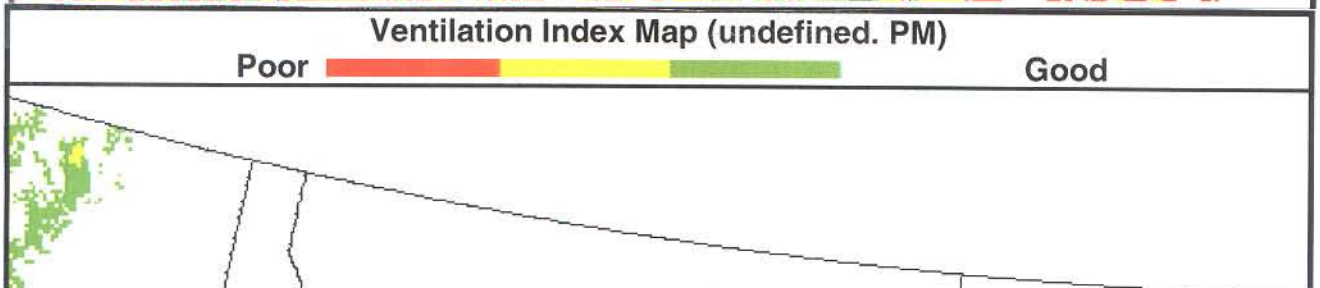
Facility	City, State	PM10	PM2.5	SO2	NOX	CO	Industry Type
							& Lignite
Plum Creek	Columbia Falls, MT	278	139	14	377	1727	Softwood Veneer & Plywood
Cenex	Laurel, MT	259	158	3049	1109	191	Petroleum Refining
Holnam, Inc.	Three Forks, MT	180	80	2334	1614	69	Cement, Hydraulic
Luzenac America – Yellowstone Mine	Cameron, MT	158	60	5	48	40	Minerals, Ground or Treated
Continental Lime	Townsend, MT	154	63	4	297	34	Lime
Exxon	Billings, MT	152	127	5319	692	96	Petroleum Refining
Ash Grove Cement	Clancy, MT	140	66	94	551	20	Cement, Hydraulic
Conoco	Billings, MT	136	116	821	833	201	Petroleum Refining
Louisiana-Pacific	Missoula, MT	132	55	2	18	56	Reconsituted Wood Products
Stimpson Lumber	Missoula, MT	124	113	9	208	253	Sawmills & Planing Mills
Holly Sugar	Sidney, MT	111	60	75	245	167	Beet Sugar
IDAHO SOURCES RANKED BY PM10							
Amalgamated Sugar	Nampa, ID	3575	1037	946	1133	32	Beet Sugar
Potlach	Lewiston, ID	3018	2468	1467	626	3181	Paper Mills
Fmc	Pocatello, ID	1657	1391	2935	9	2	Phosphate Rock
Amalgamated Sugar	Paul, ID	630	214	511	432	131	Beet Sugar
Boise Cascade	Emmett, ID	564	553	17	323	176	Wood Products
Amalgamated Sugar	Twin Falls, ID	449	148	347	259	75	Beet Sugar
Potlach Corp.	Pierce, ID	406	398	9	177	252	Paper Mills
Beker Industries	Conda, ID	379	232	1330	1	0	Industrial Inorganic Chemicals

Facility	City, State	PM10	PM2.5	SO2	NOX	CO	Industry Type
Potlatch Corp	St. Maries, ID	354	347	8	155	221	Wood Products
JR Simplot	Pocatello, ID	307	245	7134	1012	12	Fertilizers
Daw Forest Porducts	Oldtown, ID	294	288	7	128	183	Forest Products
Ash Grove Cement	Inkom, ID	289	185	489	124	0	Cement
Idaho Supreme Potato	Firth, ID	244	71	67	65	2	Food
JR Simplot	Conda, ID	181	60	4	115	0	Fertilizers
Potlach Corp	Coeur d'Alene, ID	115	113	2	51	72	Wood Products
NORTH DAKOTA SOURCES RANKED BY PM10							
Coal Creek	Underwood,, ND	1808	1297	49743	12862	2136	Electric Services
Amoco	Mandan, ND	578	543	610	1744	108	Petroleum Refining
Milton R Young	Center, ND	485	102	41344	22098	1345	Electric Services
Leland Olds	Stanton, ND	435	178	50107	12955	868	Electric Services
Antelope Valley	Beulah, ND	324	155	15516	13290	1624	Electric Services
R M Heskett	Mandan, ND	290	69	2208	853	229	Electric Services
Minn-Dak Farmers Cooperative	Wahpeton, ND	257	219	116	141	945	Beet Sugar
North Dakota State University	Fargo, ND	146	146	253	55	16	Colleges & Universities
Stanton	Stanton, ND	119	81	9784	3172	192	Electric Services
Dakota Gasification Company	North Beulah, ND	102	56	45333	523	97	Crude Petroleum & Natural Gas
SOUTH DAKOTA SOURCES RANKED BY PM10							
Hills Materials Company	Rapid City, SD	287	148	0	0	0	Dimension Stone

Facility	City, State	PM10	PM2.5	SO2	NOX	CO	Industry Type
South Dakota State University	Brookings, SD	258	90	374	215	0	Colleges & Universities
South Dakota Cement	Rapid City, SD	163	86	654	2877	0	Cement
Big Stone	Big Stone City, SD	110	66	2569	5235	79610	Electric Services

Appendix 2 – Ventilation Index Map





ACROLEIN: A hazardous air pollutant, emanating from fire smoke.

AEROSOL: Solid particles or liquid droplets that are small enough to be suspended in the air.

AIR QUALITY RELATED VALUE (AQRV): A feature or property of physical or biological property that is (or has potential to be) impacted by air pollution. General categories of AQRV's are: flora, fauna, soil, water, cultural resources, odor and visibility

AIRSHED: A geographic area that, because of topography, meteorology, and/or climate, is frequently affected by the same air mass.

Appendix 3

Glossary of National Fire and Air Terms

ACRES BLACK: Area within a fire perimeter that was actually touched by fire.

ACROLEIN: A hazardous air pollutant, emanating from fire smoke.

AEROSOL: Solid particles or liquid droplets that are small enough to be suspended in the air.

AIR QUALITY RELATED VALUE (AQRV): A feature or property of physical or biological property that is (or has potential to be) impacted by air pollution. General categories of AQRV's are: flora, fauna, soil, water, cultural resources, odor and visibility

AIRSHED: A geographic area that, because of topography, meteorology, and/or climate, is frequently affected by the same air mass.

AIRSHED CAPACITY: Process for quantifying the relative emissions contributions by source within a **airshed**.

AMBIENT AIR: The air of the surrounding outdoor environment. The air encompassing a specific geographic area.

ATTAINMENT AREA: An area considered having air quality as good as or better than the National Ambient Air Quality Standards (NAAQS) as defined in the Clean Air Act. Note that an area may be in attainment for one or more pollutants but be a non-attainment area for one or more other pollutants. (See Non-attainment area).

AVAILABLE FUEL: The portion of the total fuel that actually burns.

AVOIDANCE: A smoke emission control strategy that considers meteorological conditions when scheduling prescribed fires in order to avoid incursions into smoke sensitive areas.

BACK TRAJECTORY/TRAJECTORY MODELING: Estimates of the general path air masses may have traveled over the 24 to 96 hours prior to arriving at a particular study location. These estimates of air movements are important to understanding air pollution. The meteorological dynamics that cause air to rise or fall, and that determine its path can affect air quality by

carrying air pollutants many miles from their sources. Model e.g.: HYSPLIT4 (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model developed by the Air Resources Laboratory of the National Oceanic and Atmospheric Administration.

BACM (BEST AVAILABLE CONTROL MEASURES): An emission limitation action based on the maximum degree of emission reduction (considering energy, environmental, and economic impacts) achievable through application of production processes and available methods, systems, and techniques.

BACT (BEST AVAILABLE CONTROL TECHNOLOGY): The control level (or control measures) required for sources subject to PSD - see 40 CFR §52.21(b)(12), or 40 CFR §51.166(b)(12)

BART (BEST AVAILIABLE RETROFIT TECHNOLOGY): A process under the CAA to evaluate the need and, if warranted, install the most effective pollution controls on an already existing air pollution source.

BENZENE: A hazardous air pollutant. Known carcinogen. Respiratory failure at high concentrations.

BURN SEVERITY: A qualitative assessment of the heat pulse directed toward the ground during a fire. Burn severity relates to soil heating, large fuel and duff consumption, consumption of the litter and organic layer beneath trees and isolated shrubs, and mortality of buried plant parts.

CARBON DIOXIDE (CO2): A colorless, odorless, nonpoisonous gas, which results from fuel combustion and is a normal a part of the ambient air. Atmospheric CO_2 has increased about 25 percent since the early 1800s, with an estimated increase of 10 percent since 1958 (burning fossil fuels is the leading cause of increased CO_2, deforestation the second major cause). The increased amounts of CO_2 in the atmosphere enhance the greenhouse effect, blocking heat from escaping into space and contributing to the warming of Earth's lower atmosphere.

CARBON MONOXIDE (CO): A colorless, odorless, poisonous gas produced by incomplete fuel combustion. Carbon monoxide is a criteria pollutant and is measured in parts per million.

CLASS I AREA: A geographic area designated for the most stringent degree of protection from future air quality degradation. The Clean Air Act designates as mandatory Class I areas each National Park over 6,000 acres and each Wilderness or National Wildlife Refuge over 5,000 acres in existence as of August 7, 1977. Subsequent additions of land to those Class I wildernesses are also considered to be “Class I”.

CLASS II AREA: A geographic area designated for a moderate degree of protection from future air quality degradation. Moderate increases in new pollution may be permitted in a Class II area. All Wildernesses designated after August 7, 1977 are automatically Class II Areas, as are all other National Forest System lands that are not Class I. Most areas in the United States that are not Class I are Class II.

CLEAN AIR ACT (CAA or CAAA): A federal law enacted to insure that air quality standards are attained and maintained. Initially passed by Congress in 1963, it has been amended several times, with the majority of changes in August, 1977, and November, 1990.

CONDITION CLASS: An expression of the departure of the current condition from the historical fire regime. Consequently, it is derived from the historical fire regime and the current fire severity.

It is used as a proxy for the probability of severe fire effects (e.g., the loss of key ecosystem components - soil, vegetation structure, species; or alteration of key ecosystem processes - nutrient cycles, hydrologic regimes). Consequently, the fire-regime condition class is an index of ecosystem risks attributable to wildland fire.

CONFORMITY: Conformity of Federal actions to a SIP to ensure Federal activities do not interfere with the budgets in the SIPs, do not cause or contribute to new violations, and ensure attainment and maintenance of the NAAQS (see **General Conformity**)

CONSUME: Consume 2.1 is a PC-based, interactive fuel consumption model that predicts total and smoldering fuel/biomass consumption during prescribed fires and wildland fires. Predictions are based on weather data, the amount and fuel moisture of fuels, and a number of other factors.

CONSUMPTION: The amount of a specified fuel type or strata that is removed through the fire process, often expressed as a percentage of the preburn weight.

CRITERIA POLLUTANTS: A group of very common air pollutants regulated by EPA on the basis of criteria (information on health and/or environmental effects of pollution). Criteria air pollutants are widely distributed all over the country. Criteria pollutants are carbon monoxide (CO), lead (Pb), nitrogen dioxide(NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2). There are also a large number of compounds which have been determined to be hazardous which are called air toxics. Ozone and particulate matter are the criteria pollutants of greatest consideration to fire.

E-BAM PARTICULATE SAMPLER: A portable real-time sampler providing data for EPA requirements for automated PM 2.5 and PM 10 measurement.

EMISSION FACTOR: A relationship between the amount of emissions that are released and the activity of the producer. Emission factors are used to predict emission levels for different industries. For fire, the parameter of lbs of pollutant/ton of fuel consumed is used.

EMISSONS BUDGET: A quantitative description of the emissions for a physical or ecological system. The amount of source emissions utilized in a attainment demonstration becomes the “emissions budget.”

EMISSIONS INVENTORY: Emission inventories are quantities of pollutants measured over time. Emission inventories can be compared with air pollutant levels in an area to determine if increased emissions decreases the air quality.

EMISSION FACTOR: The estimated average emission rate of a given pollutant for a given source, relative to units of activity. Emissions rates are stated as “Pounds of emission produced per ton of fuel consumed.”

ENHANCED SMOKE MANAGEMENT PROGRAM (ESMP): A program for fire emissions that considers visibility effects, in addition to health and nuisance objectives, and is based on the criteria of efficiency, economics, law, emission reduction opportunities, management objectives, and reduction of visibility impact.

EXCEEDANCE: Violation of the pollutant levels permitted by environmental protection standards.

F-CAMMS (Fire **C**onsortia for **A**dvanced **M**odeling of **M**eteorology and **S**moke)**:** A coordinated group of regional cooperative centers for high-resolution simulation modeling of weather, fire & smoke. They are initiated under support from FS Research as part of the National Fire Plan.

FIRE USE: The combination of wildland fire use and prescribed fire application to meet resource objectives.

FCCS (Fuel Characteristic Classification System): A comprehensive set of fuelbeds and fire potentials that provide a method for assigning fuel properties to landscapes across the United States. FCC Release Expected October, 2003

FEDERAL REFERENCE METHOD MONITOR: A minimum set of quality control monitoring samples from which to judge data quality for PM 2.5. It is the responsibility of both the EPA and State and local organizations to assess the quality of the data and take corrective action when appropriate.

FINE PARTICULATES: Aerosols smaller than 2.5 micrometers in diameter. (A micrometer is one millionth of a meter, a human hair is about 70 micrometers in diameter.)

FIRE EMISSION TRACKING: Data and models of fuel consumption, emissions, meteorology, and smoke dispersion; producing predictions of cumulative impacts of agriculture, forest, and range fires – e.g. BLUESKY.

FIRE SEVERITY: A prediction of the likely severity (expressed as a percentage of overstory replacement) of a fire should it burn under the current conditions of the vegetation. The likely fire severity is strongly tied to cover type (e.g., species' tolerance to fire), size class, canopy cover, and slope. Current fire severity is used to derive fire-regime condition class.

FORMADEHYDE: A colorless, pungent, and irritating gas, a hazardous air pollutant, one of those emanating from fire.

FUEL CHARACTERSISTIC CLASS POTENTIALS (FCC POTENTIALS): Three sets of numbers that describes the fuel complex and facilitate communication among users.

1. Fire Behavior Potential: Quantifies potential fire behavior based on estimates of reaction intensity (I_R) and energy release component (ERC), rate of spread (SI), and fireline intensity (BI).
2. Crown Fire Potential: Ranks the potential for fire to reach (torch potential) and carry through the canopy (dependent and independent crown fire potentials).
3. Available Fuel Potential: Available fuel loading partitioned into components expected to be consumed in either the flaming (flame available fuel), or smoldering (smolder available fuel and residual smolder potential) phases of fire.

Fuel Characteristic Classification is a system for classifying wildland fuelbeds according to the set of inherent properties necessary to predict potential fire behavior and effects. The Fuel Characteristic Classification System is being developed by the Fire and Environmental Research Applications team (FERA) of the USDA Forest Service, Pacific Northwest Research Program for the Joint Fire Science Program.

FUELBED: An array of fuels usually constructed with specific loading, depth and particle size to meet experimental requirements; also, commonly used to describe the fuel composition in natural settings.

FUELBED COMPONENTS: Each fuelbed category has a set of unique classes based on specific morphological, chemical and structural features of its constituents. For example, shrubs

are grouped into unique sets comprising common features of foliage type, growth habit and accelerant potential. Each physiognomic class has its own unique fuel characteristics. The description of fuelbed category physiognomy identifies the relevant fuelbed components to which fuel characteristics are assigned. Fuelbed components are basic elements that combust differently and have a unique influence on fire behavior and effects.

FUEL LOADING: The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available fuel (consumable fuel) or total fuel and is usually dry weight.

GACCS (**Geographical Area Coordination Center):** Comprised of eleven centers across the United States, including Alaska which locate and dispatch additional firefighters and support personnel throughout a geographic area.

GENERAL CONFORMITY: Section 176(c) of the Clean Air Act prohibits Federal entities from taking actions in non-attainment or maintenance areas which do not conform to the State implementation plan (SIP) for the attainment and maintenance of the national ambient air quality standards (NAAQS). Therefore, the purpose of conformity is to (1) ensure Federal activities do not interfere with the budgets in the SIPs; (2) ensure actions do not cause or contribute to new violations, and (3) ensure attainment and maintenance of the NAAQS.

HAPS: Hazardous air pollutants. Ex: mercury.

HC: Hydrocarbons. A group of chemicals containing hydrogen and carbon that often contribute to air pollution as OCs or VOC's. They are involved in forming ozone, and some hydrocarbons are toxic. Term often used interchangeably with VOCs.

HEAT RELEASE RATE: (1) Total amount of heat produced per unit mass of fuel consumed per unit time. (2) Amount of heat released to the atmosphere from the convective-lift fire phase of a fire per unit time.

Hg: Mercury. A hazardous air pollutant; one of those emanating from fire.

INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS (IMPROVE): **I**nteragency **M**onitoring of **Pro**tected **V**isual **E**nvironments, a group of federal agencies using a common set of standards to monitor visibility across the United States. Other nations have also adopted portions or all of the IMPROVE monitoring techniques.

INCREMENTS: Allowable increases in ambient concentrations of sulfur dioxide and particulates from new or existing sources. The amount of allowable increase is dependent on whether the area is designated Class I, Class II, or Class III for PSD.

LIGHT EXTINCTION: The "loss" of light as it travels through the air. Light can be truly lost by being absorbed by gases and aerosols in the air. Light can also be "lost" as it scatters off gases and aerosols.

MAINTENANCE AREA: A geographic region where concentrations of a particular air pollutant no longer exceed the NAAQS. A three year period is required to demonstrate to the EPA that the implementation measures taken will continue these concentrations to be defined an **attainment** area by the EPA.

MESOSCALE: Used to simulate sub-grid scale phenomena not resolved by regional-scale models. The mesoscale ranges as defined by Orlanski (1975).

MIE DATARAM: Dual-wavelength aerosol monitor continuously displays and logs the concentrations and sizes of airborne particulates.

MM5: A fifth-generation mesoscale meteorology model - a research oriented numerical weather prediction model, maintained by the National Center for Atmospheric Research, Mesoscale and Microscale Meteorology Division (NCAR/MMM).

MOBILE SOURCE: A pollution source that moves. Mobile sources are often divided into road sources, including cars, trucks, buses, and motorcycles, and non-road sources like trains, planes, boats, lawnmowers, etc.

MODIS(**M**oderate **R**esolution **I**maging **S**pectroradiometer): Part of NASA's Earth Observing System (EOS). A key instrument aboard the Terra (EOS AM) and Aqua (EOS PM) satellites, it will view the entire surface of the Earth every 1-2 days, making observations in 36 co-registered spectral bands, at moderate resolution (0.25 - 1 km), of land and ocean surface temperature, primary productivity, land surface cover, clouds, aerosols, water vapor, temperature profiles, and fires.

NATURAL BACKGROUND CONDITIONS: An estimate of the visibility conditions at each Federal Class I area that would exist in the absence of human-caused impairment. Conditions substantially unaltered by humans or human activities. As applied in the context of visibility, natural conditions include naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS): Legal limits of atmospheric pollution established by the EPA, as the concentration limits needed to protect all of the public against adverse effects on public health and welfare, with an adequate safety margin. Primary standards are those related to health effects; secondary standards are designed to protect the public welfare from effects such as visibility reduction, soiling, material damage, and nuisances. NFDRS: National Fire Danger Rating System:

NCEP (National Centers for Environmental Prediction): One of the initial sources of critical meteorological data available to FCAMMS. Previously the National Meteorological Center, a NOAA facility. The source of most of the model output data that appears in GRIB form on the HDS data stream

NEW SOURCE REVIEW: A review of a new facility that has the potential to emit air pollutants in amounts specified by law. The review is done to establish the impact of the pollution, and the options available to control that pollution

NEPHELOMETER: An instrument that measures the amount of light scattered by fine particles suspended in the air.

NFDRS (National Fire Danger Rating System): A multiple index system developed to provide information about current and predicted fire danger conditions.

NITROGEN OXIDES (NOx): Gases formed from atmospheric nitrogen and oxygen when combustion takes place under conditions of high temperature and pressure. Nitrogen Oxides are primary air pollutants, which can be harmful in themselves, as well as act as precursors of

photochemical oxidants (particularly ozone) and acidic deposition. NOx often has a reddish-brown color.

NON-ATTAINMENT AREA (NAA): A geographic region where concentrations of a particular air pollutant exceed the NAAQS. A particular location may be non-attainment for more than one pollutant.

OC (organic carbon): Organic **C**arbon: carbon combined with other elements to form complex compounds, often given off by plants and most human activities. A fire contribution to PM2.5.

OZONE: A pungent, colorless, toxic gas that contributes to photochemical smog. No sources directly produce ozone; it is created when nitrogen oxides, hydrocarbons, and volatile organic compounds (VOC's) mix and are exposed to sunlight.

PAHs (Polynuclear Aromatic Hydrocarbons): A hazardous air pollutant emanating from fire.

PARTICULATE MATTER (PM): Any liquid or solid particles that are or have been airborne. "Total suspended particulates" as used in air quality management are those particles suspended in or falling through the atmosphere. Generally they range in size from 0.1 to 100 microns.

PHOTOCHEMICAL POLLUTANT: Any pollutant produces by photochemical reactions. The most common photochemical pollution involves the ultraviolet portion of sunlight, nitrogen oxides, and certain hydrocarbons. A wide variety of new products are produced, including ozone; many of which are harmful to plants and animals.

PM-10: Particulate Matter less than 10 micrometers. Particles this size and smaller have been shown to cause problems with human health.

PM-2.5: Particulate Matter less than 2.5 micrometers. Particles this size and smaller have been shown to impact visibility as well as incur greater threats to human health than PM-10.

POINT SOURCE: Any source that emits air pollutants through an identifiable stack or a specific source of air pollution.

PRESCRIBED FIRE: Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition. This term replaces management ignited prescribed fire.

PREVENTION OF SIGNFICANT DETERIORATION (PSD): A program mandated by the Clean Air Act to prevent air quality and visibility degradation, and to remedy existing visibility degradation. Before the construction of certain new pollution sources is approved, they must apply for and receive a PSD permit from the appropriate air regulatory agency. The Forest Service has input in to this PSD permitting process by providing comment to air regulatory agencies on potential source impacts to AQRV's.

RAYLEIGH SCATTERING: The scattering of light by particles much smaller than the wavelength of the light, *e.g.*, molecular scattering in the natural atmosphere.

RAWS (Remote Automated Weather Station): A special remote fire weather observation station which takes timed measurements of the various weather factors used to calculate fire danger and behavior. These stations usually transmit data via satellite telemetry to the National

Interagency Fire Center for distribution to fire managers nation-wide.

RAZU: The online burn reporting system used by members of the Montana/Idaho Airshed Group. ..allows members to build preseason burn-lists directly into the program's master database, propose burns on a daily basis and report accomplishments on burns that they conduct.

REASONABLE PROGRESS: Refers to progress in reducing human-caused haze in Class I areas under the national visibility goal. The Clean Air Act indicates that "reasonable" should consider the cost of reducing air pollution emissions, the time necessary, the energy and non-air quality environmental impacts of reducing emissions, and the remaining useful life of any existing air pollution source considered for these reductions

REASONABLY AVAILABLE CONTROL MEASURES (RACM): Developed by EPA that apply to wood combustion, fugitive dust, and prescribed and silvicultural burning in and around "moderate" PM10 non-attainment areas. RACM is designed to bring an area back into attainment and uses a smoke management program that relies on weather forecasts for burn/no-burn days.

REGIONAL HAZE VISIBILITY IMPAIRMENT: Any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions, caused predominantly by a combination of many sources from, and occurring over, a wide geographic area.

REGIONAL HAZE RULE (RHR):

- July 1, 1999, EPA promulgated rules for the Regional Haze Regulations
  Rules are designed to address the National Visibility Goal
- § 169A of the Clean Air Act sets as a national goal "*the prevention of any future, and remedying of any existing impairment of visibility, in mandatory class I areas which impairment results from manmade air pollution."*

REGIONAL PLANNING ORGANIZATIONS (RPOs): Five regional planning organizations that address regional haze and related issues. These organizations will first evaluate technical information to better understand how their States and Tribes impact national park and wilderness areas (Class I areas) across the country, and they will then pursue the development of regional strategies to reduce emissions of particulate matter and other pollutants leading to regional haze.

- WRAP: Western Regional Air Partnership
- CENRAP: Central States Regional Air Partnership
- MRPO: Midwest Regional Planning Organization
- MANE-VU: Mid-Atlantic/Northeast Visibility Union
- VISTAS: Visibility Improvement State and Tribal Association of the Southeast

SENSITIVE RECEPTORS: An element of an AQRV that is most sensitive to or first modified by anthropogenic air pollution. For example, a sensitive receptor for visibility (an AQRV) might be a particular view. Potential human-caused changes to that view might be changes in sensitive receptor indicators such as contrast, visual range, or coloration. Another example would be a sensitive receptor for water. Potential human-caused changes to it could affect sensitive receptor indicators such as pH, ANC, metals concentrations, other toxics. dissolved-oxygen concentrations, nutrients, or anion and cation concentrations.

SENSITIVE-RECEPTOR INDICATOR: A measurable physical, chemical, biological, or social characteristic of a sensitive receptor. See definition above for examples.

SMOKE MANAGEMENT PLAN (SMP): A standard framework of requirements and procedures for managing smoke from prescribed fires, typically developed by States or Tribes with cooperation from stakeholders

STANDARD VISUAL RANGE: An index used to quantify visibility conditions, typically expressed in kilometers. Technically, it is the distance at which a large black disappears from view above the horizon.

STATE IMPLEMENTATION PLANS (SIPS or S/TIPS): Subset of a State's Air Agency Rules. Those rules dealing with the attainment and maintenance of NAAQS. Includes every guideline letter, graph, table, legal & regulatory opinion, decision, and emission budget in a State's Air Agency files dealing with the attainment and maintenance of NAAQS.

SULPHUR DIOXIDE (SO2): A gas that is a common industrial air pollutant. SO2 is easily transformed into sulfate in the atmosphere. Sulfate scatters light efficiently, thereby resulting in visibility degradation. It also can convert into acid droplets, consisting primarily of sulfuric acid.

TRANSMISSOMETER: An instrument that measures the amount of light extinction over a specified path length.

VENTILATION INDEX: An index that describes the potential for smoke or other pollutants to ventilate away from its source. Also called clearing index. It is the product of mixing height and the mean wind within the mixed layer trajectory wind.

VENTILATION CLIMATE INFORMATION SYSTEM: Assessing values of air quality and visibility at risk from wildland Fires. Part of the Fire and Environmental Research Applications (FERA) team of the USDA Forest Service, Pacific Northwest Research Station in Seattle, Washington.

VOC's (Volatile Organic Carbons): These are one of the precursors of ozone formation. A carbon-containing material that evaporates and may form *OC aerosols.*

Wildfire - An unwanted wildland fire. This term was only included to give continuing credence to the historic fire prevention products. This is not a separate type of fire under the new terminology.

WFU (WILDLAND FIRE USE): The management of naturally ignited wildland fires to accomplish specific pre-stated resource management objectives in predefined geographic areas outlined in Fire Management Plans. Wildland fire use is not to be confused with "fire use," which is a broader term encompassing more than just wildland fires.

WUI (WILDLAND-URBAN INTERFACE): The line, area, or zone, where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuel.

Models

BEHAVE: Fire Behavior Prediction and Fuel Modeling System gathers available fire models into a system that is driven by direct user input. The fire modeling capabilities will be significantly expanded and the user interface will be vastly improved with the updated Behave Plus: Fire Modeling System

BLUESKY: A smoke modeling framework that links together data and models of fuel consumption, emissions, meteorology, and smoke dispersion; producing real-time predictions of cumulative impacts of agriculture, forest, and range fires.

CALPUFF: a non-steady-state modeling system being used for a wide variety of air quality modeling studies, including:

- Near-field impacts in complex flow or dispersion situations
    - complex terrain
    - stagnation, inversion, recirculation, and fumigation conditions
    - overwater transport and coastal conditions
    - light wind speed and calm wind conditions
- Long range transport
- Visibility assessments and Class I area impact studies
- Criteria pollutant modeling, including application to State Implementation Plan (SIP) development
- Secondary pollutant formation and particulate matter modeling
- Buoyant area and line sources (e.g., forest fires and aluminum reduction facilities)

The CALPUFF modeling system has 3 main components: CALMET (a diagnostic 3-D meteorological model), CALPUFF (the transport and dispersion model), and CALPOST (a post-processing package). Each of these programs has a graphical user interface (GUI). In addition to these components, there are several other processors that may be used to prepare geophysical (land use and terrain) data in many standard formats, meteorological data (surface, upper air, precipitation, and buoy data), and interfaces to other models such as the Penn State/NCAR Mesoscale Model (MM5).

EMISSION PRODUCTION MODEL (**EPM**)**:** Emissions Production Model predicts air pollutant emissions source strength, heat release rate, and plume buoyancy consistently for all fire environments and fuel types. It requires an estimate of flaming and smoldering consumption, and a stylized description of ignition pattern. EPM then calculates timed emission rates for gases, particles, and heat. integrating fuel characteristics, predicted fire behavior (burn plan), three-stage combustion process, and the application of emission factors.

FARSITE: A fire growth simulation model. It uses spatial information on topography and fuels along with weather and wind files. FARSITE incorporates the existing models for surface fire, crown fire, spotting, and fire acceleration into a 2-dimensional fire growth model. FARSITE runs under Microsoft Windows operating systems (Windows 3.1x, 95, NT) and features a graphical interface. Users must have the support of a geographic information system (GIS) to use FARSITE because it requires spatial landscape information to run. ms

FASTRACS: Fuel Analysis, Smoke Tracking, and Report Access Computer System. It provides a system for planning, tracking, and reporting fuels management related activities. The program introduces two new approaches:

- Identification of tasks based on “Projects, Boundary Units, and Activities”—a familiar sounding set of terms used in a program-specific way to organize and manage traditional fuels management work.
- Implementation of a new methodology for estimating fuel loadings and calculating consumption and emissions based on Fuels Characterization Classes (FCC).

FIRE EFFECTS TRADEOFF MODEL (FETM):

Landscape-scale disturbance model

- Designed to simulate the long-term *effects* of management activities and natural disturbances on vegetation:
- Vegetation composition
- Wildland fire acres burned
- Residue loading and consumption
- Smoke production
- Fire and fuel treatment costs

Also designed to demonstrate *tradeoffs* between different types of disturbances (for example, prescribed fire vs. wildfire acres and emissions). Focus is on fire behavior and effects (by vegetation class) and for the entire landscape including:

- Stochastic—Number of fire starts per year treated as random variable
- Dynamic—Deals with annual changes over any future time period, 1 to ~300 years
- Non spatial—Results are tracked by vegetation class (FCC), without regard to location
- Public domain software
- Designed for use by any organization (federal, state, private)

FOFEM5: First Order Fire Effects Model: A easy-to-use computer program for predicting effects of prescribed fire and wildfire. FOFEM predicts fuel consumption, smoke production and tree mortality. Area of applicability is nationwide on forest and non-forest vegetation types. FOFEM also contains a planning mode for prescription development.

PFIRS: (Prescribed Fire Ignition Reporting System): A computer system developed by the state of California that will allow participating agencies to enter information on the location, size, date, and estimated emissions of each prescribed burn. The information will help coordinate their ability to meet local air quality requirements and adjust the
timing of individual projects to reduce cumulative air quality impacts.

SMOKE IMPACT SPREADSHEET MODEL (SIS):

- Simple-to-use, screening level emissions and dispersion modeling system.
- Development sponsored by USDA Forest Service Region 1 Air Quality Program
- Uses state-of-the-art modeling techniques (e.g., FOFEM5 emissions model, CALPUFF dispersion model).
- Goal to minimize development costs by using existing tools rather than creating an entirely new application.

Microsoft Excel provides user interface

- First Order Fire Effects Model (FOFEM5) provides front-end emissions calculator
- CALPUFF performs plume rise and downwind dispersion calculations
- CALPOST averages the CALPUFF outputs