Air Quality Specialist Report

Randall Hall
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AFFECTED ENVIRONMENT

This section includes a summary of applicable air quality rules and regulations, a description of current air quality of the surrounding area, and an assessment of potential emissions from prescribed burns and wildfires.

Air Quality Regulations

Federal Clean Air Act

Congress passed the Clean Air Act (CAA) in 1955, with later amendments to the Act in 1967, 1970, 1977, and 1990. The CAA is a legal mandate designated to protect public health and welfare from pollution. States develop specific programs for implementing the goals for the CAA through their State Implementation Plan Plans (SIPs). The United States Environmental Protection Agency (EPA) adopted National Ambient Air Quality Standards (NAAQS) under the authority of the CAA. These standards include acceptable levels pollutants called criteria pollutants. The NAAQS are designed to protect human health and public welfare (USDI and USDA Forest Service 2001, p 61-63). Table 1 lists the six NAAQS, including those adopted by Colorado (CAQCC 1993, p. 2; CDPHE 2002. p.20).

Table-1National and Colorado Ambient Air Quality Standards.

Pollutant	*Time Period Average*	*Federal*	*Colorado*
Carbon Monoxide (CO)	One hour 8-Hour	40 mg/m^3 10 mg/m^3	40 mg/m^3 10 mg/m^3
Lead (Pb)	Calendar Quarter (90-day)	1.5 µg/m^3 ----------	1.5 µg/m^3
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean Hourly Average	100µg/m^3 ----------	100µg/m^3
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean 24-Hour 3-Hour Hourly Average	80µg/m^3 365µg/m^3 1300µg/m^3 ----------	80µg/m^3 365µg/m^3 *700µg/m^3 ----------
Ozone (O_3)	8-Hour Hourly Average	157µg/m^3 235µg/m^3	 235µg/m^3
PM_{10}	Annual Arithmetic Mean 24-Hour Average	50 µg/m^3 150 µg/m^3	50 µg/m^3 150 µg/m^3
$PM_{2.5}$	Annual Arithmetic Mean 24-Hour Average	15 µg/m^3 65 µg/m^3	--------- ---------

ppm = parts per million
µg/m^3 = micrograms per cubic meter
mg/m^3= milligrams per cubic meter

* The actual concentration of sulfur dioxide at any given receptor site (no greater than five meters above ground) in the State of Colorado shall not exceed a three-hour maximum of 700 micrograms per cubic meter (ug/m3) more than once in twelve-month period. (Colorado Ambient Air Standards, Colorado Air Pollution Control Commission).

The CAA also required the initiation of the Prevention of Significant Deterioration (PSD) program to protect air quality in certain National Parks and Wilderness Areas and insure economic growth consistent with the preservation of the existing air resources. Three air quality classes (I, II, III) define allowable levels of air quality deterioration. Certain National Parks and Wilderness areas are identified mandatory "Class I Federal Areas," imposing the most stringent restrictions and include protection of visibility (USDI and USDA Forest Service 2001, p 67).

Interim Air Quality Policy on Wildland and Prescribed Fires

The EPA's *Interim Air Quality Policy on Wildland and Prescribed Fires* (EPA 1998) addresses public health and welfare impacts caused by wildland and prescribed fires that are managed to achieve "resource benefits" (e.g., hazard reduction, wildlife habitat improvement). The primary indication of adverse impacts on human health would be an ambient concentration that is greater than the NAAQS for particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$) and particulate matter less than 10 microns in aerodynamic diameter (PM_{10}). Visibility impairment is used as the primary indicator of an adverse public welfare impact.

This interim policy (EPA 1998) integrates two public policy goals: 1) to allow fire to function, as nearly as possible, in its natural role of maintaining healthy wildland ecosystems, and 2) to protect public health and welfare by mitigating the impacts of air pollutant emissions on air quality and visibility. The policy encourages thoughtful use of fire by private, public, and tribal wildland owners/managers under smoke management plans to maintain healthy wildland ecosystems (EPA 1998).

Visibility Regulations/Regional Haze Rule

The EPA has issued regional haze regulations to protect Class I areas. These regional haze regulations address a variety of pollution sources that cause visibility impairment across broad geographic areas (EPA 1999).

The cause of visibility impairment in Colorado, as with other states, is most often fine particles in the 0.1 to 2.5 micrometer size range. Sunlight entering a pollution cloud may be scattered, adding brightness to the view and making it difficult to see elements of the vista. Visibility conditions vary across the state, and though visibility problems occur periodically, visibility in Colorado is among the best in the country (CDPHE 2000, p.63).

Denver's "Brown Cloud" persists and there is concern about potential of worsening visibility. Monitoring performed in and near national parks, monuments, and wilderness areas shows pollution-related visibility impairment occurring in the these areas in Colorado. The type of impairment most often impacting Colorado's important scenic mountain views is known as regional haze. It is characterized by having interstate or even regional scale transport between source areas and areas of impact.

There is no quantitative visibility standard for Colorado's pristine and scenic rural areas. However, in the 1977 amendments to the CAA, Congress added Section 169a and established a

national visibility goal that created a quantitative standard of "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." The implementation of Section 169a has led to federal requirements to protect visual air quality in large national parks and wilderness areas (CDPHE 2000, p. 64). The Colorado Air Quality Control Commission's Regional Haze SIP Development Process (Revised 2/25/2002) describes potential options for future haze planning and a timeline of rules set forth by the EPA.

State Regulations

The state of Colorado regulates air quality through a citizen board called the Colorado Air Quality Control Commission (CAQCC), created by the Colorado Air Quality Control Act. The nine commissioners are advised by the Department of Health. The role of the Commission is to 1) adopt an air quality program for the state, 2) assure the state's program meets the requirements of the Federal Clean Air Act, and 3) issue or deny permits and enforce orders.

The CAQCC adopted Regulation 9 on January 17, 2002, to more clearly define Colorado's smoke management program. Regulation 9 applies to all open burning throughout the State and provides specific compliance standards, direction, application procedures and permitting process for anyone conducting open burning in the State. The CAQCC will evaluate prescribed fires proposed during the application and permitting process to determine whether the fire will pose high smoke risk, and if so will provide appropriate notice to the public. Under Regulation 9, large prescribed fires that receive the highest smoke risk rating are also subject to a 30-day public notice and comment period for public review. This program makes it possible for the State to predict the amount of smoke produced in each air shed and to control the amount of prescribed burning conducted. When there is a concern that air quality problems will develop, burning operations that would cause impacts can be shut down.

U.S. Forest Service Air Resource Management Policy

USDA Forest Service units administer lands under nationally and regionally developed policies and procedures that are relevant to the statutory directive identified in CAQCC Regulation No. 9, "to minimize emissions using all available and practicable methods that are technologically feasible and economically reasonable in order to minimize the impact or reduce the potential for such impact on both the attainment and maintenance of National Ambient Air Quality Standards and the achievement of federal and state visibility goals" (USDA Forest Service 2002).

The role of the Forest Service in air quality management is coordination of National Forest activities with the State and Federal air quality control efforts. This is accomplished by managing the air pollution created by the Forest Service activities. The Forest Service shall comply with burning application permit requirements of the Air Pollution Control Division (LRMP 1985).

The Forest Service is also a signatory to the joint Memorandum of Understanding (MOU) established by the Colorado Department of Public Health and Environment. The Forest Service

is committed to conducting prescribed fire operations consistent with the CAA, the Colorado Smoke Management MOU, CAQCC Regulation No. 9, applicable Forest Service Manuals and Handbooks, and project level Prescribed Fire Burn Plans and Permits. All projects will be planned and conducted to balance the needs of the ecosystem and the general public with the utmost concern for public health and welfare (USDA Forest Service 2002).

Existing Condition

Meteorology/Weather

The climate of the area is profoundly affected by differences in elevation, and to a lesser degree by orientation of mountain ranges and valleys with respect to air movement. Wide variations occur within short distances. The difference in annual mean temperature between Pikes Peak and Las Animas, 90 miles to the southeast, is about the same as that between southern Florida and Iceland. Locals refer to Woodland Park as "the city above the clouds." Air movement is generally brisk at these high elevations. Temperature inversions may occur at any time of the year but are more common during the winter months. 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.

Based on the Manitou Experimental Weather Station Site located within the project area, average precipitation for this area is 15.91 inches per year with the highest precipitation occurring during June and July. One of the more critical elements relating to smoke emissions is the wind. Winds are variable but are generally from the south and west most of the year. Because the area is mountainous, topographic features and the heating and cooling of the earth's surface tend to modify winds. Topography and weather patterns determine the extent to which airborne particulate matter accumulates within the project area. Air flows upward within valleys, with the heating of the earth's surface. At night, the cool denser air near the surface of slopes flows downward, much like water following a natural drainage (USDA 1970, pg 115).

Ventilation Climate Information System (VCIS) (an experimental program) was also used as an indicator to help determine climate information for the project area. VCIS is based on a 30-year database (1961-1990) that includes twice-daily values of wind, mixing height, and ventilation index (the product of wind speed and mixing height). The surface wind speed times the mixing height give an estimate of ventilation potential. Indications are that good ventilation occurs within the project area most of the year during the afternoon hours and is more varied during the morning hours (Ferguson 1999). This is most likely attributable to the high elevation of the project area.

Air Quality/Pollution

The EPA's Pollutant Standard Index (PSI) generally rates air quality in the vicinity of the project area as "good." The PSI is a system for measuring and rating pollution levels for five of the six "criteria" pollutants regulated under the CAA. Criteria pollutants included in the PSI are total suspended particulate matter, sulfur dioxide, carbon monoxide, oxides of nitrogen, and volatile organic compounds; lead is the single criteria pollutant not included in the PSI. The PSI is based on a sliding scale ranging from 0 to 500, corresponding from "good to unhealthful." The EPA determines the index value on a daily basis for each of the measured pollutants. Table 2 displays the index values than have been recorded for Teller and Douglas counties.

EPA 2002 AIRData http://www.epa.gov/air/data/geosel.html

Table-2 Pollutions Standard Index (PSI)

AIRData- Monitor PSI Report 5/22/2002				
		%Days	**%Days**	**%Days**
County	**Year**	**Good**	**Moderate**	**Unhealthful**
Teller	1996	77	21	2
	1997	68	32	0
	1998	70	30	0
	1999	90	10	0
	2000	91	9	0
	2001	98	2	0
	Average	82%	17%	1%
Douglas				
	1996	53	47	2
	1997	56	44	0
	1998	53	47	0
	1999	56	44	0
	2000	58	42	0
	2001	55	45	0
	Average	55%	44%	1%

Particulate Matter and Public Health

Particulate matter is the term used for tiny particles of solid or semi-solid material suspended in the air. Particles can range in size from less than 0.1 microns to 50 microns. Particles larger than 50 microns tend to settle out of the air quickly and are less likely to affect public health. Particles 10 microns and smaller are considered inhalable and have the greatest health effect. Coarse particles, from 2.5 to 10 microns in diameter, come from sources such as windblown dust and dust kicked up on unpaved roads by vehicle traffic. Fine particles, smaller than 2.5 microns in diameter, are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere when gases emitted by combustion activities are transformed by chemical reactions in the air (CDPHE 2000, p. 35).

Inhalation of smoke from whatever source can cause acute or chronic damage to health. The acute or immediate symptoms are caused by exposure to high concentrations over short periods (Smoke Management Guide 1985).

The health risk from an inhaled dose of particulate matter depends on the size and concentration of the particulate. Size determines how deeply the inhaled particulate will penetrate into the respiratory tract where it can persist and cause respiratory damage (CDPHE 2000, p. 36). Particulate matter can reduce lung function, aggravate respiratory conditions and may increase the long-term risk of cancer or development of respiratory problems (CAQCC 2000, App. p. 4).

There is not much data which specifically examines the effects of wildland fire smoke on public health, although some studies are planned and underway (USDI and USDA Forest Service 2001, p 29)

Doctor Sharkey states that smoke from wildland fires contributes to short-term and intermediate health effects. The effects have been shown to be reversible in most cases. Long-term exposure has the potential to cause or exacerbate heath problems such as coronary artery disease, chronic obstructive pulmonary disease, and cancer. Individuals with asthma, allergies, or the capacity to develop reactive airways are more likely to be susceptible to the effects of smoke (Health hazards of smoke 1997, pg 46).

Sources of Particulate Matter

Mobile

In 1995, the Colorado General Assembly established the Northern Front Range Air Quality Study to identify sources of air pollution along Colorado's Front Range (USDA 2000). This research found that during winter episodes of high haze in the Denver area, the primary contributors of directly emitted particulate matter smaller than 2.5 microns ($PM_{2.5}$) are mobile sources. Exhaust from cars, trucks, construction equipment, and locomotives and dust from roads and construction contributed 75 percent of the directly emitted $PM_{2.5}$. The study also found that summer pollution episodes in Denver generally result in a lower concentration of fine particulate matter than during the winter episodes and that, during the summer months, dust constitutes a greater proportion of the airborne particulate matter (USDA 2000).

Stationary

Such sources of particulate matter in the region include power plants, ready- mix concrete plants, electronics manufacturing facilities, mining activities, quarries, and extensive military operations. Other sources include motor vehicle emissions, wood burning, street sanding operations and particulate emissions from unpaved roads, and construction activities (CAQCC 2000, p. 28). The closest known stationary sources are two gold mines near Cripple Creek, located approximately 20 miles south of the project area (EPA 2002).

Dust

Highways 24 and 67 and County Roads 3, 5, 22, 25, 51, 68, 78, 79, and 511 access the project area. Some county roads and many forest system roads that access the area are unpaved. The CAAQC *Report to the Public 1999-2000* states that approximately 75% of PM_{10}, defined in Table 1, is attributed to street sand, soil, and road dust in typical mountain communities (CAQCC 2000, pg 2).

Particulate emissions occur when vehicles travel on unpaved roads. The force of the wheels on an unpaved road surface causes pulverization of the surface material. Dust is lifted and dropped from the rolling wheels and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The amount of particulate matter emitted from a given road varies proportionally with the amount, weight, and speed of traffic. Silt content of the road surface and weather conditions also affect the amount of dust generated.

Controls to reduce particulate emissions from unpaved roads include reducing the amount of traffic and treating and improving the road surface. Surface treatments include application of water or chemical stabilizers to the road surface. Watering increases the road surface moisture content and conglomerates the silt particles. Application of chemical stabilizers suppresses emissions by changing the physical properties of the road surface. Chemical dust suppressants form a hardened surface by binding surface particles together. Paving is a highly effective control, but can be costly. Other surface improvements that can reduce emissions include covering the road with a new material of lower silt content and regular maintenance to help retain larger aggregate sizes on the traveled portion of the road.

Wildfire

Smoke from wildfire could potentially produce the greatest amount of emissions from the project area. Smoke from wildfires can contain high concentrations of fine particulates. Concentrations of 5,000 micrograms per cubic meter for PM_{10} have been measured on some wild land fires (USDA 2000).

Large wildfires have been common in recent years near the project area - the Buffalo Creek Fire in 1996, the Hi Meadow Fire in 2001, and the Hayman Fire in June 2002. These hot, fast moving fires ranged in size from 10,000 to over 137,000 acres. Because of the current forest

conditions, large crown fires are likely to occur elsewhere in the project area. Smoke from these wildfires contributes high amounts of emissions to the local air shed for a period of a few days to several weeks. Smoke from fires such as the Hayman fire and the Cerro Grande near Los Alamos, New Mexico were noticeable for hundreds of miles.

It is well documented that extreme wildfires can significantly impact air quality. Both gases and particulate emissions occur during the combustion of forest fuels. The emission rates (the amount of emissions produced per unit of time) can vary significantly depending on a variety of factors including fuel types, amount, condition, and combustion characteristics (Sampson et al. 2000, pg 123).

Prescribed Burning

The Pike National Forest currently treats approximately 5,000 acres a year through prescribed burning. Known prescribed burning activities scheduled within the project area include the Trout Creek Timber Sale, which is currently underway. The Hayman fire consumed approximately 1,000 acres of the sale area. It is anticipated that approximately 500 acres of broadcast burning will occur on this sale to clean up down woody debris.

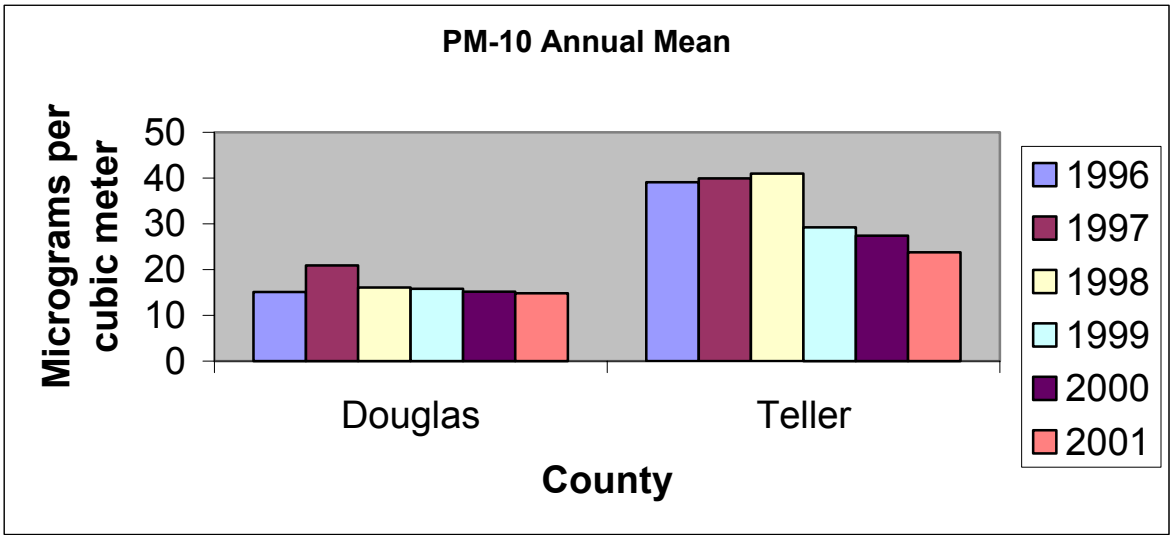
Effective prescribed burning requires that burning plans be developed to specify the objectives of each burn and prescribe the conditions, techniques, and precautions required to meet those objectives. Important factors that determine the effects of prescribed burning on air quality include the ignition pattern employed, local weather conditions at the time of burning, and fuel characteristics.

Current Air Quality Monitoring

Colorado's Air Pollution Control Division measures ambient air quality throughout the state with a network of pollution monitors. There are several monitors within 100 kilometers of the project area (see Attachment 1).

Monitoring data from the EPA 2002 AIR*Data* summaries indicate that PM_{10} annual averages have been decreasing since about 1998 for Teller and Douglas Counties. Figure 1 displays the annual mean concentrations of PM_{10} for Teller and Douglas Counties from 1999-2001.

Figure 1-Annual Mean Concentrations of PM_{10} for Teller and Douglas Counties (1999-2001)



In Colorado, several agencies of the federal government, in cooperation with regional and nationwide state air pollution organizations, also monitor visibility in a number of Class I areas, either individually or jointly through the Inter-agency Monitoring of Protected Visual Environments (IMPROVE) monitoring program. The goals of monitoring programs are to establish background visibility levels, identify trends of deterioration or improvement and to identify suspected sources of visibility impairment. Visibility and the atmospheric constituents that cause visibility degradation are characterized with camera systems, transmissometers and extensive fine-particle chemical composition measurements by the monitoring network. The closest known IMPROVE site is located at Rocky Mountain National Park approximately 65 miles to the north of the project area. IMPROVE data are not contained in this report, but are available online at the following website: http://alta.vista.circa.colostate.edu.

Sensitive Areas

There are several important or relevant air quality designations or classifications, either Federal or State delineations, to identify for analysis (CAQCC 2002). These, along with population centers, main travel corridors, and scenic or important view areas, are identified as "sensitive" features or areas. The proximity of these areas along with general weather patterns (prevailing direction of the transport winds), topography, and the amount of particulates and expected duration of emissions are important in determining the potential for effects on sensitive areas.

Non-Attainment/Attainment Maintenance Designation

The EPA designated many Colorado cities and towns as nonattainment areas in the 1970s and 1980s because these areas violated the National Ambient Air Quality Standards. Colorado has made great strides towards improving air quality over the years. Beginning in the 1980s and into the 1990s many areas in Colorado came into compliance with various standards and have now been re-designated to "attainment /maintenance" or even attainment status.

The Trout-West project area lies primarily within Teller County, with a small portion in Douglas County. Teller County is designated as an attainment area for all six criteria pollutants. Until recently, Douglas County was listed as a non-attainment area for PM_{10} (EPA 2002). As of October 2002 Douglas County was re-designated as an attainment area for PM_{10}. This means that Douglas County now meets National Ambient Air Quality Standards for PM_{10}. The *de minimis* level is 100 tons for PM_{10} non-attainment areas (USDI and USDA Forest Service 2001, pg 84). The PM_{10} *de minimis* level is the amount of PM_{10} that can be emitted *from one contiguous site.* A full conformity analysis would be needed if the predicted annual PM_{10} emissions from each area covered by a different burn plan were greater than 100 tons. Since the project area is not within a non-attainment area no conformity analysis is anticipated.

Federal Class I Areas

On August 7, 1977, Congress designated the national parks and wilderness areas as Class I areas. These areas are afforded the visibility protection under the CAA. The Federal Clean Air Act Amendment in Section 169A, set as a national goal the prevention of any future, and remedying any existing, impairment of visibility in mandatory Class I federal areas the impairment of which results from man made pollution. During the permitting process for major stationary sources of air pollutants, the visibility impacts due to source emissions have historically needed to be estimated to cause less than 5 percent change in the visibility conditions at federal Class I areas. If the impact of source emissions is greater than 5 percent, mitigation efforts will be applied. Change in visibility can be expressed as extinction of deciview. A change in visibility condition of one deciview is perceptible to the average person (Sampson et al. 2000). The Eagles Nest Wilderness is locatedapproximately 60 miles northwest of the project site. This area is expected to be outside the area affected by prescribed fire because the prevailing wind direction planned for prescribed burning should push smoke away from the wilderness.

Class II Areas with Visibility Protection

In addition to the Class I areas there are eight wildland areas in Colorado that have been given visibility protection at the same level as the federally designated areas (Sampson et al. 2000, pg 130). In these areas, the increase in sulfur dioxide emissions from stationary sources cannot exceed the allowable increase limit set for the Class I Federal Areas. The impact on visibility is being considered in this assessment because the regulation was adopted to provide protection of visibility, even though sulfur dioxide is not a significant component of wood smoke.

Florissant Fossil Beds National Monument lies to the south and is the closest Class II area with visibility protection. This area is also expected to be outside the area affected by prescribed fire because the prevailing wind direction planned for prescribed burning is expected to push smoke away from this area; therefore no further analysis will be done.

Other Class II Areas

Other Class II areas not designated for protection, but noted in this report because of their importance to the public, are the Lost Creek Wilderness, Mount Evan Wilderness, and

Roxburough Park. No impact to the Lost Creek Wilderness and Mount Evan Wilderness is expected because the prevailing wind direction planned for prescribed burning should push smoke away from these sites; however, there could be smoke impacts on Roxburough Park.

Cities with Visibility Standards

The CAQCC established a visibility standard in 1990 for the Front Range cities from Fort Collins to Colorado Springs. The standard, an atmospheric extinction of 0.076 per kilometer, or 7.6 percent of the light blocked in a kilometer of air, was based on the public's definition of unacceptable amounts of haze as judged from slides of different haze levels taken in the Denver area. The standard applies from 8 a.m. to 4 p.m. each day, during those hours when relative humidity is less 70 percent. Visibility, along with meteorology and levels of other pollutants from which NAAQS exist, is used to determine the need for mandatory wood burning and voluntary driving restrictions (CDPHE 2000, p.64).

Colorado Springs lies approximately 18 miles to the southeast of the project area and is not expected to be impacted from prescribed fire because the prevailing wind direction planned for prescribed burning should push smoke to the north of this area; therefore further analysis will not be carried foreword.

Other Population Centers

Potential health and visibility impacts from air pollution are a key consideration in prioritizing areas where public land management actions may reduce or increase the potential of extreme wildfires and/or introduce management ignited prescribed fire. Denver, Roxborough Park, Woodland Park, Castle Rock, Deckers, U.S. Air Force Academy, Oxyoke, Sprucewood, and Monument are towns considered downwind and have potential for nighttime smoke impacts. There are single dwellings, subdivisions, and unincorporated communities within the project area such as Ridgewood, Quinlan Gulch, West Creek, and Tranquil Acres. Small population centers are not addressed in this document because of their distance from the project area, their relation to topographical features, and anticipated transport wind projections. Because of the difficulty in forecasting absolute climatic weather changes, there could be potential intrusion and effects from nuisance smoke on areas not mentioned in this assessment.

Scenic Vistas and or Important View Areas.

The Colorado Smoke Management MOU lists important vistas and scenic areas that must be addressed for potential impacts from a project proposing the use of prescribed fire (CAPCD 2001). Those scenic areas within reasonable proximity of the project area are South Park, Devils Head Tower, and Wilkerson Pass. Wilkerson Pass lies approximately 13 miles west and South Park lies approximately 40 northwest of the project area. The analysis assumes Wilkerson Pass and South Park will not be impacted from prescribed fire because the prevailing wind direction planned for prescribed burning should push smoke away from these areas.

Transportation Routes and Airports

Another layer to be considered is the impact on visibility and resultant safety at major airports and on major roadways. Highway 67 travels north and south through the project area, Highway 24 is located approximately 2 miles south of the project area, and Interstate Highway 25 is located approximately 18 miles east of the project area. Colorado Springs Airport is the closest airport, located approximately 25 miles southeast of the project area. A standard visual range of 5 miles is considered sufficient viewing range to allow for safe flying conditions. Federal Aviation Administration rules require flights to switch to instrument controls when visibility is less than 5 miles (Sampson et al. 2000). The analysis assumes visibility impairment at Colorado Springs Airport will not result from prescribed fire because the prevailing wind direction planned for prescribed burning should push smoke away from this site.

Table 3 provides a representation of areas within the project area and downwind that could be affected by smoke during prescribed burning in the project area

Table-3 Sensitive Areas

Identified Area	*Approximate Distance From Project Area (air miles)*	*Approximate Direction from Project Area*	*Downwind from Project Area (Y/N)*	*Possible Residual Nighttime Flow Potential*
Denver	42	North	Y	N
Roxborough Park	20	North	Y	N
Woodland Park	2	Southeast	N	Y
Castle Rock	20	Northeast	Y	N
Deckers	8	North	Y	Y
US Air Force Academy	10	East	Y	N
Oxyoke	12	North	Y	Y
Sprucewood	15	North	Y	Y
Monument	12	Northeast	Y	N
Ridgewood Subdivision	<1	Within	Y	Y
Quinlan Gulch Unincorporated	<1	Within	Y	Y
West Creek	<1	Within	Y	Y
Tranquil Acres	<1	Within	Y	N
Devils Head Tower	8	North	Y	N
State Hwy 67	1	North	Y	Y
Interstate Hwy 25	18	East	Y	N
State Hwy 24	2	South	N	Y

The assessment concentrates on the potential effects of smoke resulting from the prescribed burning on these sensitive areas.

Air Quality Issues

Several environmental and social issues are associated with smoke that may be produced from the Trout-West Project. People are concerned about the duration of prescribed burning and potential health effects of smoke from this project.

Emissions of particulate matter smaller than 10 microns aerodynamic diameter (PM_{10}) were estimated for each alternative. The duration of annual burning and potential effects on local communities are also addressed.

Alternatives and Environmental Consequences

This section evaluates the direct, indirect and cumulative effects of the alternatives on air quality. See the Draft EIS for a description of the alternatives and design features and mitigation measures that apply to the project. This analysis assumes that mitigation measures would be followed as described in the EIS.

Direct Effects

Modeling fire emissions and dispersions to predict compliance with the NAAQS is a difficult and complex process, and is subject to a variety of uncertainties in the choice of input data and assumptions. To more directly assess the air quality impacts from the proposed prescribed burning in the project area, air quality monitoring would need to be conducted.

The Simple Approach Smoke Estimation Model (SASEM) (USDI-BLM 1993) was used to estimate emissions. Table 4 provides a summary of emissions based on estimated annual acreage burned in each alternative (see Attachment 2 for details of the model).

Table-4 Summary of PM_{10} Emissions by Alternative

Alternative	*Pile Only*		*Pile or Broadcast*		*Maximum Total PM_{10}Tons*	*Estimated Annual PM_{10}Tons*	*Compliance with NAAQS*	*Estimated Annual Days of Burning*
	Acres	*PM_{10}Tons*	*Acres*	*PM_{10}Tons*				
No Action	0	0	0	0	0	0	NA	0
Proposed	10,660	885	6,600	1,178	2,063	206	Yes	6-10
Alt A	0	0	0	0	0	0	Yes	0
Alt B	10,660	885	0	0	885	88	Yes	3-5
Alt C	10,660	885	6,660	1,178	2,063	206	Yes	6-10
Alt D	0	0	3,840	685	685	68	Yes	1-3
Alt E	13,500	1,120	9,410	1,680	2,800	280	Yes	10-13

Concentrations of particulate matter ($PM_{2.5}$) relative to smoke sensitive areas and effects on human health were also assessed using the First Order Fire Effects Model, version 5 (FOFEM 5) which was then applied to a Smoke Impact Spread Sheet (SIS). Assumptions are that pile burning generally occurs during the winter or during wet conditions and broadcast burning

occurs when conditions are much drier. Pile burning generally produces fewer emissions and is much easier to control than prescribed broadcast burning.

Of all the action alternatives, Alternative E proposes the greatest amount of potential prescribed burning, at 9,410 acres. Assuming that 1,000 acres were ignited on a single day and assuming that sensitive receptors were directly up wind, the model predicts that the 24-hour average ($PM_{2.5}$) concentration could be 263.28 $\mu g/m^3$ at 0.1 miles and 79.5 $\mu g/m^3$ at 0.4 miles from the fire edge. At 0.5 miles out and beyond, the model indicates concentrations less than 65 $\mu g/m^3$.

Denver is estimated to be approximately 42 miles from the project area. The model indicates that if smoke from this hypothetical 1,000 acre prescribed burn were transported directly to Denver that concentration estimates at Denver would be approximately 2.9 $\mu g/m^3$. The 24-hour average standard for ($PM_{2.5}$) is 65 $\mu g/m^3$. However, since burning usually doesn't occur if wind patterns are projected to transport smoke directly to sensitive areas and if mitigation measures are applied, the chances of impacting sensitive areas are expected to be low (See Attachment 2 for details of the model).

Given the modeling results, all alternatives can be implemented without violating air quality standards. Careful application of mitigation measures and monitoring of results would assure standards are met.

Indirect Effects

Indirect effects from the project include a reduction in risk of wildfire. The No Action alternative is likely to produce smoke from wildfire. FOFEM-5 was used to assess emissions produced by wildfire in particulate matter less than 10 microns in aerodynamic diameter (PM_{10}). The fuels report includes predictions for acres burned over a ten year period under No Action, and for each alternative, once fuels reduction projects are complete. Table 5 summarizes predicted wildfire emissions for each alternative. Please note that wildfires are likely to occur in the Trout and West Creek watersheds regardless of fuels reduction alternative, but that the acres burned would be significantly reduced under many of the action alternatives.

Table-5 Summary of PM_{10} Emissions for Wildfire

Alternative	*Project Area*			*Watershed Area*			*Total Tons PM_{10} (WildFire)*
	% Risk Over a 10 Year Period within the Project Area	*Total Acres Estimated to Burn Per Decade*	*Tons PM_{10} (WildFire)*	*% Risk Over a 10 Year Period within the Watershed Area*	*Total Acres Estimated to Burn Per Decade*	*Tons PM_{10} (WildFire)*	
No Action	100	10,500	5,145	100	31,500	15,435	20,580
Proposed	20	2,100	1,029	30	9,450	4,630	5,659
Alt A	20	2,100	1,029	30	9,450	4,630	5,659
Alt B	40	4,200	2,058	60	18,900	9,261	11,319
Alt C	20	2,100	1,029	30	9,450	4,630	5,659
Alt D	80	8,400	4,116	100	31,500	15,435	19,551

Alternative	*Project Area*			*Watershed Area*			*Total Tons PM_{10} (WildFire)*
	% Risk Over a 10 Year Period within the Project Area	*Total Acres Estimated to Burn Per Decade*	*Tons PM_{10} (WildFire)*	*% Risk Over a 10 Year Period within the Watershed Area*	*Total Acres Estimated to Burn Per Decade*	*Tons PM_{10} (WildFire)*	
Alt E	20	2,100	1,029	30	9,450	4,630	5,659

Analysis of Effects: No Action Alternative

Direct Effects

There would be no direct effects on air quality or human health with this alternative because it does not propose prescribed burning. Impacts from dust, vehicle emissions and other sources would not change from current conditions.

Indirect Effects

Wildfires would continue to occur within the projects area and smoke from these fires would not be manageable, especially under severe burning conditions during summer. This smoke could occur when dispersion is poor and would likely produce more smoke and particulate matter, and last longer than planned ignitions. Under this alternative the fuels analysis assumes that a wildfire of approximately 10,500 acres is 100% probable within the project area within the next decade. The fuels analysis also assumes there is a 100% probability of three such fires occurring within the balance of the watershed within the next decade. Wildfires of this magnitude could generate approximately 20,580 tons of $PM_{10.}$

A large wildfire has the potential to emit large amounts of smoke that could remain in the local airsheds for a few days to several weeks, depending on the size and intensity of the fire. The Hi Meadow, Buffalo Creek, and Hayman fires provide local examples of smoke effects from wildfire. These wildfires consumed from 10,000 to approximately 137,000 acres of forest vegetation. Each had impacts on air quality. The resultant emissions from a wildfire of these sizes could release from 4,900 to 67,130 tons of PM_{10}, respectively, over a period of a few days.

Many of the small communities within the project area would be affected if a wildfire did develop. Wildfires can occur when weather conditions are not good for dispersal. Smoke generated from a wildfire could be caught within an inversion layer along the Trout and West Creek drainages and into the Upper South Platte River drainage, reducing visibility in the area. Depending on the size of the fire and weather conditions, these effects could last anywhere from one night to several weeks and have an affect on public health. The Hayman fire that occurred in June 2002 is a good example of significant impacts on visibility and regional haze. Moderate to heavy dense smoke from the Hayman fire impacted Denver and other surrounding communities for several days.

Cumulative Effects

Past activities having the greatest effect on air quality were wildfires such as the Buffalo Creek fire in 1996, the Hi Meadows fire in 2001, and the most recent Hayman fire in June 2002. Smoke from wildfires such as these contributes high amounts of emissions to the local airshed for a period of a few days to several weeks. These fires had a large immediate effect on the air quality of the area, the District and beyond. However those effects, as great as they were, are gone and cannot be viewed cumulatively. Other past activities include the Pohemus prescribed burn in 2001, which was approximately 8,000 acres in size. Effects from this burning are also gone and cannot be viewed cumulatively with current and foreseeable activities.

Present and reasonably foreseeable activities include 500 acres of prescribed burning on the Trout Creek Timber Sale located within the project area. The Hayman fire consumed a large portion of the Trout Creek Timber Sale. The Trout Creek Timber Sale project is in the implementation stage. The purpose of burning is to clean up woody debris after harvest is completed. Burning is scheduled to take place within a year. According to The SASEM Model, approximately 89 tons of PM_{10} emissions could be generated from this activity. It is highly probable that this burning would be completed prior to implementation of the Trout-West Project.

Analysis of Effects: The Proposed Action

Direct Effects

Under this alternative, approximately 10,660 acres would be piled and burned and 6,600 acres would be piled and burned or broadcast burned. Based on the SASEM computer model, an estimated 2,063 tons of PM_{10} could be released if all acres were ignited at one time. These burns are likely to be implemented over a 10-year period. If these burns were conducted over a 10-year period an average of 206 tons of PM_{10} would be released annually. Effects on air quality are expected to be short term. These estimates of emissions are based on the assumption that all areas proposed for burning would have continuous fuels across the area as a result of harvest and thinning activities. These estimates represent the high end of the possible amount of emissions released under this alternative because of these assumptions. Actual emissions would likely be less than these estimates because there are natural openings, areas of light fuels, and areas that would not be burned. Site-specific fuels data would be available after thinnings and new emissions estimates would be generated prior to burning actually taking place.

Sensitive receptors near the burn units could be affected by nuisance smoke during prescribed burning. It is estimated that 6-10 days per year could be affected by smoke during burning operations. Smoke from the proposed burning and the associated emissions would reside in the local airsheds a relatively short time, from a few hours to several days, depending on the weather. This could cause irritation to sensitive persons, create traffic hazards, and settle in low-lying areas during the evening hours. There also could be some smoke settling into the Trout Creek and West Creek Watersheds with some eventual flow into the Upper South Platte during the evenings following a prescribed burn. Smoke trapped in low-lying areas would be expected to dissipate once morning temperatures rose and the nighttime inversion lifted. Some decreased

visibility along travel corridors such as Highway 67 could occur. Little impact is expected on Interstate Highway 25 and State Highway 24. Dispersed smoke could drift as far as Denver; however, little visibility impairment would be expected. Prescribed burning would be conducted when weather conditions are predicted to be good for smoke dispersal. According to the SASEM model, no exceedances of PM_{10} or $PM_{2.5}$ are expected; therefore, no violation of the NAAQS is anticipated. Since no exceedence is predicted, this would also indicate no health hazards are likely. Since the amount of burning conducted within any one airshed is monitored and controlled by the State, and by applying mitigation measures, this alternative would not be expected to result in violations of air quality standards.

Indirect Effects

An indirect effect of the proposed action is a reduction in the emissions that would be released from wildfires in the area. Under this alternative the fuels analysis assumes a wildfire of approximately 10,500 acres is 20% probable within the project. It also assumes there is a 30% likelihood of three such fires occurring within the balance of the watershed. The risk of reduction is applied to the 10-year period following project completion. Based on FOFEM 5, approximately 5,659 tons of PM_{10} of emissions could be generated from these wildfires.

Cumulative Effects

Past activities and their effects are the same as those described under the No Action alternative. Present and reasonably foreseeable activities include approximately 17,260 acres of pile and prescribed broadcast burning proposed under the Proposed Action, and 500 acres of prescribed burning on the Trout Creek Timber Sale located within the project area. The Trout Creek Timber Sale will likely be accomplished within one year. The overall effects should not differ much beyond those described under direct effects for this alternative. Burning is scheduled over a 10-year period. The State permitting process would regulate the amount of burning in the area, thus reducing or eliminating foreseeable smoke related problems to sensitive areas from the proposed actions.

Analysis of Effects: Alternative A

Direct Effects

This alternative proposes no burning. Only mechanical manipulation and removal of the fuels is anticipated under this proposal. This alternative would have direct air quality effects similar to those of the No Action alternative.

Indirect Effects

Under this alternative, the indirect effects would be similar to the Proposed Action Alternative.

Cumulative Effects

Past, present, and foreseeable activities are the same as those described in the No Action alternative.

Analysis of Effects: Alternative B

Direct Effects

Under this alternative, approximately 10,660 acres would be piled and burned only. No broadcast burning is proposed. An estimated 885 tons of PM_{10} could be released as a result of the burning operations. If these burns were conducted over a 10-year period an average of 88 of PM_{10} would be released annually. Estimated emissions are lower than for the Proposed Action alternative because of lesser amounts of fuels burned. Under this alternative, the treatment emphasis is proposed only within 1 mile of the urban interface buffer zone. Only pile burning is planned within this zone. Pile burning is generally much easier to facilitate because burning can occur under wet and windy conditions allowing for good smoke dispersion. The effects on air quality are expected to be short term; however, smoke can linger from some piles that may have excessive dirt in them. As with all the action alternatives, when the burn plans are developed following the mechanical treatments, more site-specific fuels data would be available and new emissions estimates would be generated.

Sensitive receptors near the burn units could be affected by nuisance smoke during prescribed burning. It is estimated that 3-5 days per year could be affected by smoke during burning operations. Burning would be conducted over a fewer number of days as opposed to the Proposed Action alternative. Smoke from the proposed burning and the associated emissions would reside in the local airsheds a relatively short time, from a few hours to several days, depending on the weather. This could cause irritation to sensitive persons, create traffic hazards, and settle in low-lying areas during the evening hours. There also could be some smoke settling into the Trout Creek and West Creek Watersheds, with some eventual flow into the Upper South Platte during the evenings following a prescribed burn. Smoke trapped in low-lying areas would be expected to dissipate once morning temperatures rose and the nighttime inversion lifted. Some decreased visibility along travel corridors such as Highway 67 could occur. Little impact is expected on Interstate Highway 25 and State Highway 24. Dispersed smoke could drift as far as Denver; however, little visibility impairment would be expected. Prescribed burning would be conducted when weather conditions are predicted to be good for smoke dispersal. According to the SASEM model, no exceedances of PM_{10} or $PM_{2.5}$ are expected; therefore, no violation of the NAAQS is anticipated. Since no exceedeence is predicted this would also indicate no health hazards are likely. Since the amount of burning conducted within any one airshed is monitored and controlled by the State, and by applying mitigation measures, this alternative would not be expected to result in violations of air quality standards.

Indirect Effects

An indirect effect of this alternative is a reduction in the emissions that would be released from wildfires in the area. Under this alternative the fuels analysis assumes a wildfire of approximately 10,500 acres is 40% probable within the project area. It also assumes there is a 60% likelihood of three such fires occurring within the balance of the watershed. The risk of reduction is applied to the 10-year period following project completion. Based on the FOFEM 5 model, approximately 11,319 tons of PM_{10} of emissions could be generated from these wildfires.

Cumulative Effects

Past activities and their effects are the same as those described under the No Action alternative. Present and reasonably foreseeable activities include approximately 10,660 acres of pile burning and 500 acres of prescribed burning on the Trout Creek Timber Sale, for approximately 11,160 acres. A cumulative effect of these burns would be an increased chance of delay in burning. The cumulative effects on the scheduling of burns and the possibility for delays would be less than the Proposed Action alternative. Since fewer fuels would be burned under this alternative, a fewer number of days would be needed to conduct the burning. As with all the action alternatives the State permitting process would regulate the amount of burning in the area, thus reducing or eliminating foreseeable smoke related problems to sensitive areas proposed by this alternative.

Analysis of Effects: Alternative C

This alternative is similar to the Proposed Action alternative for prescribed burning. All burning and emissions estimates would be the same as the Proposed Action; therefore, the direct, indirect and cumulative effects are estimated to be the same as the Proposed Action.

Analysis of Effects: Alternative D

Direct Effects

Under this alternative, approximately 3,840 acres would be piled and burned or broadcast burned. Assumptions for modeling were based on broadcast burning since it tends to generate greater emissions outputs. Based on the SASEM model, an estimated 685 tons of PM_{10} could be released if all acres were ignited at one time. If these burns were conducted over a 10-year period, an average of 68 of PM_{10} would be released annually. Estimated emissions under this alternative are lower than all the action alternatives because of the lesser amounts of fuels proposed for burning. Under this alternative, the treatment emphasis is proposed only within 1/2 mile of occupied private land. Effects on air quality are expected to be short term. As with all the action alternatives site specific fuels data would be available after thinnings and new emissions estimates would be generated prior to burning actually taking place.

Sensitive receptors near the burn units could be affected by nuisance smoke during prescribed burning. It is estimated that 1-3 days per year could be affected by smoke during burning operations. Smoke from the proposed burning and the associated emissions would reside in the local airsheds a relatively short time, from a few hours to several days, depending on the

weather. This could cause irritation to sensitive persons, create traffic hazards, and settle in low-lying areas during the evening hours. There also could be some smoke settling into the Trout Creek and West Creek Watersheds, with some eventual flow into the Upper South Platte during the evenings following a prescribed burn. Smoke trapped in low-lying areas would be expected to dissipate once morning temperatures rose and the nighttime inversion lifted. Some decreased visibility along travel corridors such as Highway 67 could occur. Little impact is expected on Interstate Highway 25 and State Highway 24. Dispersed smoke could drift as far as Denver; however, little visibility impairment would be expected. Prescribed burning would be conducted when weather conditions are predicted to be good for smoke dispersal. According to the SASEM model, no exceedances of PM_{10} or $PM_{2.5}$ are expected; therefore, no violation of the NAAQS is anticipated. Since no exceedance is predicted this would also indicate no health hazards are likely. Since the amount of burning conducted within any one airshed is monitored and controlled by the State, and by applying mitigation measures, this alternative would not be expected to result in violations of air quality standards.

Indirect Effects

An indirect effect of this alternative is a reduction in the emissions that would be released from wildfires in the area. Under this alternative, the fuels analysis assumes a wildfire of approximately 10,500 acres is 80% probable within the project area. It also assumes there is a 100% likelihood of three such fires occurring within the balance of the watershed. The risk of reduction is applied to the 10-year period following project completion. Based on the FOFEM 5 model, approximately 19,551 tons of PM_{10} of emissions could be generated from these wildfires. This alternative predicts the greatest impact on air quality from wildfire of all the action alternatives.

Cumulative Effects

Past activities and their effects are the same as those described under the No Action alternative. Present and reasonably foreseeable activities include approximately 3,840 acres of pile burning and 500 acres of prescribed burning on the Trout Creek Timber Sale, for approximately 4,340 acres. The cumulative effects on the scheduling of burns and the possibility for delays would be less than all the action alternatives; a fewer number of days would be needed to conduct the burning.

As with all the action alternatives, the State permitting process would regulate the amount of burning in the area, thus reducing or eliminating foreseeable smoke related problems to sensitive areas proposed by this alternative.

Analysis of Effects: Alternative E

Direct Effects

Under this alternative, approximately 13,500 acres would be piled and burned and 9,410 acres would be piled and burned or broadcast burned. Based on the SASEM computer model a

maximum of 2,800 tons of PM_{10} could be released if all acres were ignited at one time. These burns are likely to be implemented over a 10-year period. If these burns were conducted over a 10-year period, an average of 280 tons of PM_{10} would be released annually. Since a greater amount of smoke and emissions would be produced under this alternative, these effects would be greater. As with all the action alternaitives, effects on air quality are expected to be short term. These estimates of emissions are based on the assumption that all areas proposed for burning would have continuous fuels across the area as a result of harvest and thinning activities. These estimates represent the high end of the possible amount of emissions released under this alternative because of these assumptions. Actual emissions would likely be less than these estimates because there are natural openings, areas of light fuels, and areas that would not be burned. Site-specific fuels data would be available after thinnings and new emissions estimates would be generated prior to burning actually taking place

Sensitive receptors near the burn units could be affected by smoke during prescribed burning. It is estimated that 10-13 days per year could be affected by smoke during burning operations. Of all the action alternatives, this alternative is expected to produce the most number of smoky days because more burning is proposed. Smoke from the proposed burning and the associated emissions would reside in the local airsheds a relatively short time, from a few hours to several days, depending on the weather. This could cause irritation to sensitive persons, create traffic hazards, and settle in low-lying areas during the evening hours. Because more days would be needed to burn these fuels, there would be an increased chance of smoke getting caught within an inversion layer and residing within the low lying areas overnight. There also could be some smoke settling into the Trout Creek and West Creek watersheds, with some eventual flow into the Upper South Platte during the evenings following a prescribed burn. Smoke trapped in low-lying areas would be expected to dissipate once morning temperatures rose and the nighttime inversion lifted. Some decreased visibility along travel corridors such as Highway 67 could occur. Little impact is expected on Interstate Highway 25 and State Highway 24. Dispersed smoke could drift as far as Denver; however, little visibility impairment would be expected. Prescribed burning would be conducted when weather conditions are predicted to be good for smoke dispersal. According to the SASEM model, no exceedances of PM_{10} or $PM_{2.5}$ are expected; therefore, no violation of the NAAQS is anticipated. Since no exceedance is predicted this would also indicate no health hazards are likely. Since the amount of burning conducted within any one airshed is monitored and controlled by the State, and by applying mitigation measures, this alternative would not be expected to result in violations of air quality standards.

Indirect Effects

An indirect effect of this alternative is a reduction in the emissions that would be released from wildfires in the area. Under this alternative the fuels analysis assumes a wildfire of approximately 10,500 acres is 20% probable within the project area. It also assumes there is a 30% likelihood of three such fires occurring within the balance of the watershed. The risk of reduction is applied to the 10-year period following project completion. Based on the FOFEM 5 model, approximately 5,659 tons of PM_{10} of emissions could be generated from these wildfires. This alternative predicts the greatest impact on air quality from wildfire of all the action alternatives.

Because of the change in stand structure, the potential of a crown fire developing within these stands would be reduced. The post treatment stand structures and the location of these stands across the landscape would result in a decreased potential for crown fires and help to reduce the extent of wildfires in the area. These reductions in intensity and extent of wildfires would also result in a reduction in the amount of PM_{10} released if a wildfire developed.

Cumulative Effects

Past activities and their effects are the same as those described under the No Action alternative. Present and reasonably foreseeable activities include approximately 22,910 acres of pile and prescribed broadcast burning along with 500 acres of prescribed burning on the Trout Creek Timber Sale. Since more fuels would be burned under this alternative and the emissions released would be greater, a greater number of days would be needed to conduct the burning. This could result in creating more burning delays as a result of the demand for burning within the area.

As with all the action alternatives, the State permitting process would regulate the amount of burning in the area, thus reducing or eliminating foreseeable smoke related problems to sensitive proposed by this alternative.

Summary of Effects

Table 8 presents a summary of emissions by alternative and comparison of alternatives.

Table-6 Summary of PM_{10} Emissions by Alternative and Comparison of Alternatives

Alternative	*Maximum PM_{10}Tons From All Proposed Prescribed Burning*	*Maximum PM_{10}Tons From Future Forseable Prescribed Burning*	*Maximum PM_{10}Tons From Wildfire*	*Compliance with NAAQS For PM_{10}*	*Estimated Annual Days of Burning*
No Action	0	89	20,580	NA	0
Proposed Action	2,063	89	5,659	YES	6-10
Alt-A	0	89	5,659	YES	0
Alt-B	885	89	11,319	YES	3-5
Alt-C	2,063	89	5,659	YES	6-10
Alt-D	685	89	19,551	YES	1-3
Alt-E	2,800	89	5,659	YES	10-13

CONCLUSION

No Action has the greatest potential impact on air quality, because the current fuel hazard would not be reduced. Alternative A has the least potential to affect air quality, because it effectively reduces risk of damaging crown fire, but produces no smoke from prescribed burning.

All of the action alternatives are expected to meet federal, state and local air quality regulations. Prescribed burning under all alternatives is not expected to adversely affect any sensitive areas.

The State permitting process would regulate the amount of burning in the area; state regulations reduce or eliminate foreseeable smoke related problems to sensitive areas. Wildfire emissions would not be regulated and are more likely to cause adverse impacts on air quality.

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ATTACHMENT 1

KNOWN MONITORS IN OPERATION
Estimated Within 100 Kilometers of the Project Area)
EPA 2002 AIRData http://www.epa.gov/air/data/geosel.html

County	Site Name	Location	TSP	Pb	CO	SO^2	NO^2	O^3	PM_{10}	$PM_{2.5}$
Boulder	Boulder	2150 28th St			X					
"	Boulder	14051/2 S Foothills Rd						X		
"	Boulder	2440 Pearl St							X	X
"	Longmont	3rd Ave. & Kimbark Dr							X	X
"	Longmont	440 Main St			X				X	
"	Hygiene	17024 Ute Hwy								
Denver	Denver Camp	2105 Broadway	X	X	X	X	X		X	X
"	Denver NJH	14th Ave. 7 Abion St			X					
"	Denver Carriage	23rd Ave. & Julian St			X			X		
"	Denver Gates	1050 S. Broadway	X	X					X	
"	Visitor Center	225 W Colfax							X	
"	Fire House	1300Blake Ave			X					
"	Lowry AFB	8100 Lowry Blvd							X	
Douglas	Castle Rock	310 3rd St							X	
"	Chatfield Res	Roxbourgh Pk Rd						X		
"	Park	Library								X
Elbert	Elbert	Wright Inghram								X
El Paso	Colorado Spr	1-25 & Uintah St			X					
"	Colorado Spr	3730 Meadowlands							X	X
"	Colorado Spr	101 W. Costilla St	X	X					X	X
"	Colorado Spr	USAFA Rd 640						X		
"	Colorado Spr	690 W Hwy 24			X					
Fremont	Canon City	7th Ave. & Macon							X	
Jefferson	Arvada	W. 57th Ave & Garrison			X			X		
"	Welch	12400 W. Hwy 285								
"	NREL	20th Ave Quaker St						X		
"	Rocky Flats	16600 W. Hwy 128	X					X	X	
"	Rocky Flats	11501 Indiana St	X						X	
"	Rocky Flats	9901 Indiana St	X				X		X	
"	Rocky Flats	18000 W Hwy 72	X						X	
"	Rocky Flats	11190 N. Hwy 93	X				X		X	
Lake	Leadville	510 Harrison St	X	X						
Pueblo	Pueblo	211 D St							X	X
Summit	Breckenridge	County Justice Center							X	
"	Silverthorne	430 Rainbow Dr							X	
Teller	Cripple Crk	209 E. Bennet Ave							X	

Total Suspended Particulates (TSP)
Carbon Monoxide (CO)
Lead (Pb)
Sulfur Dioxide (SO^2)
Nitrogen Dioxide (NO^2)
Ozone (O^3)
Particulate Matter <10 Microns (PM10)
Fine Particulates (PM2.5)

ATTACHMENT 2

ANALYIS METHODS

Assessing Emissions from Prescribed Burning

The Simple Approach Smoke Estimation Models (SASEM version 4.0; USDI-BLM 1993) was used to estimate emissions for proposed prescribed burning. SASEM is a straight-line Gaussian plume dispersion model designed as a screening tool to predict maximum particulate concentrations and visual impacts from prescribed fires. SASEM simulates emissions, transport, dispersion, and optical effects of any inert pollutants. Emissions are calculated from fire line intensity, average fuel loading, and the area and duration of the burn. To run the model, estimates of the amount of fuel that would be burned are required. According to the SASEM Model a "no exceedance" would indicate no violation of the NAAQS for $PM_{10.}$ The model was run for each alternative to estimate exceedence of the NAAQS for PM_{10}. Outputs are summarized in Table-6. Prior to burning actually taking place, a site specific Prescribed Burn Plan will be developed. Air quality emissions will be modeled more accurately after proposed vegetation treatments have occurred. Smoke emissions will be evaluated for compliance by the Colorado Air Quality Control Commission (CAQCC). Guidance and direction is more clearly outlined in the *Prescribed Fire Planning Document in compliance with Air Quality Control Commission, Regulation No. 9, Rocky Mountain Region (R-2)* document (USDA Forest Service 2002). (See process records for SASEM model outputs.)

Assessing Emissions from Wildfire

The First-Order Fire Effects Model, Version 5 (FOFEM-5) was used to assess emissions produced from wildfires in particulate matter less than 10 microns in aerodynamic diameter (PM_{10}). FOFEM-5 is a computer program that was developed by the USDA Forest Service Intermountain Fire Sciences Laboratory (Missoula, Montana) to meet the needs of resource managers, planners, and analysts in predicting and planning for fire effects. First-order fire effects are those that concern the direct or immediate consequences of fire, including fuel consumption, smoke production, and tree mortality. These first-order effects form the basis for predicting secondary effects such as tree regeneration, plant succession, and changes in site productivity. Internally, FOFEM5 used the BURN-UP algorithm for predicting fuel consumption (and consequently, emissions) of dead-and-down woody fuel and litter. For other fuel bed components (e.g., duff, live woody and herbaceous loading, tree crowns), FOFEM-5 uses a set of predictive equations (algorithms) gleaned from the scientific literature and available in FOFEM Version 4 (FOFEM-4). FOFEM-5 is national in scope, and includes default fuel loading information for specific vegetative cover types found in various regions of the United States. Geographic regions and cover types are both used as part of the algorithm selection key used to determine fuel consumption for non dead-and-down woody fuel consumption and litter consumption. Default values were used in the model for light and heavy fuels to generate a

range of potential emissions. FOFEM projected a range from 261 to 980 pounds of PM_{10} per acre. For comparison, emissions that were estimated for a modeled wildfire within the Trout-West area for PM_{10} was estimated to average 406 pounds per acre (Sampson et al. 2000, pgs 53 & 62). I elected to use 980 pounds of PM_{10} per acre burned to represent the worst case wildfire fire emissions that might be generated. Emissions estimates are summarized in Table-6 based on percent of risk over a 10-year period for the project area and by watershed.

Assessing Concentrations of Particulate Matter ($PM_{2.5}$ in micrograms per cubic meter, $\mu g/m^3$) Relative to Smoke Sensitive Areas

The Smoke Impact Spreadsheet (SIS) model was used to assess concentrations of particulate matter ($PM_{2.5}$) relative to smoke sensitive areas and public health. SIS is a simple-to-use, screening-level modeling system for calculating $PM_{2.5}$ emissions and airborne concentrations downwind of natural or managed wildland fires. As a screening model, SIS provides conservative (that is, higher than actual) predictions of the downwind air concentrations at user-selected receptors for comparison with appropriate federal or state air quality standards for $PM_{2.5}$.

The SIS model has four main components: a graphic user interface based on a series of Excel spreadsheets for easy data entry and model execution, an emissions module based on the Emissions Production Model (EPM 3.5), a dispersion module based on the CALPUFF dispersion model (version 5.5), and graphical output for presenting the results. As an alternative to EPM, the SIS model can utilize emission data generated from FOFEM-5. The SIS model was ran based on a broadcast burn size of 1,000 acres. I elected to use the FOFEM-5 model to run with the SIS model to produce expected concentrations of $PM_{2.5.}$ Based on the outputs from the model, under the worst case scenario if the sensitive receptors were located directly up-wind on a center line from the proposed prescribed fire, the model indicates that the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ $\mu g/m^3$ for a 24 hour period could be exceeded from 0.1 to 0.5 miles out. Beyond 0.5 miles no exceedences of $PM_{2.5}$ $\mu g/m^3$ were predicted. Denver is estimated to be one of the furthest sensitive areas downwind of the project area, at approximately 42 miles. Based on the model, if the smoke transported directly to Denver, the 24-hour average $PM_{2.5}$ concentration is predicted to not exceed 2.9 $\mu g/m^3$, which is well bellow the NAAQS for $PM_{2.5}$ (see process records for SIS outputs).

Additional Assumptions Used For The Models

- For prescribed burning, surface fuel loading were determined based on 10 plot samples taken in similar fuel types adjacent to the project area. Live fuel slash weights of submerchantable trees were estimated based on average tree size and species targeted to be felled after harvest. Potential emissions were based on maximum residue material that might remain after harvest. Although the species of trees are primarily Ponderosa Pine, Doug fir, Grand Fir, and Engleman Spruce, Doug Fir was selected as the vegetation type for the models since it depicts the highest emissions output compared with ponderosa pine (see fuels report for details of fuels estimates used for the models).

- Weather variables used for the models were taken from the Manitou Experimental Forest weather station site located within the project area and the Cheesman weather station site located to the west of the project area. Weather variables used for prescribed burning Data was also acquired through the Ventilation Climate Information System (VCIS) available at (http://www.fs.fed.us/pnw/fera/vent/). Local communication with Forest personnel was also used to determine local weather variables.
- Although prescribed burning can occur at anytime, I elected to used weather variables for the month of September for prescribed burn Modeling. This was based on the recommendation from the local District Fire Manager.

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ATTACHMENT 3

Mitigation

In order to reduce the air quality effects of prescribed burning, the following mitigation measures would be implemented for this project. General permitting requirements outlined in the State of Colorado's Regulation 9 require smoke risk analysis and modeling prior to any prescribed burn being initiated. The Prescribed Fire Plan is the site-specific implementation document as required by Forest Service Handbook (FSH) 5140.3 and 5142.2. It includes the specific resource objectives and fire treatment objectives to be achieved by prescribed fire. One of the components of a prescribed fire plan is the Smoke Management section that is required by FSH 5144. This section describes the actions that will be taken to meet the state standards for reducing emissions and minimize impacts of smoke to sensitive receptors. The accepted reference guide that is used for planning for and managing smoke from prescribed fire is the Prescribed Fire Smoke Management Guide (NWCG, NFES 1279, PMS 420-1). This guide identifies several key techniques for minimizing smoke production and impacts. They are as follow:

- Burn only when conditions are favorable for rapid smoke dispersion.
- Do not burn when air stagnation advisories are in effect or when temperature inversions exist.
- Burn smaller blocks when appropriate.
- Burn only when fuel moisture conditions are favorable. Target fuels should be consumed during the flaming phase rather than the smoldering phase and fuel moisture of heavier fuels should be high and not readily available to burn.
- Use backing fires when applicable.
- Rapid mop-up of large fuels.
- Expand the burning season to times other than "traditional" burning season which can be conducive to reduced smoke production and better lofting and smoke dispersion.
- Piles and windrows should be as dirt free as possible.
- Carefully consider the impacts when burning at night.
- Ensure adequate and timely public notification of prescribed burning information prior to ignition.

- Avoid wind directions that will transport smoke towards a sensitive receptor.
- When it is compatible with resource objectives, "mass ignition" firing techniques will be considered to maximize fire heat production and the resultant plume heights in order to promote mixing at higher altitudes.
- Where smoke is a potential problem on roads, traffic control will be provided to reduce potential traffic problems.
- Avoid burning during high visitor use periods such holidays.

Monitoring

The Forest Service is committed to conducting prescribed fire operations consistent with the Clean Air Act, the Colorado Smoke Management MOU, Colorado Air Quality Control Commissions Regulation No. 9, applicable Forest Service Manuals and Handbooks, and project-level Prescribed Fire Burn Plans and Permits. All projects will be planned and conducted in an attempt to balance the needs of the ecosystem and the general public with the utmost concern for public health and welfare (USDA Forest Service 2002). During the application and permitting process the significance of any burn will be evaluated and a determination made as to specific monitoring that may be required. Equipment appropriate for smoke monitoring differs based on the objectives. An example of particulate monitoring and techniques used are described in (USDI and USDA Forest Service 2001, p179-185).