BITTERROOT BURNED AREA RECOVERY PROJECT

AIR QUALITY ANALYSIS

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AIR QUALITY

Introduction

The smoke from fire contains a number of pollutants, including tiny particles called "particulate matter" (PM). Exposure to PM can cause significant health problems, especially for people suffering from respiratory illnesses. Smoke also adversely affects the clarity of the air, or visibility. Based on recent health research, Environmental Protection Agency (EPA) revised the air quality standards to provide improved health and visibility protection. With the new standards in place, land managers must consider using techniques that minimize prescribed fire emissions and the adverse impacts of smoke on public health and the environment. Careful planning and cooperation among land managers, air quality regulators, and local communities ensures that prescribed fire, clean air and public health goals can be met.

The main air quality concern associated with this Burn Area Recovery project is the quantity, concentration and duration of PM produced by proposed prescribed burning. Particulate matter is comprised of a mixture of solid particles and liquid droplets. Some particles are large or dark enough to be seen as dust or soot, but most are so small the human eye cannot see them. Particle size is measured in microns (one micron equals one millionth of a meter). Particles can be up to 50 microns or larger. This size tends to settle out of the air quickly and is less likely to affect public health. Particles 10 microns and smaller (PM-10) may be inhaled deep into the lungs and pose a greater threat to public health and visibility. Fine particles, 2.5 microns and smaller (PM-2.5), are of the highest concern and are generally emitted from activities such as industrial and residential combustion, wildland fire, agricultural burning, and vehicle exhaust.

Air Quality Regulatory Framework

THE CLEAN AIR ACT

The basic framework for controlling air pollutants in the United States is mandated by the 1970 Clean Air Act (CAA), as amended in 1977 and 1990 and (42 U.S.C. §7401 et seq.). In 1999 minor changes were made to the CAA for visibility in section 7491 and 7492. These changes were published on July 01, 1999 as the Regional Haze Rules (64 FR 35714). The CAA was designed to protect and enhance the quality of the Nation's air resources. The Act encourages reasonable Federal, State and local government actions for pollution prevention. State Implementation Plans (SIPs) are developed by each state to implement the provisions of the Clean Air Act. The SIPs describe the actions the State will take to achieve and maintain the "national ambient air quality standards" (NAAQS).

National Ambient Air Quality Standards (NAAQS)

The EPA has established NAAQS for six criteria pollutants that have been determined to be harmful to the public and the environment. Table 1 lists the six NAAQS. Montana has adopted most of these standards called the Montana Ambient Air Quality Standards.

Table 1-National and Montana Ambient Air Quality Standards.

Pollutant	*Time Period Average*	*Federal*	*Montana*
Carbon Monoxide (CO)	One hour	35 ppm*	**23 ppm
	8-Hour	9 ppm	9 ppm
Lead (Pb)	Calendar Quarter	1.5 $\mu g/m^3$	--------
	(90-day)	----------	1.5 $\mu g/m^3$
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.053 ppm	0.05 ppm
	Hourly Average	----------	0.03 ppm
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	0.03 ppm	**0.02 ppm
	24-Hour	0.14 ppm	**0.10ppm
	3-Hour	0.50 ppm	----------
	Hourly Average	----------	0.50 ppm
Ozone	8-Hour	0.12ppm	0.10 ppm
	Hourly Average	0.08 ppm	----------
PM_{10}	Annual Arithmetic Mean	50 $\mu g/m^3$	50 $\mu g/m^3$
	24-Hour Average	150 $\mu g/m^3$	150 $\mu g/m^3$
$PM_{2.5}$	Annual Arithmetic Mean	15 $\mu g/m^3$	---------
	24-Hour Average	65 $\mu g/m^3$	---------

* ppm = parts per million

$\mu g/m^3$ = micrograms per cubic meter

** Denotes more stringent standard than federal

As mentioned previously, the main air quality concern associated with the Burn Area Recovery project is the quantity, concentration and duration of PM produced by prescribed burning. In addition to PM prescribed burning produces carbon dioxide, water and carbon monoxide. However, atmospheric dilution of these elements minimizes the impacts on public health at distances away from the immediate area of combustion. Additionally, smoke from prescribed fire must meet the ambient air quality standards for PM-10 and PM-2.5. Smoke from wildfires is not subject to the ambient air quality standards, but public health concerns are addressed in Montana's Natural Events Action Plan.

Prevention of Significant Deterioration

The Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act require 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 therefore established for areas designated as "Class I" areas (42 U.S.C.§7475 (d)(2)(B)). Designation as a Class I area allows only very small increments of new pollution above already existing air pollution levels.

Class I areas are:

(1) international parks,

(2) national wilderness areas greater than 5,000 acres,

(3) national memorial parks greater than 5,000 acres,

(4) national parks greater than 6,000 acres

which existed on August 7, 1977. All other areas of the country are designated as Class II or III.

Mandatory Class I areas in or near the Burn Area Recovery Project are the Selway-Bitterroot Wilderness and the Anaconda-Pintler Wilderness.

A requirement of PSD is that new major stationary sources or major modifications of existing stationary sources must first receive a PSD permit from the appropriate air regulatory agency before construction or modification is implemented. A stationary source is a source of pollution that is well defined, such as the smokestack of a coal-fired power plant or smelter. *The Burn Area Recovery project is not considered a major stationary source and therefore is not subject to the PSD permitting process.*

Visibility Protection

The Clean 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" (42 U.S.C. §7491 et seq.).

Visibility impairment is a basic indicator of air pollution. The EPA has determined that regional variation in visibility needs to be addressed. As a result, the EPA promulgated Regional Haze Regulations for Protection of Visibility in National Parks and Wilderness Areas in 1997. These regulations are intended to improve visibility, or visual air quality, in more than 150 Class I Areas across the country. 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.

The Regional Haze regulations propose " presumptive reasonable progress targets" for improving visibility in each Class I area. The progress targets are described in terms of deciviews, a measure for describing perceived changes in visibility. For example, a deciview of zero represents pristine conditions. For most views in Class I areas the average person considers a change of one deciview perceptible. In this proposal, EPA is requesting that every 3 years, States review progress in each Class I area in relation to the area's relevant progress targets.

Montana will consider emissions from prescribed fire and wildland fire use as they evaluate progress toward the national visibility goal.

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 state must then demonstrate to the public and EPA how that area will meet the ambient air quality 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 as part of this demonstration. The PM-10 non-attainment areas nearest to the project area are Missoula, Butte and the Flathead Indian Reservation.

Conformity

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 as defined in the area plan. Federal agencies are required to ensure their actions conform to applicable State Implementation Plans. *The Burn Area Recovery Project is not subject to the Conformity process since it does not occur within a non-attainment area boundary*.

POLICIES AND PROGRAMS

Interim Air Quality Policy on Wildland and Prescribed Fires

The "Interim Air Quality Policy on Wildland and Prescribed Fires" (EPA 1998) addresses public health and welfare impacts caused by wildland fires managed to meet resource objectives and prescribed fires. This policy complements the Natural Events Policy, which addresses public health impacts, caused by wildland fires. The Interim Air Quality Policy urges states and tribal managers to collaborate with wildland owners and managers to mitigate the air quality impacts that could be caused by the increase of prescribed fires and wildland fires managed to meet resource objectives.

The Interim Policy "urges wildland owners/managers to: (1) notify air quality managers of plans to significantly increase their future use of fire for resource management, (2) consider the air quality impacts of fires and take appropriate steps to mitigate those impacts, (3) consider appropriate alternative treatments, (4) and participate in the development and implementation of State and Tribal Smoke Management Plans". *This Burn Area Recovery Project meets the intent of the Interim Policy through the NEPA analysis process and the practices of the Montana / Idaho Airshed Group.*

Smoke Management Program

Coordinating smoke from prescribed burning in forested areas began in 1978, when Federal, State, and local government agencies formed the Montana State Airshed Group. In 1990, agencies and forest products industry in North Idaho joined the Montana State Airshed Group, and in 1999, South Idaho joined. The Airshed group is now the Montana/Idaho Airshed Group and operates under the guidelines of the Montana/Idaho Smoke Management Plan (SMP). The intent of the SMP "is to minimize or prevent smoke impacts to communities while using fire to accomplish land and resource management objectives". The SMP identifies the responsibilities of Montana and Idaho air regulatory agencies, and federal, tribal, state, and private land managers. The SMP provides accurate and reliable guidance and direction to the individuals doing the burning. This program is designed to meet the state's regulatory needs as well as the Interim Policy mentioned above.

Members of the Montana/Idaho Airshed Group report planned burns to the smoke Monitoring Unit in Missoula. Burns are reported by "airshed" (geographical areas identified by the Airshed Group with similar topography and weather patterns) and "impact zones" (communities identified by the Airshed Group susceptible to smoke intrusions). The smoke Monitoring Unit meteorologist/program coordinator evaluates proposed burns, existing air quality, and forecasted weather conditions including atmospheric stability and transport winds. This information, in consultation with the Montana and Idaho air quality regulators, is used to issue daily burn restrictions for members of the Airshed Group. Burn restrictions are issued primarily from spring through fall. Montana Department of Environmental Quality (DEQ) prohibits prescribed burning in the winter (December – February) except for those few burns deemed "essential".

Area of Analysis

Airshed 4, Ravalli County, Montana, is the primary air quality analysis area for the Burn Area Recovery project. There are no non-attainment areas in Airshed 4. Non-attainment areas in Montana closest to Airshed 4 are Missoula, 50 to 100 miles north; Butte, 100 miles east and the Flathead Indian Reservation 25 miles north. Missoula is both a non-attainment area and an impact zone. The nearest non-attainment area in Idaho is Pinehurst 200 miles northeast. The nearest impact zone is Salmon, 100 miles south. Airshed 4 is adjacent to and connected with Montana Airshed 3A, 3 B, 5, and Idaho Airshed 13.

With the prevailing southwesterly winds, the Salmon River and Selway River areas of Idaho are generally upwind of the analysis area. Downwind areas in Montana are the Rock Creek, Flint Creek, Big Hole, and upper Clark Fork Valleys.

Class I areas within this project's analysis area include the Selway-Bitterroot Wilderness, located on the western portion of the analysis area, and the Anaconda-Pintler Wilderness, located on the southeastern portion of the analysis area. Class I designation provides the most protection to pristine lands, and the greatest challenge to smoke management, by limiting the increment of additional "man-made pollution" that can be added to the area. Class II Wilderness areas within this projects analysis area include The Frank Church River-of-No-Return Wilderness, located on the southwestern edge of the analysis area, and the Welcome Creek Wilderness, located on the northeastern edge of the analysis area.

The analysis area includes Blodgett, Skalkaho-Rye, East Fork, and West Fork geographic areas of Airshed 4. Smoke from the slash piles, underburning, and jackpot burning has been modeled for these four areas. Analysis of the four geographic areas can be expanded to follow normal weather patterns of southwesterly and westerly winds with potential to carry smoke downwind into the Rock Creek watershed of the Lolo NF, and the Big Hole River and upper Clark Fork watersheds of the Beaverhead-Deerlodge NF.

The Blodgett geographic area includes the Tag Alder Creek airshed in Mill Creek for which a Memorandum of Understanding (MOU) is being updated to protect a long term air quality study by coordinating Bitterroot National Forest management activities in the airshed with Dr. Charles David Keeling of Scripps Institute of Oceanography, University of California, San Diego, and the Fire Sciences Laboratory of the Forest Service Rocky Mountain Research Station. Dr. Keeling is studying long-term carbon dioxide (CO_2) forest interactions with global atmospheric processes. Prescribed burns in the Tag Alder airshed in Mill Creek have been planned by personnel from the Stevensville Ranger District of the Bitterroot National Forest and the Forest Service Fire Sciences Laboratory, in cooperation with Dr. Keeling, and the Fire Sciences Laboratory has monitored prescribed fire emissions. Coordination of forest management activities with Dr. Keeling's CO_2 climate study in the airshed of Tag Alder Creek in Mill Creek is outlined in the MOU and in the air mitigation measures in this burn area recovery environmental assessment.

Existing Condition

METEOROLOGY/WEATHER

The Bitterroot Valley is a long, narrow, north-south mountain basin bounded by the Bitterroot Mountains on the west and Sapphire Mountains on the east. Both mountain ranges are barriers to westerly flowing weather movement, and often trap air within the basin. Topography and weather patterns determine the extent to which airborne particulate matter accumulates within the Airshed. Air flows within valleys, upward with diurnal heating and downward with nocturnal cooling, much like water flows within stream channels.

Daily Patterns

Diurnal daytime temperature changes affect how PM and other pollutants are dispersed. The cooling of the earth's surface at night creates downslope winds that carry pollutants from higher terrain to low lying areas. Here pollutants may pool or exit the region along the river drainages. The heating of the earth's surface during the day causes pollutants to rise with the heated air where they are diluted and dispersed with the westerly flow. Temporary inversions can cause smoke to lie along drainages at night and early morning.

Seasonal Patterns

Temperature inversions may occur at any time of the year, but are more common during the winter months of December, January, and February. During this time period, emissions can be trapped in a layer of cold surface air. This happens when snow covers the ground and keeps the earth's surface from heating. It is particularly pronounced in mountain valleys that trap air. Atmospheric conditions of high pressure contribute to stable, slow moving stagnant air masses. Weather changes with frontal systems and low pressure helps move air and break down inversions. However, inversions may persist throughout the day in winter when heating is less than in summer.

Prevailing southwesterly winds above Bitterroot National Forest mountainous terrain usually moves smoke from the southwest toward the northeast in the direction of the Beaverhead-Deerlodge and Lolo National Forests. Locally, topographic features and the heating and cooling of the earth's surface modify winds. Consequently, all major drainages are subject to local variations that can temporarily trap smoke, affecting its dilution and dispersal.

AIR QUALITY

Sources of Particulate Matter

Private debris burning, agricultural burning, and wood burning stoves all contribute smoke in Airshed 4. Many residents burn fencerows and irrigation ditches in the early spring. Farmers in north Idaho burn large grain fields in the fall and smoke is transported into Airshed 4 by a west to southwesterly flow. The Airshed also receives emissions from increasing numbers of cars and trucks. Inversion conditions, which are common during the winter, often trap pollutants in inhabited areas. Road dust, including that from winter road sanding and summer use of unpaved roads, contributes particulate matter emissions. There are no known large stationary point sources of air pollutants in the Bitterroot valley. Vehicles are a mobile and growing source of air emissions

Forest Service wildland fire use and wildfires also contribute smoke and cause short-term deterioration of air quality in Airshed 4. Wildland fires used for resource benefits are permitted to burn within predetermined parameters that consider smoke effects to the airshed and surrounding wilderness. If any of the prescription parameters are exceeded, the appropriate suppression response is initiated. Climate and weather control large and intense wildfires.

On the Bitterroot National Forest, prescribed burning is generally accomplished during spring and early summer when dilution, dispersal, and mixing conditions are generally good to excellent; and late summer and early fall when conditions may be more restrictive. Spring burning often has snow packs to help bound burn areas and wetter conditions that facilitate prescribed burning, as well as frequent optimal atmospheric dispersion conditions. Early fall burning may have high fire danger weather and dryer fuel conditions, which limit prescribed burning. Late fall burning often has weather patterns and cool nights with more frequent atmospheric inversion conditions which limit burning opportunities. Prescribed burning is only done when atmospheric dispersion for smoke is forecast as favorable.

Emissions from Wildfire and Prescribed Fire

Roger Ottmar and others (1996) developed a methodology to assess emissions from wildfire and prescribed fire for 337 watersheds in the Columbia River Basin. Their methodology was used for this project to estimate emissions from some recent wildfires impacting the Bitterroot Valley (see Table 2) in the upper Clark Fork area.

Over 356,000 acres of the Bitterroot National Forest burned during the wildfires of 2000. Assuming a PM-10 emission factor of 369.78 pounds per acre, an estimated 66,000 tons of PM-10 were produced from those fires. Other smoke, which would have impacted the Bitterroot, originated from the Payette (150 miles upwind) and the Nez Perce National Forests. On the Payette National Forest, approximately 339,000 acres burned. Assuming a PM-10 emission factor of 382.33 pounds per acre, approximately 65,000 tons of PM-10 was produced. The 2000 wildfires on the Nez Perce National Forest burned approximately 37,757 acres, and using the 382.33 pounds per acre for central Idaho, approximately 7,200 tons of PM-10 was produced.

During 2000, the Bitterroot National Forest (Bitterroot Valley) also experienced smoke from upwind wildfires in Washington, Oregon, and other parts of Idaho. Additional large acreage burned on the Salmon National Forest in 2000. Much, but not all, of that Salmon smoke would have been carried south of the Bitterroot Valley. Clearwater National Forest 2000 wildfires were relatively small acreages. Most of that Clearwater smoke likely flowed north of the Bitterroot National Forest (Bitterroot Valley).

Relatively high smoke concentrations occurred within the Bitterroot National Forest (Bitterroot Valley) during the 1994 and 1995 wildfire seasons. In 1994 wildfires northeast of McCall, Idaho (Payette National Forest), burned approximately 339,000 acres; in 1995 wildfires southwest of Hamilton on the upper Selway River (Bitterroot National Forest) burned approximately 39,000 acres.

Table 2-National Forest Wildfires of 1994 and 2000.

Year	Forest	Wildfire Acres	Average fuel loading (tons per acre)	PM-10 Emissions (pounds per acre)	Total PM-10 (tons)
2000	Bitterroot	356,000	19.09	369.78	66,000
2000	Payette	339,000	19.11	382.33	65,000
2000	Nez Perce	37,757	19.11	382.33	7,200
1994	Payette	339,000	19.11	382.33	65,000

Brown and Bradshaw (1994) used the significant wildfire year of 1988 to estimate emissions generated from the Selway Bitterroot Wilderness. Using their methodology and emission factors, they estimated approximately 14,000 tons of PM-10 to be produced from 53,100 acres (Table 3). These Selway Bitterroot emissions would have affected the Bitterroot Valley in that year (1988).

Table 3-Selway-Bitterroot Wildfire Emissions Estimated by Brown and Bradshaw (1994).

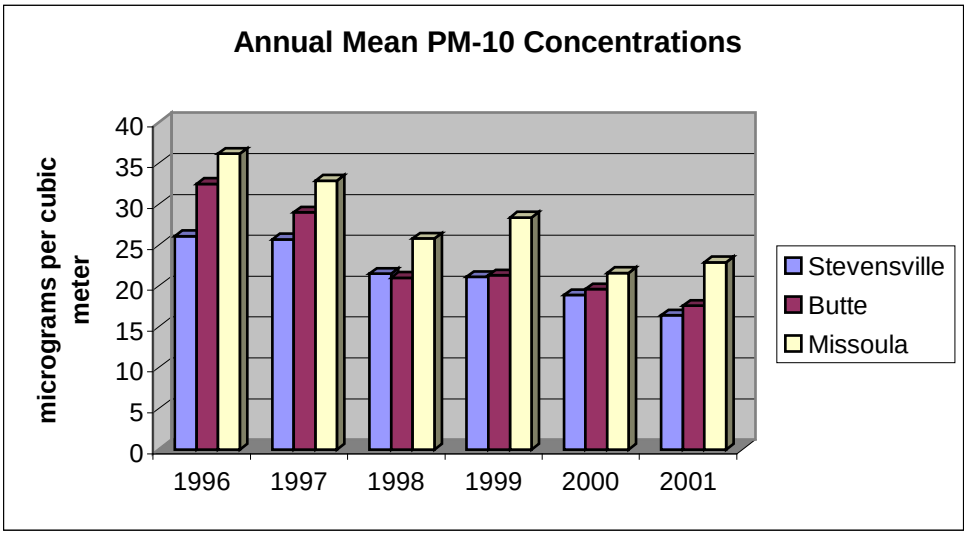
Year	Forest	Wildfire Acres	Total PM-10 (tons)
1988	Selway Bitterroot Wilderness	53,100	14,000*

**Note: Brown and Bradshaw (1994) developed their own formulas and emission factors to arrive at the total PM-10 emissions. Ottmar and others (1996) developed a different methodology to assess emissions from wildfire and prescribed fire within the Columbia River Basin.*

Existing Air Quality Concentrations

Air quality in the Airshed 4, Bitterroot Valley, Ravalli County, is considered good to excellent during most of the year. Monitoring data from the EPA AIRData indicates PM-10 annual averages have been decreasing over the last five years. In Stevensville, annual concentrations are generally around 20 micrograms per cubic meter (the standard for an annual average is 50 micrograms per cubic meter). The 2000 wildfire smoke is considered a natural event and is not included in the annual average for 2000. (Figure 1) (EPA AIRSData – Monitor Summary Report. July 5, 2001).

Figure 1-Annual mean PM-10 concentrations for 3 sites in the Bitterroot Valley.



High particulate concentrations measured in 2000 due to wildfire smoke are not reflected in the data. Accounting for those concentrations is part of the Natural Events Policy.

Daily (24-hour averages) rather than annual averages of PM-10 monitoring at Stevensville and West Fork Ranger Stations range from lows near 10 micrograms per cubic meter in very clean air during rainy weather to 30 - 60 micrograms per cubic meter during winter inversions. Emissions from woodstoves, automobiles and road sanding contribute to winter concentrations. From spring through fall, concentrations can be between 10 - 60 micrograms per cubic meter. Smoke from wildfire and prescribed fire both inside and outside can contribute to those concentrations.

Smoke Contributions to Existing Air Quality

Particulate matter has been monitored in Ravalli County by Montana DEQ in Hamilton, and the Forest Service at Stevensville and West Fork Ranger Stations since 1994. Bitterroot wildfires in 2000 were much larger than the usual wildfires experienced annually on the Bitterroot National Forest and surrounding Forests. Between the Payette, Nez Perce and Bitterroot National Forests approximately 733,000 acres burned that summer. Particulate matter monitoring at Stevensville and Hamilton reached hundreds of micrograms per cubic meter (24-hour average) during August 2000. The levels of PM-10 and PM-2.5 were greater than in any previous year's monitoring (Hammer 2000 Smoke from wildfires is usually considered a "natural event" by the EPA, and as such is not subject to the NAAQS. However, for comparison, PM-10 concentrations were greater than the NAAQS for six days (Montana DEQ) at Stevensville. PM-2.5 concentrations were greater than the Standard for seven days (Missoula Technology and Development (MTDC), U.S. Forest Service, Air Quality Sampling Data) at Hamilton.

The 1994 wildfires northeast of McCall, Idaho (Payette National Forest), burned approximately 339,000 acres. This smoke moved southwest for 150 miles into the Bitterroot Valley contributing to PM-10 concentrations up to 80 micrograms per cubic meter (24-hour average) at Stevensville (Hammer, 1995). The 1995 wildfires southwest of Hamilton on the upper Selway River (Bitterroot National Forest) burned approximately 39,000 acres. PM-10 concentrations of 81 micrograms per cubic meter (24- hour average) were measured at the West Fork Ranger Station, 54 micrograms at the Stevensville Ranger Station, and 69 micrograms at Hamilton (Hammer, 1996). Spring 1998 prescribed burning in Big Creek, located six miles upwind of Stevensville, resulted in a maximum PM-10 of 78 micrograms per cubic meter per 24 hours (Hammer 1998).

Table 4 displays PM-10 measured concentrations that coincided with wildfire events and estimated emissions previously displayed in Table 2. The 1998 Big Creek prescribed burn is also displayed in the table to compare

estimated emissions and measured concentrations. Emissions were estimated using Ottmar and others prescribed burn emission factor of 131 pounds per acre burned.

Depending on weather and topography, total particulate emissions from a fire may be dispersed over a broad area over time. Smoke concentrations reflect monitoring a specific geographic point during a period of time, such as the maximum 24-hour concentrations shown in the table below.

Table 4-Estimates of some emissions from 1994-2000.

Year	Forest	Wildfire Acres	PM-10 Emissions (pounds per acre)	Total PM-10 (tons)	Maximum 24-Hour Average PM-10 Concentration $\mu g/m^3$ at Stevensville (unless noted otherwise)
2000	Bitterroot	356,000	369.78	66,000	
2000	Payette	339,000	382.33	65,000	
2000	Nez Perce	37,757	382.33	7,200	
2000	**TOTAL**	732,757		138,200	200+
1998	Bitterroot (Big Creek Prescribed Burn)	1,782	369.78	117	78
1995	Bitterroot	39,000	369.78	7,200	81 (West Fork) 54 (Stevensville) 69 (Hamilton)
1994	Payette	339,000	382.33	65,000	80

$\mu g/m^3$ = micrograms per cubic meter, 24-hour average

VISIBILITY

PM-10 and PM-2.5 concentrations less than NAAQS for human health may diminish visibility. Experience with particulate monitoring at Stevensville, Hamilton, West Fork, and Sula Peak monitoring sites indicates the public is increasingly concerned when PM-10 concentrations are greater than 30 micrograms per cubic meter per 24-hour average. The scenic view of the Bitterroot Mountains disappears when concentrations are greater than 80 micrograms.

9/5/1994
12:00:00 PM
~5 ug/m3

9/8/1994
12:00:00 PM
~90-100 ug/m3

In 1988, the U.S. Forest Service became a primary participant in the national visibility-monitoring program titled Interagency Monitoring of Protected Visual Environments (IMPROVE). The objectives of the Program are to:

- Establish current visibility and aerosol conditions in mandatory Class I areas,
- Identify chemical species and emission sources responsible for existing human-made visibility impairment,
- Document long-term trends for assessing progress towards the national visibility goals,
- With the enactment of the Regional Haze Rule, to provide regional haze monitoring representing all visibility-protected federal Class I areas where practical.

Land managers, industry planners, and air quality regulators use data collected at these sites to understand and protect the visual air quality resource in Class I areas. An IMPROVE monitor is located at Sula Peak Lookout. Data from this site indicates visibility can be as great as 340 km (211 miles) and as limited as 20 km (12 miles). Atmospheric weather conditions such as clouds, fog, humidity, and emissions from forest wildfires, agricultural burning, other agricultural practices, and rural and urban development/expansion cause the main impacts to visibility. Visibility at Sula Peak Lookout is characterized by seasonal patterns of regional and local haze mostly influenced by weather conditions, smoke, and dust.

Visual range 186-210 miles, Sula Peak
Looking easterly, Bitterroot National Forest

Visual range 18-24 miles, Sula Peak
looking easterly, Bitterroot National Forest

Analysis Methods

Air quality is temporarily affected by several activities associated with forest management. Prescribed burning produces smoke. Harvesting activities can produce dust as well as vehicle emissions. Dust and vehicle emissions can temporarily reduce air quality in the immediate vicinity of machinery operations. All alternatives involving commercial removal would require the application of dust abatement to roads. Impacts from dust and vehicle emissions would be short-term and temporary in nature. The focus of this portion of the analysis is on prescribed burning smoke from Alternatives B, D, E, F, and G. Alternative A (no action), and Alternative C would produce no smoke from prescribed burns.

The First Order Fire Effects Model (FOFEM), version 4.0, rather than Ottmar and others' regionalized fuels methodology, was used to estimate smoke emissions from prescribed burning because site-specific fuel treatment data is available. Fuel loadings for the proposed alternatives are higher than the average fuel loadings for the Bitterroot National Forest using the upper Clark Fork region emission factors and fuel loadings in Ottmar and others. The NFSPUFF model, version 1.21, was used to estimate downwind smoke dispersions and concentrations.

Three vegetation response units (VRUs), represented in the FOFEM model by ponderosa pine, Douglas-fir, and lodgepole pine; four geographic analysis areas, Blodgett, Skalkaho-Rye, East Fork, and West Fork; and two prescribed burn treatments, piles and underburn/jackpot burn, were modeled with FOFEM for Alternatives, B, D, E; F, and G. Average fuel loading for each VRU, each analysis area, and each of two fuels treatment, piles/underburn and jackpot burn were cumulated for each alternative to run FOFEM.

The Project File contains unit-by-unit tabulations of alternatives, detailed FOFEM outputs showing fuel consumption and smoke emissions, and a printout of each NFSPUFF smoke dispersion plume for each Geographic Area.

Because Alternative D (pile burning) has the most smoke emission potential, it was chosen for NFSPUFF dispersion modeling for each of the four geographic areas. The burn locations were selected with the assistance of the Sula Ranger District Fire Management Officer and the Bitterroot National Forest Fuels Management Specialist.

The NFSPUFF runs were made assuming slash piles would be burned in fall 2002, with underburning/jackpot burning in spring 2003. Average transport or steering winds in the analysis area were assumed to be southwest, 225 degrees, at 15 miles per hour. We also assumed other conditions representing good smoke dispersion, e.g. unstable atmospheric conditions and favorable plume rise. All prescribed burning is to be done in atmospheric conditions of good air quality, good plume rise, and dispersion as forecast by the Smoke Monitoring Unit. The NFSPUFF model runs were not made for stable atmospheric conditions of low transport winds and poor mixing (e.g., inversion conditions). Since good air quality and atmospheric conditions must coincide with certain vegetation and fuel conditions, it is not likely that all burn units would be accomplished in one season or year, as modeled. Thus, smoke emission and dispersion modeling for fall 2002, and spring 2003, show more smoke at one time than would likely occur with practicable burning over several seasons.

Smoke Sensitive Areas

"Smoke sensitive" areas were identified for each area. In the Blodgett geographic area, Highway 93 is four miles downwind and the community of Corvallis six miles downwind. For the Skalkaho-Rye area, there is no nearby downwind population center. The closest are sparsely populated ranches and summer homes in Rock Creek 30 miles away, then the Philipsburg and Deer Lodge communities 50 to 100 miles away. For the East Fork area, smoke sensitive areas would be the homes in the upper East Fork subdivision called Springer Memorial, 15 miles downwind. For the West Fork area, the downwind smoke sensitive areas would be the small community of Darby, 25 miles away.

Environmental Consequences

Effects Common to All Alternatives

WILDLAND FIRE

Smoke from wildland fires would occur with all alternatives, and would vary by climate and wildland fire components (i.e.: fuel loading and conditions, fire behavior, wind, drought, etc.). Wildland fires locally, or anywhere in the northwest and Canada, can affect regional haze in the Bitterroot Valley. Frequently, wildland fires 150 miles upwind on the Payette Forest are carried by southwesterly winds into the Bitterroot affecting visibility, but not exceeding PM-10. Natural phenomena like volcanic eruptions and windstorms over deserts also produce particulate matter. Dust from as far away as China in 1998 and 2001 impacted the Bitterroot Valley, as well as the 1980 eruption of Mount Saint Helens. Metropolitan areas upwind like Seattle and Portland can affect particulate matter. Smoke and dust from agricultural areas like the Palouse Prairie wheat growing area of eastern Washington and Idaho also affect particulate matter in the Bitterroot Valley. Wind on wheat fields of southern Alberta and Saskatchewan, Canada, as well as eastern Montana, has affected particulate matter in the Bitterroot Valley.

Wildland fires will continue to produce smoke, primarily during the summer months. The draft paper, "Coarse Woody Debris and Succession in the Recovering Forest" (Brown and Reinhardt, 2001) states that the risk of severe fire is relatively low within 10 years, moderate from 10 to 30 years, and high over 30 to 60 years after the fires of 2000. All alternatives have wildland fire smoke potential.

Smoke Exposure and Hospital Admissions

The Centers for Disease Control and Prevention (CDC) conducted an investigation to determine if increases in respiratory and cardiovascular hospital admissions occurred in four Montana counties during summer 2000 forest fires. The study was released in May 2001. Its goal was to quantify and compare the changes in hospital admissions rates from 1999 (when forest fires were not a problem) to 2000 (when they were). The counties included Ravalli, with the highest exposure, Missoula, and Lewis and Clark, both with moderate exposures, and Yellowstone with low exposure. Hourly PM-10 levels were used to characterize exposures. Hospital admission records were used to represent respiratory and cardiovascular admissions. The study excluded transfers, elective procedures, and admissions of non-residents. Monthly and 3-month hospitalization rates were calculated for each year by dividing admissions by the 1999 census population for each county. Respiratory disease (chronic obstructive pulmonary disease and pneumonia) and circulatory disease admissions were evaluated.

Particulate levels were higher during the 12-week period in 2000 than in 1999, with mean PM-10 levels of 47 ug/m3 for Ravalli County, 34.2 ug/m3 for Missoula County, and 32.6 ug/m3 for Lewis and Clark County. Hospital admission rates for the period (July, August, September) increased in 2000 for respiratory and circulatory problems, and the admissions rates were higher in the high-exposure area. However, when the data were analyzed month by month, a temporal exposure-response relationship between particulate levels and rates of hospital admission for respiratory and circulatory problems occurred in July – before the high smoke exposures of August. Missoula County had fewer admissions for circulatory causes in August, while Yellowstone County, the low exposure area, showed an increase. Additional research and analysis is need to link hospital admissions to smoke exposure (MTDC, 2001).

Effects Common To All Action Alternatives

PRESCRIBED FIRE

Daily particulate matter standards should be met by following the Montana/Idaho Smoke Management Plan. That is, NAAQS for PM-10 and PM-2.5 would be met with all action alternatives. Smoke from prescribed burning would cause short-term impacts on recreation and transportation in and near the project areas. The size and location of a prescribed burn and weather conditions (e.g., temperature, wind, atmospheric stability and mixing, and fuel moisture) determine how much and in what direction smoke travels. Residents in or near the mouths of drainages might experience short-term periods of smoke during early morning inversions.

The heavy fuel loadings, 25 to 42 tons per acre, and the resulting emissions in all action alternatives are more than the regional averages for upper Clark Fork and central Idaho described by Ottmar and others (1996) or Brown and

Bradshaw in their work. The average fuel loadings in Ottmar and others for the upper Clark Fork are 19.09 tons per acre, which is far less than the action alternatives' average fuel loadings. All prescribed fire action alternatives have estimated emissions that are near or exceed Ottmar's emissions for *wildfire* by nearly two to six times. Other work by Ottmar and Hessburg (1996) indicated *wildfires produce two – four times as much particulates as prescribed fire because wildfires generally burn during drought periods, consume more total fuel, and consume fuels during the less efficient smoldering stage.*

Effects Common to No Action Alternatives

Table 5 displays the emissions potentially produced from each proposed alternative. Alternative A (no action) and Alternative C (watershed improvement) produce no smoke from prescribed burns. Smoke from wildland fires would

Table 5– Tons of Particulate Matter by Burn Type.

Location	Alternative	Fall 2002 - Piles		Spring 2003 - Underburn/Jackpot		All Burning
		Acres	Tons PM-10 Produced	Acres	Tons PM-10 Produced	Tons PM-10 Produced
Blodgett	A	0	0	0	0	0
	B	411	114.4	0	0	114.4
	C	0	0	0	0	0
	D	411	114.4*	0	0	114.4
	E	377	108.3	238	28.5	136.8
	F	397	110.5	0	0	110.5
	G	608	238.9	608	140	
Skalkaho-Rye	A	0	0	0	0	0
	B	6191	1615.9	3253	601.0	2216.9
	C	0	0	0	0	0
	D	5637	1458.1*	3544	553.3	2011.4
	E	3378	768.2	1660	253.1	1021.3
	F	5969	1347.9	2754	455.6	1803.5
	G	3810	1167.3	3476	647.6	
East Fork	A	0	0	0	0	0
	B	9495	2098.7	3088	494.9	2593.6
	C	0	0	0	0	0
	D	14464	2347.5*	4107	687.5	3035
	E	5539	1237.6	1424	201.4	1439
	F	9763	2226.7	2784	458.7	2685.4
	G	5259	1459.9	4604	783.2	
West Fork	A	0	0	0	0	0
	B	826	236.7	557	82.2	82.2
	C	0	0	0	0	0
	D	97	30.2*	557	82.2	112.4
	E	0	0	0	0	0
	F	97	30.2	557	82.2	112.4
	G	8	3.1	8	1.8	
Total Airshed	A	0	0	0	0	0
	B	16923	3829.0	6898	1178.1	5007.1
	C	0	0	0	0	0
	D	20609	3950.2*	8208	1323.0	5273.2
	E	9294	2114.1	3322	483.0	2597.1
	F	16226	3715.3	6095	996.5	4711.8
	G	9685	2869.7	8776	1572.6	4442.3

*Trigger for NFSPuff Modeling

occur with all alternatives, and would vary by climate and wildland fire components (i.e.: fuel loading and conditions, fire behavior, wind, drought, etc.). Wildland fires will continue to produce smoke, primarily during the summer months. Forest Plan standards for meeting EPA and State air quality standards for PM-10 and PM-2.5 will be met with all alternatives, including A and C.

Smoke emissions modeled with FOFEM can be tabulated in PM-2.5 and PM-10. PM-2.5 is about 85 percent of PM-10.

Direct and Indirect Effects

Emissions

Prescribed burning is proposed in Alternatives B, D, E, F, and G. Excess slash produced by treatment activities would be piled and burned, underburned and/or jackpot burned (accumulations burned in place). Smoke emissions vary with combustion efficiency and quantity of fuel burned. Machine piles and hand piles tend to produce more smoke than other burns because much of the consumption occurs during the inefficient smoldering phase of combustion. Underburns tend to produce less smoke than jackpot burns because less fuel is available to burn. The alternatives differ in the number of acres treated by each treatment method and thus in the quantity of smoke that would be produced by prescribed burning. For the action alternatives that use prescribed burning, estimated PM-10 emissions are much less than those estimated during the 2000 Bitterroot wildfires (66,000 tons). Downwind visibility may be temporarily affected.

Concentrations

NFSPUFF was used to model smoke dispersion and concentrations for Alternative D since it was likely to produce the most emissions. Predicted ground level concentrations were less than 1 microgram per cubic meter (24 hour average) in all but a few locations. The Skalkaho-Rye and East Fork project areas produce the most smoke of the four geographic areas but even in locations of greatest smoke, concentrations are still less than 15 micrograms per cubic meter per 24 hours. Moreover, smoke plumes generated in the Skalkaho-Rye and East Fork geographic areas are likely to move downwind without impacting population concentrations. Such low PM-10 concentrations imply visibility and human health would be minimally impacted.

Cumulative Effects

The cumulative effects area is Airshed 4. The FOFEM and NFSPUFF modeling assumed that all piles would be burned in fall 2002, and all of the underburns/jackpot burns would be completed in the spring, 2003. This is unlikely to happen given the constraints of weather and air quality conditions that dictate when burning can occur. Because of these constraints, the prescribed burning is likely to be spread out over several years, making less cumulative smoke at any one time and location than that modeled.

Private burning of ditches and debris is common. Ravalli County's open burning regulations limit the types of material that may be burned and the period of burning (March 1 through November 30). Burners are also requested to call the Ventilation Hotline during the fall months to be advised of airshed burning restrictions. Although the Bitterroot National Forest (BRF) conducts prescribed burning only during periods of good or better smoke dispersion there may still be some cumulative smoke impacts from concurrent private and forestry burning. The best method to reduce cumulative impacts caused by smoke is the operations of the Montana/Idaho Airshed Group. The Forest is a member of the Montana/Idaho State Airshed Group.

Consistency with Bitterroot Forest Plan and Other Regulatory Direction

All prescribed burning would be implemented in full compliance with Montana and Idaho DEQ air programs through cooperation with the Montana/Idaho Airshed Group.

The Bitterroot National Forest Plan includes air quality goals, standards, and management direction, which is to "maintain existing air quality". The Forest is to cooperate with the Montana air quality regulators through the State Implementation Plan. Further, the Forest participates in the Montana/Idaho Airshed Group's smoke management program to meet National and State air quality standards for PM-10 and PM-2.5. This project meets all these criteria to protect air quality.

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