5.6 Air Quality

This section summarizes the impacts to air quality due to implementing either the Proposed Program or any of the alternatives.

5.6.1 Significance Criteria

Based on Appendix G of the CEQA Guidelines, an air quality impact would be considered significant if the Program and Alternatives would:

a) Conflict with or obstruct implementation of the applicable air quality plan;
b) Violate any air quality standard or contribute to an existing or projected air quality violation;
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors);
d) Expose sensitive receptors (see Glossary) to substantial pollutant concentrations;
e) Create objectionable odors affecting a substantial number of people;

5.6.2 Determination Threshold

The federal and state governments—specifically, the U.S. Environmental Protection Agency (EPA) and California Air Resources Board (CARB)—each establish ambient air quality standards for several criteria pollutants. These are referred to as the national ambient air quality standards (NAAQS) and California ambient air quality standards (CAAQS), respectively.

Currently, most of the effort to improve air quality in the United Sates and California is directed toward the control of five pollutants, called "criteria" air pollutants: ozone (O_2), CO, PM_{10}, NO_2, and SO_2. Pollutants subject to federal ambient standards are referred to as "criteria" pollutants because the EPA publishes criteria documents to justify the choice of standards.

Criteria air pollutants are classified in each air basin, county, or in some cases within a specific urbanized area. The classification is determined by comparing actual monitoring data with State and federal standards. If a pollutant concentration is lower than the standard, the pollutant is classified as "attainment" in that area. If an area exceeds the standard more times than allowed under the established violation criteria (see below), the pollutant is classified as "non-attainment". If there are not enough data available to determine whether or not the standard is exceeded in an area, the area is designated "unclassified". A nonattainment classification may be used to specify what air pollution reduction measures an area must adopt and when the area must reach attainment.

The current State of California ambient air quality standards are listed below in Table 5.6.1 and in Table 4.6.7 and in general, are more stringent than the existing federal standards for the criteria air pollutants. Most of the standards have been set to protect public health, although some are based on other values (e.g., protection of crops, protection of materials, or avoidance of nuisance conditions). The Program and Alternatives will create a significant effect as defined below in the column titled California Violation Threshold.

Table 5.6.1
California Ambient Air Quality Standards and Thresholds
(From Section 4.6)

Pollutant	Symbol	Averaging Time	California		National		California Violation Threshold	National Violation Threshold
			ppm	Mg./cu meter	ppm	Mg./cu meter		
Ozone	O_3	8 hours	0.07	137	0.075	160	N/A	If 3-year average of annual third-highest daily 8-hour maximum exceeds standard
		1 hour	0.09	180	0.12	235	If exceeded	If exceeded on more than 3 days in 3 years
Carbon monoxide	CO	8 hours	9	10,000	9	10,000	If exceeded	If exceeded on more than 1 day per year
		1 hour	20	23,000	35	40,000	If exceeded	If exceeded on more than 1 day per year
(Lake Tahoe only)		8 hours	6	7,000	N/A	N/A	If exceeded	N/A
Nitrogen dioxide	NO_2	Annual average	0.03	57	0.053	100	N/A	If exceeded
		1 hour	0.18	339	N/A	N/A	If exceeded	N/A
Sulfur dioxide	SO_2	Annual average	--	--	0.03	80	N/A	If exceeded
		24 hours	0.04	105	0.14	365	If exceeded	If exceeded on more than 1 day per year
		1 hour	0.25	655	N/A	N/A	N/A	N/A
Respirable particulate matter	PM10	Annual arithmetic mean	--	20	N/A	50	N/A	If exceeded
		24 hours	--	50	N/A	150	N/A	If exceeded on more than 1 day per year
Fine particulate matter	PM2.5	Annual average	--	12	N/A	15	N/A	If spatial average exceeded on more than 3 days in 3 years
		24 hours	No state std		N/A	65	N/A	If exceeds 98th percentile of concentrations in a year
Lead	L	30 day average		1.5	N/A	N/A	If equaled or exceeded	N/A

5.6.3 Data and Assumptions

Section 4.6 contains substantial information concerning air quality in California's 15 air basins, including the contribution of wildfire emissions to total emissions of the six criteria air pollutants. Table 4.6.2 contains information on the estimated annual air pollution due to emissions from wildfire in California between 1994-2003 in tons/yr. Table 4.6.4 shows emission factors in pounds of emissions per ton of fuel consumed for different categories of fuels by fuel moisture content. As Table 4.6.4 shows, fuel moisture content does not appear to influence the production of PM10, but wetter fuel three inches and larger does increase the production of PM2.5 and CO. According to

Table 4.6.4, fuel moisture content does not appear to change emissions of NO_2, SO2 or total non-methane hydrocarbons.

Section 4.6 also discusses the regulatory framework associated with air quality in California including the following:

- Federal Clean Air Act and NAAQS
- EPA Interim Air Quality Policy on Wildland and Prescribed Fires
- Federal requirement that States have State Implementation Plans in non-attainment air basins that address the NAAQS.
- California Clean Air Act and non-attainment air basins and districts
- Visibility requirements including requirements in Class I federal areas (generally National parks and certain wilderness areas)
- Smoke Management requirement to implement Best Available Control Methodologies in non-attainment air basins for PM10
- Smoke Management and the CARB

Sugihara (2006) also describes the regulatory environment associated with reducing air quality impacts from wildfire and prescribed fire in California. Additional regulatory requirements noted in Sugihara include:

- Prevention of Significant Deterioration Program for Class I, II and III federal areas.
- California's agricultural burning regulations in Title 17 of the California Code of Regulations. Individual AQMDs require burn plans with varying amounts of detail depending on size of burn and/or tons of fuel to be burned. Size and quantity requirements vary by AQMD.
- The Western Regional Air Partnership is a regional planning organization that is developing guidance to implement EPA's regional haze rule.

As noted in Jones and Stokes (2000), "*Many individual air districts have developed thresholds of significance to determine if project-related air quality impacts require mitigation. Those thresholds vary by air district but generally equal 15 tons per year (tpy) for PM10, 100 tpy for CO, and 27 tpy for sulfur oxides (SO_x). For the ozone precursors ROG and NO_2, the thresholds generally equal 15 tpy, especially for areas with severe or serious ozone problems*."

Table 5.6.2 shows potential Program treatment acreages by treatment type by air basin (see Figure 4.6.1 for location of air basins).

Table 5.6.2
Proposed Program Treatment Acreages by Air Basin

	Prescribed Burn	Mechanical	Hand	Herbicides	Herbivory	Total 1/
Great Basin Valleys	1,400	500	300	200	300	2,700
Lake County	1,500	500	300	300	300	2,900
Lake Tahoe	100	0	0	0	0	100
Mojave Desert	4,500	1,600	900	800	900	8,700
Mountain Counties	15,300	5,200	2,900	2,600	2,900	28,900
North Central Coast	10,900	3,700	2,100	1,900	2,100	20,700
North Coast	9,100	3,100	1,700	1,500	1,700	17,100
Northeast Plateau	12,400	4,300	2,300	2,000	2,300	23,300
Sacramento Valley	20,200	6,900	3,800	3,500	3,800	38,200
Salton Sea	1,800	600	300	300	300	3,300
San Diego County	6,100	2,000	1,100	1,000	1,100	11,300
San Francisco Bay Area	5,000	1,700	900	800	900	9,300
San Joaquin Valley	10,900	3,700	2,100	1,900	2,100	20,700
South Central Coast	10,700	3,600	2,000	1,800	2,000	20,100
South Coast	5,000	1,700	1,000	900	1,000	9,600
Total	**114,900**	**39,100**	**21,700**	**19,500**	**21,700**	**216,900**

1/ Acreage may not equal 216,910 acres of treatments due to rounding.

Data And Assumptions About Emissions From Prescribed Fire

In order to determine the emission of criteria air pollutants by air basin, the acreage treated by treatment type by WHR lifeform by air basin was determined. For broadcast and pile burning the pounds of emissions per ton of fuel consumed by major vegetation type were obtained from Sugihara's (2006) Table 21.1 for PM2.5, PM10, CO and non- methane hydrocarbons (NMHC). The pounds of NO_2 and SO_2 emissions per ton of fuel consumed and the pounds of NMHCs for herbaceous vegetation types were obtained from Battye and Battye (2002). Typical emissions from prescribed fire are in the range of 14 to 70 pounds of PM2.5 or PM10 per ton of fuel consumed for hardwood forests and 75-150 pounds of PM2.5 or PM10 per ton of fuel consumed in conifer forests. Sagebrush is expected to produce about 67 pounds of PM2.5 or PM10 per ton of fuel consumed, while chaparral is expected to give off about 150-200 pounds of PM2.5 or PM10 per ton of fuel consumed.

Fuel loading by vegetation type is a combination of Sugihara's Table 21.2 values by vegetation type and Scott and Burgan's (2005) fuel models by vegetation type. Scott and Burgan's values were based on the sum of all fuel loading and not just the fine fuel loading. Typical fuel loading varied from 4.5 tons/acre of fuel in sagebrush to 0.5 tons/acre for grass. Conifer forest fuel loadings were in the range of 14-16 tons/acre while hardwood forest fuel loadings were in the range of 6 tons/acre for oak woodlands and 14 tons/acre for montane hardwood types. Fuel loading for chaparral was based on 19.5 tons/acre from Sugihara.

Fuel load consumption values for broadcast burn and pile burn were based on work completed for the BLM PER (ENSR 2005) by ENSR International as well as professional experience. Most broadcast burn values were in the range of 25-50% fuel consumption (except for 90% for grass) including assigning a consumption value of 50% for chaparral and sagebrush burns. Burning of piles

created in mechanical and hand treatments was estimated to amount to 10% of all acres treated by the specific treatment type, e.g., if 500 acres were treated by mechanical methods, then approximately 50 acres of piles would likely be created and 90% of those piles would be burned. Fuel consumption in pile burns was estimated at 90% for all vegetation types.

Data And Assumptions About Non-Prescribed Fire Emissions

BLM's PER (ENSR 2005) includes an exhaustive analysis of the emissions expected from travel to and from treatment sites, as well as emissions from heavy equipment performing treatments. In addition, the BLM analysis includes possible dust from equipment traveling on unpaved roads as well as dust from exposed soil caused by treatments such as prescribed fire, tractor piling, masticating, etc. Emissions data are available by treatment type (e.g. prescribed burn, mechanical, hand, etc.) by state.

For this analysis, the pounds per acre of emissions for several of the criteria air pollutants were calculated using the BLM PER data for California, except for herbivory, which used South Dakota emissions. The reason to use the South Dakota herbivory data instead of the California data is because the BLM California data assumed 50% of all "biological" treatments were by herbivores and the other 50% were by insects. South Dakota's data modeled the biological treatments on 100% herbivore treatments. Also, since the BLM PER did not break out the prescribed fire emission values from the vehicle/treatment emissions, the hand treatment emissions from vehicles/equipment were used to predict the emissions of vehicles and equipment used to implement a prescribed fire. The latter approach probably overstates the emissions from vehicles/equipment that would be used in a prescribed fire, as hand treatments were modeled by the BLM to take as long as 25 person days to treat 25 acres, when in fact, it would normally be the case that a prescribed burn of 260 acres would be accomplished in one day with fewer than 25 person days assigned to the burn. Once the per-acre values were determined they were extrapolated to the entire state based on the acreage by treatment type from Chapter 2 or Chapter 3. Table 5.6.3 summarizes the expected emissions from mechanical, hand, herbicide and prescribed herbivory as well as the vehicle and other non-prescribed fire emissions for prescribed fire treatments.

Table 5.6.3
Potential Emissions From Vehicles/Heavy Equipment Performing Treatments Statewide by the Proposed Program

Pollutant	Prescribed Burn	Mechanical	Manual	Chemical	Herbivory	Total
	Tons Per Year					
PM10	29.8	5.0	5.6	16.9	0.6	29.8
PM2.5	17.4	5.0	3.3	2.4	0.0	17.4
CO	600.6	6.6	113.4	1.9	1.1	600.6
NMHC [1/]	99.3	3.3	18.7	0.9	0.0	99.3
NO_2	2.5	31.4	0.5	1.5	0.0	2.5
SO_2	0.0	1.7	0.0	0.0	0.0	0.0

[1/] NMHC emissions are generally taken as equivalent to VOC emissions (Battye and Battye, 2002).

Total California wide emissions of CO, PM10 and PM2.5 from all sources in 2005 were 5.8 million tons, 0.9 million tons and 0.39 million tons respectively. Total carbon emissions from Program mechanical and hand treatments (~60,500 acres/year) from vehicles and heavy equipment (but not from prescribed fire) are expected to be 650 tons/year or about 0.011% of all CO emissions in the state in 2005. Compared to the criteria pollutant emissions for all sources in California, the amount of emissions from the Proposed Program vehicle trips and heavy equipment is considered insignificant and is not considered further.

5.6.4 Direct Effects Common to all Bioregions From Implementing the Program/ Alternatives

Table 5.6.4 summarizes the information from the balance of this subchapter of the effects to air quality from implementing the Proposed Program across the state by air basin. In this case, a significant effect is one in which emissions exceed the California violation thresholds described in Table 5.6.1.

Table 5.6.4
Summary of Effects 1/ On Air Quality From Implementing the Proposed Program

Air Basin	Prescribed Burn	Mechanical	Hand	Herbicides	Herbivory
Great Basin Valleys	**SA**	NA	NA	NA	NA
Lake County	**SA**	NA	NA	NA	NA
Lake Tahoe	**SA**	NA	NA	NA	NA
Mojave Desert	**SA**	NA	NA	NA	NA
Mountain Counties	**SA**	NA	NA	NA	NA
North Central Coast	**SA**	NA	NA	NA	NA
North Coast	**MB**	NA	NA	NA	NA
Northeast Plateau	**SA**	NA	NA	NA	NA
Sacramento Valley	**MB**	NA	NA	NA	NA
Salton Sea	**SA**	NA	NA	NA	NA
San Diego County	**SA**	NA	NA	NA	NA
San Francisco Bay Area	**SA**	NA	NA	NA	NA
San Joaquin Valley	**MB**	NA	NA	NA	NA
South Central Coast	**SA**	NA	NA	NA	NA
South Coast	**NB**	NA	NA	NA	NA

1/ Key to effects; adverse effects are those effects which degrade the diversity, structure, size, integrity, abundance or number of; or are outside the natural range of variability, for the resource at issue. Beneficial effects are those effects that improve the diversity, structure, size, integrity, abundance or number of; or are within the natural range of variability, for the resource at issue. SA/SB – significant adverse or beneficial effects are those effects that are substantial, highly noticeable, at the watershed scale; and often irreversible. MA/MB - moderately adverse or beneficial effects - those effects that can be detected beyond the affected area, but are transitory and usually reversible. NA/NB - negligible adverse or beneficial effects - those effects that are imperceptible or undetectable.

Two minimum management requirements are expected to help reduce impacts to air quality due to implementation of the Proposed Program—MMRs 3 and 4. MMR 3 requires that applicants contact the local air quality management district and comply with all state and local laws and regulations. AQMD requirements vary as to the acres and/or tons of fuel consumed in "agricultural

burns" and the corresponding amount of information requested from the applicant. MMR 4 requires that applicants not burn on no-burn days in order to reduce emissions of criteria air pollutants into conditions where they would potentially create a health hazard or become a nuisance. Typical burn days are those with enough wind and other weather factors that lead to substantial dispersal of the smoke from prescribed fire.

Effects to Air Quality From Implementation of Proposed Program Prescribed Fire Treatments Creating CO, PM2.5, PM10, NO_2 and SO_2

The primary air pollutants that are detrimental to public health or ecosystems, or that impair visual quality include particulates, oxides of sulfur and nitrogen, elemental carbon and carbon oxides, ozone and toxic air pollutants. Air pollution affects human health and welfare. The latter includes damage to vegetation, injury to animals, effects on soil and water, and impairment of visibility. Health effects include respiratory problems and decreased lung function, heart disease and premature death. Chronic injury to plants often results from intermittent or long-term exposure to relatively low pollutant concentrations with chlorophyll destruction or chlorosis as the principal symptom of injury (USFS, 2005). Nitrates and sulfates contribute to acid rain and dry deposition of acid compounds. Lower elevation aquatic systems tend to be less sensitive to acid rain than higher elevation systems. Current levels of acidity are not high enough to cause mortality of amphibians or to fish but may have other subtle effects particularly during the spring snowmelt period (USFS, 2005).

Pollutants from prescribed fire can cause visibility reductions from natural levels in Class I areas, which is largely due to sulfates, nitrates, organic compounds and dust particles from soil.

Atmospheric conditions that create temperature inversions and permit air masses to remain stagnant for long periods allow the airborne concentrations of smoke and other pollutants to increase. These conditions aggravate air pollution over urban, industrial, and agricultural areas. Air pollution is occasionally aggravated by daily and seasonal wind patterns. Sea-to-land breezes remove pollution from coastal areas during the day as cold, dense air moves onshore, but push it back during the night as the land breeze gently flows offshore (Jones and Stokes, 2000).

Wind direction and intensity during prescribed burns and wildfires are important because air quality is poorest immediately adjacent to and downwind of such fires. Fires near populated areas may pose an increased risk of air quality–related health problems.

The potential to ignite prescribed fire is dependent on whether the particular day is a permissive burn day and whether the project area is available to burn. An analysis of the number of permissive burn days by the California Air Resources Board, Planning and Technical Support Division, Meteorology Section of burn day information in 2005 showed that on average, the number of permissive burn days varies from a low of only 15 days per month in July to a high of 28 days per month in February. On the other hand, the average number of permissive burn days varies by AQMD location; the South Central Coast AQMD, for instance only averages about 21 permissive burn days per month. The Lake Tahoe AQMD has the lowest number of permissive burn days, at 19 days per month. Permissive burn days during the critical prescribed burn months of February through June average about 28 days per month statewide.

The number of available burn days is much lower than the number of permissive burn days. Available burn days are those days where fuel moisture content, wind speed and other meteorological conditions can support a burn and the AQMD has issued a permissive burn day forecast. Forest Service data (USFS, 2005) in the Mountain Counties, Northeast Plateau and Sacramento Valley air basins shows that there are only an average of 11 available burn days per month compared to an average of 26 permissive burn days per month.

The actual amount of pollutants produced compared to the amount predicted from Table 4.6.4, due to implementation of the Proposed Program, could vary substantially. A variety of factors influence the emission of criteria pollutants in a prescribed fire including amount of area burned, whether the prescribed fire is accomplished with a broadcast burn, pile burning or windrow burning, moisture content of the fuel and type of fuel (e.g., whether the fuel is grass, sagebrush, untreated conifer forest litter, duff and shrubs). One factor is whether the entire area to be burned actually is burned. Many broadcast burns do not completely burn the entire planned area resulting in fewer pounds of emissions.

The amount of emissions is also dependent on the amount of fuel that is actually consumed in a fire, which depends on the type of fuel, its depth on the forest floor, its moisture level, and other factors, such as humidity, wind speed, and fire intensity. Many pollutants emitted from fire are products of incomplete combustion, including carbon monoxide (CO), particulate matter, and hydrocarbons. Therefore, emissions from a fire depend not only on the fuel consumption, but also on the combustion efficiency (Battye and Battye, 2002).

In general, NO_2 emissions from combustion processes can be produced by two mechanisms: 1) oxidation of nitrogen compounds in the fuel, and 2) oxidation of nitrogen gas in the combustion air. However, very high temperatures (>1000 degrees C) are required for significant oxidation of nitrogen gas. Based on a large number of field and laboratory tests, Battye and Battye concluded that temperatures in the flames of prescribed fires do not typically reach levels that would result in significant oxidization of nitrogen in the air. Therefore, NO_2 emissions from fires are strongly dependent on the nitrogen levels in fuel materials.

Sulfur compounds in fuel materials produce SO_2 emissions from wild and prescribed fires. These emissions are minor in comparison with other pollutants (Battye and Battye, 2002).

Pollutant concentrations are a function not only of the total emissions within the airshed, but also the timing of the emissions, the location of the fire with respect to sensitive receptors (e.g. schools, churches, hospitals, etc.) meteorology of the area, and the physical characteristics of the smoke plume (USFS, 2005). These factors are normally assessed during site-specific project planning.

Based on the data and assumptions noted above, implementation of the Proposed Program (Table 5.6.5) could potentially increase the amount of CO, NO_2, SO_2, PM2.5 and PM10 emitted over the amounts already being emitted under the status quo (Alternative 1). However, as noted in Section 5.2, treatments from the Proposed Program would reduce wildfire severity on about 41,500 acres per year, which could reduce the annual production of criteria pollutants to levels associated with prescribed fire.

Table 5.6.5
Annual Increase in Tons of Pollutants Emitted Due to Implementation of the Proposed Program Prescribed Fire Treatments Compared to Status Quo (Alternative 1)

Air Basin	Annual Tons Produced Above Status Quo					
	PM10	PM 2.5	CO	NMHC[2/]	NO_2	SO_2
Great Basin Valleys	123	107	996	109	80	5
Lake County	80	70	667	65	43	3
Lake Tahoe	1/	1/	1/	1/	1/	1/
Mojave Desert	203	178	1,678	158	113	9
Mountain Counties	578	519	5,597	319	207	24
North Central Coast	342	297	2,875	281	194	15
North Coast	371	337	3,695	175	108	15
Northeast Plateau	599	542	5,589	331	209	24
Sacramento Valley	362	321	3,470	216	147	16
Salton Sea	140	122	1,110	117	87	6
San Diego County	494	426	3,893	463	324	22
San Francisco Bay Area	129	113	1,135	92	59	5
San Joaquin Valley	171	150	1,538	107	73	8
South Central Coast	357	308	2,957	314	223	16
South Coast	386	333	3,100	363	258	17
Total Tons Produced by Proposed Program	**4,335**	**3,823**	**38,301**	**3,110**	**2,125**	**186**
Total Tons Produced By Status Quo	**1083**	**954**	**9370**	**797**	**539**	**46**
Total Increase Over Status Quo	**3,252**	**2,869**	**28,931**	**2,313**	**1,586**	**140**
Total Tons Produced by Wildfire	**92,485**	**78,478**	**1,445,832**	**11,154**	**nd**	**8,927**

1/ The Proposed Program would potentially only treat about 100 acres with prescribed fire in this air basin, which is below the analytical threshold for this Programmatic analysis.

2/ NMHC emissions are generally taken as equivalent to VOC emissions (Battye and Battye, 2002).

Overall, emission of criteria pollutants from prescribed fire treatments due to the Proposed Program would exceed the thresholds for CO (100 tons/year), PM10 (15 tons/year) and ozone precursors (NMHC – 15 tons/year) in all air basins except for the Lake Tahoe Air Basin. Emission of SO_2 by prescribed fire treatments would not exceed the threshold of 27 tons/year in any of the air basins, but would approach the threshold in the Mountain Counties and San Diego County air basins.

Effects to Air Quality From Implementation of Alternatives 1 through 4 Prescribed Fire Treatments Creating CO, PM2.5, PM10, NO_2 and SO_2

Table 5.6.6 shows the effects to air quality from implementing Alternatives 1 through 4 treatments. Implementation of Alternative 1 would result in less tons of pollutants being emitted as a result of treatments compared to the Proposed Program, but would not change the overall emission of pollutants from wildfire from that described in Table 4.6.2, as 47,000 acres of treatments are already incorporated into the wildfire emissions shown. The emissions shown do not include any net gains or decreases due to change in wildfire behavior due to treatments.

Table 5.6.6
Comparison of Pollutants Emitted by Alternatives 1-4 Prescribed Fire Treatments

Alternative	PM10	PM 2.5	CO	NMHC	NO_2	SO_2
	Annual Tons of Pollutants Emitted by Treatments					
Proposed Program (from Table 5.6.5)	4,335	3,823	38,301	3,110	2,125	186
Alternative 1	1,083	954	9,370	797	539	46
Alternative 2	4,436	3,907	39,082	3,210	2,191	191
Alternative 3	4,534	3,998	39,788	3,257	2,204	193
Alternative 4	483	421	5,253	314	257	29

Alternatives 2 and 3 would produce about the same amount of pollutants and have the same impact on wildfire emissions as the Proposed Program. Alternative 4 could have a dramatically lower impact on air quality as pollutants would be reduced in some cases by nine-fold over the Proposed Program (e.g. 4,538 tons of CO produced by Alternative 4 compared to 33,353 tons by the Proposed Program). Implementing Alternative 4 in the Great Basin, Lake County, Lake Tahoe, North Central Coast, North Coast, Sacramento Valley, San Diego Coast and the South Central Coast air basins would not increase PM10 and CO above air basin thresholds. No air basin would exceed the threshold for SO_2 as a result of implementing Alternative 4.

Effects to Air Quality From Implementation of Proposed Program Treatments on Wildfire CO, PM2.5, PM10, NO_2 and SO_2 Emissions

Section 5.2 describes treatments by prescribed fire, mechanical and hand, which are expected to result in a reduction in the severity of wildfire, and potentially a reduction in the overall number of acres burned. Implementation of 216,910 acres of annual treatments by the Proposed Program is expected to reduce wildfire severity from severe to low-to-moderate on 29,000 acres annually. Average annual emissions from wildfire across the entire state (not just on jurisdiction lands) have previously been described in Table 4.6.2. The change in severity from severe fire behavior to low-to-moderate fire behavior is approximated here as a change in emissions between wildfire and prescribed fire. Based on Ahuja's (2006) Table 21.5 values, the difference in the emission rate of pollutants between wildfire and prescribed fire is on the order of about 30-40% for PM2.5, PM10, CO and volatile organic compounds (Table 5.6.7). There is little difference in the amount of SO_2 emitted between wildfire and prescribed fire. Prescribed fire is expected to emit substantially less NO_2 emissions because prescribed fires are expected to burn at lower temperatures than wildfire.

Table 5.6.7
Reduction in Pollutants Emitted by Wildfire as a Result of Program Treatments

Pollutant	Wildfire	Prescribed	% Reduction
	Pounds/acre emitted		
PM10	300.6	180.2	40.1%
PM2.5	257.7	158.6	38.5%
VOC	145.5	97.3	33.1%
CO	3089.5	1819.8	41.1%
SO_2	18.3	18.0	1.5%
NO_2	66.4	7.2	89.1%

Total Program emissions from both wildfire and prescribed fire together are potentially lower than the Status Quo as a result of treatments shown in Table 5.6.8. These effects are speculative in that, while there is a moderate degree of certainty as to the amount of pollutants emitted by prescribed fire, there is a low degree of certainty that a treated area will be burned by wildfire as well as to the amount of emissions these acres emit due to wildfire in a particular bioregion or air basin. Thus, while there is a moderate degree of confidence in the estimates of the pollutants emitted by the Proposed Program prescribed fire treatments, there is a low degree of confidence in predictions about the amount of pollutants that might be "saved" due to treated areas burning at lower intensity by wildfire.

Table 5.6.8
Tons of Pollutants Not Emitted ("Saved") as a Result of Proposed Program Treatments

Air Basin	Treated	Annual Acreage Burned 1994-2003	Acreage Burned By Wildfire At Low-Moderate Severity As A Result Of Treatments	Annual Tons Emitted By Wildfire				Tons Of Pollutants Emitted By Wildfires After Proposed Program Treatments			
				CO	SO2	PM10	PM25	CO	SO2	PM10	PM25
	Acres			Tons of Pollutants 1/							
Great Basin Valleys	2,700	7,392	361	3,074	34	321	272	3,012	34	314	267
Lake County	2,900	10,629	387	45,139	471	4,660	3,954	44,463	471	4,592	3,899
Lake Tahoe	100	89	13	344	3	35	30	323	3	33	28
Mojave Desert	8,700	19,398	1,162	34,655	318	3,492	2,964	33,802	318	3,408	2,895
Mountain Counties	28,900	42,900	3,861	144,667	1,365	14,648	12,430	139,316	1,363	14,120	11,999
North Central Coast	20,700	14,579	2,766	15,882	167	1,643	1,394	14,644	167	1,518	1,292
North Coast	17,100	24,811	2,285	143,315	1,542	14,886	12,631	137,891	1,540	14,337	12,183
Northeast Plateau	23,300	27,053	3,113	77,485	809	8,000	6,788	73,821	808	7,631	6,488
Sacramento Valley	38,200	37,755	5,104	138,172	1,353	14,088	11,954	130,495	1,350	13,325	11,333
Salton Sea	3,300	4,549	441	4,414	39	443	376	4,238	39	426	362
San Diego County	11,300	60,514	1,510	50,215	474	5,089	4,319	49,700	474	5,038	4,278
San Francisco Bay Area	9,300	7,920	1,243	18,017	183	1,850	1,570	16,855	182	1,734	1,475
San Joaquin Valley	20,700	58,206	2,766	126,841	1,193	12,835	10,892	124,364	1,192	12,591	10,693
South Central Coast	20,100	57,534	2,686	43,676	417	4,435	3,763	42,838	417	4,352	3,696
South Coast	9,600	55,477	1,283	599,937	559	6,059	5,142	594,237	558	6,003	5,096
Total	216,900	428,806	28,979	1,445,832	8,927	92,485	78,478	1,409,999	8,916	89,423	75,984

1/ Figures may not add due to rounding

Table 5.6.9 summarizes the amount of pollutants that would be emitted as a result of treatments reducing wildfire severity from severe to low/moderate on 29,000 of the 156,000 acres burned annually. As a result of treatments, about 1.409 million tons of CO would be emitted by wildfire after treatment instead of 1.445 million tons without treatment, an annual savings of about 35,800 tons of CO. About 3,060 tons of PM10 and about 2,500 tons of PM2.5 would not be emitted as a result of wildfire burning at lower intensity. As noted above, there is low degree of certainty as to whether a treated area will be burned by wildfire, whereas there is a relatively high degree of certainty as to the amount of pollutants emitted by prescribed fire. However these effects are outweighed by the production of the same criteria pollutants by the prescribed fire treatments.

Table 5.6.9
Comparison of Tons of Pollutants Emitted by Proposed Program Treatments and Tons of Pollutants "Saved" by Proposed Program Treatments

	Annual Tons Of Pollutants					
	PM10	**PM2.5**	**CO**	**NMHC**	**NO_2**	**SO_2**
Increase due to Treatments (Table 5.6.5)	4,335	3,823	38,301	3,110	2,125	186
Decrease Due to Change in Wildfire Behavior (Table 5.6.8)	-3,062	-2,494	-35,832	**nd**	nd	-11
Difference ("-" indicates an overall reduction)	1,273	1,329	2,469	**nd**	nd	175

Implementation of the Proposed Program would potentially increase the amount of PM10, PM2.5, CO, and SO_2 generated from the combination of prescribed fire and reduction in wildfire emissions.

Implementation of the Proposed Program would likely meet the goal to reduce impacts to air quality from wildfires as a result of treatments which reduce the severity of fire on treated acres as well as treating about 2.6% of the state's watersheds during a decade at a level where the extent and size of fire would be reduced (e.g. at the 35% level). As noted above the effect of implementing the program on wildfire emissions would be to reduce PM10, PM2.5 and CO emissions. Overall emissions of these criteria pollutants might increase over the status quo, though the prescribed fire emissions would likely occur at a time of year when the receiving air quality is much higher compared to the air quality when wildfire emissions normally occur.

Effects to Air Quality From Implementation Alternatives 1 through 4 Treatments on Wildfire CO, PM2.5, PM10, NO_2 and SO_2 Emissions

Alternatives 1, 2 and 3 would have similar impacts to air quality as the Proposed Program in terms of reducing emissions from wildfire, that is wildfire emissions would be reduced on approximately 29,000 acres per year due to treatments. Alternative 4, on the other hand, treats so few acres annually, since so few watersheds experience more than 35% treatment, wildfire behavior is not reduced nearly as much as the other alternatives. As a result, emissions from wildfire would only be affected on about 5,000 of the 93,000 acres treated in Alternative 4, out of the 156,000 acres per year that are likely to burn, statewide on jurisdiction lands.

Alternatives 1, 2 and 3 would each meet the goal related to reducing air quality impacts from wildfire (Goal 5) at about the same rate and level as the Proposed Program (e.g. 1/5 of all acres burned annually on jurisdiction lands would likely have reduced emissions as a result of treatments).

Alternative 4 would not meet this goal nearly as well since the rate of treatment would only reduce emissions from about 1/15 of the acres that burn annually on jurisdiction lands due to wildfire.

Effects to Visibility From Implementation of Proposed Program Treatments

As noted in Section 4.6, there are 29 Class I areas within the State. The location of these is mostly off jurisdiction lands, however prescribed fire on jurisdiction lands can create haze and reduce visibility off site. Class I areas can be considered "smoke sensitive areas" as almost no change from current air quality is allowed from new sources.

Fine particulate matter (PM2.5) is more efficient per unit mass than coarse materials at causing visibility impairment. Current visual range in the western US is about 60-90 miles (40 CFR Part 51). Visibility rules enacted by the EPA in 1999 (40 CFR Part 51) require states to make reasonable progress toward the Clean Air Act goal of "prevention of any impairment of visibility" (Sanberg, Ottmar, Peterson and Core 2002). Current data from a national visibility-monitoring network do not show fire to be a predominant long-term source of visibility impairment in any Class I area (40 CFR part 51). However wildfire (and prescribed fire) can have short-term visibility effects on Class I areas (Sanberg, Ottmar, Peterson and Core, 2002). Guidance from the Western Regional Air Partnership (WRAP) now classifies some wildfire and prescribed fire emissions as "natural" in recognition of fire's inherent occurrence as part of the landscape (Ahuja, 2006). The EPA haze reduction rule (40 CFR Part 51) guidance requires that states address natural reductions of visibility from fire as well as identify those fire emissions that need to be controlled to achieve progress toward the 2064 natural conditions goal.

There are two general strategies for reducing smoke emissions: avoidance (e.g., fire prevention and suppression) and fuel modification. The latter includes techniques for altering the existing fuel loading, structure, or both. Techniques for fuel modification include utilization (such as thinning or final harvest), mechanical treatment (piling, lopping and scattering, and crushing), and prescribed fire. These strategies can benefit air quality both short and long term.

Battye and Battye (2002) note that prescribed fire emissions can be reduced by:

1. Having clear smoke management objectives,
2. Burning when conditions favor rapid combustion and dispersion,
3. Burning under favorable moisture conditions,
4. Using backfires when applicable,
5. Burning smaller vegetation blocks when appropriate, and
6. Coordinating with regional and local air pollution and fire control officials to ensure that the burn plan complies with federal, state, and local regulations.

The WRAP has produced guidance to prescribed fire managers that includes: 1) minimizing air pollution emissions, 2) public education, 3) surveillance and enforcement, 4) program evaluation and reporting, 5) air quality monitoring, 6) evaluation of smoke dispersion and 7) regional coordination.

As noted in Section 4.6, the application of best available control measures (BACM) for prescribed fire is a required element of State Implementation Plans for PM10 non-attainment areas

that are significantly impacted by prescribed fire smoke (US EPA, 1992). When a burn plan is completed for a project it should include the following smoke management components:

- Actions to minimize fire emissions – The steps taken prior to the burn and actions that will be taken after the burn to reduce air pollutant emissions.
- Evaluate smoke dispersion – Fire prescriptions submitted prior to the day of the fire must specify minimum requirements for the atmospheric capacity for smoke dispersal such as minimum surface and upper level wind speeds, desired wind direction, minimum mixing height, and dispersion index.
- Public notification and exposure reduction procedures – Actions should be taken to notify populations and authorities at sensitive receptors, including those in adjacent jurisdictions, prior to the fire. The plan should also identify contingency actions that will be taken if smoke intrusions occur.
- Air Quality Monitoring – The plan should identify how the effects of the fire on air quality at sensitive receptors and visibility in mandatory Class I Federal areas will be monitored.

Implementation of the above practices will help reduce the effects of implementing the Proposed Program on Class I air quality areas. The Proposed Program is expected to emit an estimated 4,325 tons of PM2.5 annually across the entire state, which is 1.1% of the total PM2.5 emitted annually across the state between 1994 and 2003. A greater impact on Class I areas is the impact expected from wildfire, which is expected to emit approximately 78,500 tons of PM2.5 statewide annually. Because of the small amount of PM2.5 emitted annually by the Proposed Program, some of which is expected to be classified as natural, there is not expected to be a significant deterioration to visibility in Class I air quality areas across the state due to implementation of the Program. There is expected to be a short-term degradation to visibility at some Class I areas, but due to the fact that actual treatment locations are not known at this point, it is speculative to predict which areas might be affected. Mitigation measures described below will help to reduce effects on Class I areas. In addition, treatments between now and the 2064 target date are likely to result in 1.64 million treated acres burning at lower intensities from wildfire due to treatments which will likely reduce the amount of PM2.5 generated by wildfire.

5.6.5 Bioregion Specific Direct Effects of Implementing the Program/ Alternatives

While treatments produce CO, PM2.5 and PM10, they also reduce wildfire emissions of the same pollutants due to reducing the severity of wildfire on approximately 29,000 acres. However, as noted above, these effects are speculative because while the effects from prescribed fire and wildfire are relatively certain, there is far less certainty that a treated area will burn due to wildfire, notwithstanding the relative fire frequency in a particular bioregion or air basin. Thus, while there is a moderate degree of certainty in the estimates of the emissions emitted by the Proposed Program prescribed fire treatments there is a low degree of certainty in predictions about the amount of pollutants that might be “saved” due to treated areas burning at lower intensity.

Table 5.6.10 compares the emissions due to prescribed fire treatments with the possible reduction in emissions from wildfires due to treatments.

Table 5.6.10
Comparison of Proposed Program Annual Treatment Emissions to Emissions "Saved" on Treated Areas Burned by Wildfire

Air Basin	Treatment Emissions				Emissions "Saved" By Wildfire Burning Treated Areas				Net Increase (+) or Decrease (-) in Emissions			
	PM10	PM 2.5	CO	SO2	PM10	PM25	CO	SO2	PM10	PM25	CO	SO2
	Tons of Pollutants Emitted Annually											
Great Basin Valleys	123	107	996	5	-6	-5	-62	0	117	102	934	5
Lake County	80	70	667	3	-68	-55	-676	0	12	15	-9	3
Lake Tahoe 1/	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mojave Desert	203	178	1,678	9	-84	-68	-853	0	119	109	824	8
Mountain Counties	578	519	5,597	24	-528	-430	-5,351	-2	50	89	246	22
North Central Coast	342	297	2,875	15	-125	-102	-1,238	0	217	196	1,636	15
North Coast	371	337	3,695	15	-549	-447	-5,423	-2	-179	-111	-1,729	13
Northeast Plateau	599	542	5,589	24	-369	-300	-3,664	-1	231	242	1,925	23
Sacramento Valley	362	321	3,470	16	-763	-622	-7,676	-3	-400	-301	-4,206	13
Salton Sea	140	122	1,110	6	-17	-14	-176	0	123	108	935	6
San Diego County	494	426	3,893	22	-51	-41	-515	0	443	384	3,378	21
San Francisco Bay Area	129	113	1,135	5	-116	-95	-1,162	0	12	18	-26	5
San Joaquin Valley	171	150	1,538	8	-244	-199	-2,477	-1	-74	-49	-938	7
South Central Coast	357	308	2,957	16	-83	-68	-838	0	274	241	2,120	16
South Coast	386	333	3,100	17	-56	-46	-5,700	0	330	287	-2,600	17
Total	**4,335**	**3,823**	**38,301**	**186**	**-3,060**	**-2,493**	**-35,811**	**-11**	**1,273**	**1,329**	**2,469**	**175**

1/ The Proposed Program would potentially only treat about 100 acres with prescribed fire in this air basin, which is below the analytical threshold for this Programmatic analysis.

The greatest effects to air quality from potential treatments occur in the North Central Coast, Northeast Plateau, San Diego County, South Coast and South Central Coast air basins. Total annual production of CO ranges from a savings of 4,200 tons in the Sacramento Valley to 2,120 additional tons/year in the South Central Coast, which exceeds the threshold value of 100 tons/year stated above. Values for PM2.5 and PM10 also exceed threshold values in various air basins. Some air basins experience improvements in some criteria pollutants such as the Sacramento Valley where the scope of treatments and the incidence of recurrent wildfire result in substantial savings in emissions.

Overall, due to differences in vegetation types, location of treatments, location of wildfires and differences in treatment types different air basins experience different results from treatments. The Great Basin Valleys, Mojave Desert, Mountain Counties, North Central Coast, Northeast Plateau, Salton Sea, San Diego County and South Central Coast all have CO emissions that would exceed thresholds even when accounting for reductions due to changes in wildfire behavior. Proposed Program treatments would exceed PM10 thresholds for the Great Basin Valleys, Mojave Desert, Mountain Counties, North Central Coast, Northeast Plateau, Salton Sea, San Diego County, South Central Coast and South Coast. Improvements in air quality due to the combination of vegetation, treatment acreage, location of wildfires and range of treatment types might be experienced in the

North Coast, Sacramento Valley and San Joaquin air basins with respect to PM10 and for the same air basins along with the South Coast air basin with respect to CO.

Bioregion Specific Effects to Air Quality From Implementation of Alternatives 1 through 4 Prescribed Fire Treatments Creating CO, PM2.5, PM10, NO_2 and SO_2

At the bioregional level implementation of Alternative 1 would result in less tons of pollutants being emitted as a result of treatments compared to the Proposed Program, but would not change the overall emission of pollutants from wildfire from that described in Table 4.6.2, as 47,000 acres of treatments are already incorporated into the wildfire emissions shown. The emissions shown do not include any net gains or decreases due to change in wildfire behavior due to treatments.

At the bioregional level Alternatives 2 and 3 would produce about the same amount of pollutants and have the same impact on wildfire emissions as the Proposed Program. Alternative 4 could have a dramatically lower impact on air quality as pollutants would be reduced in some cases by 9-fold over the Proposed Program (e.g. 4,538 tons of CO produced by Alternative 4 compared to 33,353 tons by the Proposed Program). Implementing Alternative 4 in the Great Basin, Lake County, Lake Tahoe, North Central Coast, North Coast, Sacramento Valley, San Diego Coast and the South Central Coast air basins would not increase PM10 and CO above air basin thresholds. No air basin would exceed the threshold for SO_2 as a result of implementing Alternative 4. On the other hand, because so few acres are treated and because so few watersheds experience more than 35% treatment, wildfire behavior is not reduced nearly as much as the other alternatives. As a result, emissions from wildfire would only be affected on about 5,000 of the 80,400 treated acres in Alternative 4, out of the 156,000 acres per year that are likely to burn, statewide.

5.6.6 Indirect Effects of Implementing the Program/Alternatives

Over 70% of the total mass of emissions from prescribed fire (and wildfire for that matter) is in the form of CO_2. As a result, impacts to greenhouse gases, which have been discussed in Section 5.4 –Climate Change, are substantially affected by the different proportion of treatments among the alternatives. Thus, while the impact of the Proposed Program may be positive with respect to the emission of criteria pollutants, there may be indirect and adverse effects to climate from the Proposed Program. Increases in the amount of SO_2 and NO_2 could potentially lead to increases in acidification of low elevation lakes with possible impacts to amphibians. Although most of the prescribed fire takes place on private lands, there is a potential to create nuisance effects to neighbors including the soiling of adjacent properties with soot, ash, etc. There is also a potential nuisance effect from prescribed fire on visibility.

5.6.7 Determination of Significance

There is a relatively high degree of certainty associated with the prediction of emissions of pollutants from treatments under the Proposed Program, while there is a low degree of certainty about the effect of treatments on emissions from wildfires. Emission of five of the six criteria pollutants from the Proposed Program treatments could potentially exceed thresholds for CO, PM10 and ozone precursors (NMHCs) in all air basins except for the North Coast, Sacramento Valley, San Joaquin and possibly the South Coast air basins which would likely result in a substantial adverse effect to air quality. Treatments by the Program could exceed the SO_2 thresholds in all air

basins resulting in a significant effect. Proposed Program treatments would exceed the thresholds of NO_2 in all air basins. As a result, the Program and Alternatives will potentially create a significant impact to air quality because total emissions of criteria pollutants will likely exceed California's Ambient Air Quality Standards, but with mitigation, the impacts are expected to be less than significant.

Mitigation measures described below will ensure that impacts to air quality are reduced to less than significant.

5.6.8 Similar Effects Described Elsewhere

The effects to climate and greenhouse gases described in Section 5.4 are similar to the effects to air quality.

5.6.9 Mitigation Measures for the Proposed Program

Adopt Mitigation Measures 5.6-1 through 5.6-2 to help ensure that adverse effects to air quality are reduced to the greatest extent possible.

Mitigation Measure 5.6-1. The project applicant shall submit a Smoke Management Plan and obtain a smoke management permit from the local Air District.

Mitigation Measure 5.6-2. Active-phase smoke monitoring shall be conducted during prescribed burns. If smoke impacts occur the mitigations or contingencies in the smoke management plan will be implemented.