APPENDIX F
AIR QUALITY

This appendix describes in greater detail the air quality issues referenced in the text and tables presented in Section 3.5 and 4.5.

Table of Contents

Supporting Tables

Table F-1 Highest Predicted 1-Hour CO Concentrations for Eight Receptor Locations Years 2005 & 2010 (ppm)

Supporting Figures

None

Supporting Analyses

Section F.1 General Information on Carbon Monoxide, Ozone, and Particulate Matter

Table F-1
Highest Predicted 1-Hour and (8-Hour) CO Concentrations for Eight Receptor Locations
Years 2005 & 2010
(ppm)

Receptor No. (data presented are for worst-case site within the receptor)	Alternatives									
	1		2		3		4		5	
	2005	2010	2005	2010	2005	2010	2005	2010	2005	2010
Alternatives 2, 4, and 5 Region of Influence										
1	3.8 (2.3)	3.8 (2.3)	5.2 (3.3)	6.1 (3.9)	n/a	n/a	5.2 (3.3)	6.2 (4.0)	5.2 (3.3)	6.1 (3.9)
2	3.9 (2.4)	4.0 (2.4)	5.1 (3.2)	6.1 (3.9)	n/a	n/a	5.1 (3.2)	6.2 (4.0)	5.1 (3.2)	6.1 (3.9)
3	3.9 (2.4)	4.0 (2.4)	5.2 (3.3)	6.1 (3.9)	n/a	n/a	5.2 (3.3)	6.2 (4.0)	5.2 (3.3)	6.1 (3.9)
4	3.7 (2.2)	3.8 (2.3)	5.1 (3.2)	6.2 (4.0)	n/a	n/a	5.1 (3.2)	6.2 (4.0)	5.1 (3.2)	6.1 (3.9)
Alternative 3 Region of Influence										
5	4.5 (2.8)	5.0 (3.1)	n/a	n/a	5.4 (3.4)	6.4 (4.1)	n/a	n/a	n/a	n/a
6	4.7 (2.9)	5.2 (3.3)	n/a	n/a	5.3 (3.4)	6.8 (4.4)	n/a	n/a	n/a	n/a
7	5.1 (3.2)	6.0 (3.8)	n/a	n/a	5.7 (3.6)	6.9 (4.4)	n/a	n/a	n/a	n/a
8	6.0 (3.8)	6.7 (4.3)	n/a	n/a	6.7 (4.3)	7.5 (4.9)	n/a	n/a	n/a	n/a

Source: Baker, 1999c.

F.1 GENERAL INFORMATION ON CARBON MONOXIDE, OZONE, AND PARTICULATE MATTER

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless and, at high levels, poisonous gas, formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust, which now accounts for 77 percent of national total CO emissions. High concentrations of CO generally occur in areas with heavy traffic congestion. Other sources of CO emissions include industrial processes, non-transportation fuel combustion, and natural sources such as wildfires. Peak CO concentrations typically occur during the colder months of the year, when CO automotive emissions are greater and nighttime inversion conditions (where air pollutants are trapped near the ground beneath a layer of warm air) are more frequent.

Carbon monoxide enters the bloodstream through the lungs and reduces oxygen delivery to the body's organs and tissues. The health threat from lower levels of CO is most serious for those who suffer from cardiovascular disease, and may aggravate such conditions as angina pectoris. At much higher levels of exposure, CO can be poisonous, and even healthy individuals may be affected. Visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty in performing complex tasks are all associated with exposure to elevated levels of CO.

Between 1988 and 1997, despite a 25 percent increase in vehicle miles traveled in the U.S., nationwide ambient CO concentrations decreased 38 percent, and the estimated number of exceedances of the national standard decreased 95 percent. Between 1996 and 1997, ambient CO concentrations decreased 7 percent, while CO emissions decreased 3 percent.

Ozone

Ground-level ozone (O_3), the primary constituent of smog, continues to be a pervasive pollution problem throughout many areas of the United States. Ozone is not emitted directly into the air but is formed by the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NOx) in the presence of heat and sunlight. Ground-level ozone forms readily in the atmosphere, usually during hot summer weather.

VOCs are emitted from a variety of sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, and other industrial sources. Nitrogen oxides are emitted from motor vehicles, power plants, and other sources of combustion. Changing weather patterns contribute to yearly differences in ozone concentrations from city to city. Ozone and the precursor pollutants that cause ozone also can be transported into an area from pollution sources located hundreds of miles upwind.

Short-term (1 to 3 hours) and prolonged (6 to 8 hours) exposures to ambient ozone have been linked to a number of health problems. Longer-term exposures to moderate levels of ozone may

lead to irreversible changes in the lungs that, in turn, could lead to premature aging of the lungs and/or chronic respiratory illnesses.

Ozone also affects vegetation and ecosystems, leading to reductions in agricultural and commercial forest yields, reduced growth and survivability of tree seedlings, and increased plant susceptibility to disease, pests, and other environmental stresses (e.g., harsh weather). In long-lived species, these effects may become evident only after several years or even decades, thus posing the potential for long-term effects on forest ecosystems. Ground-level ozone damage to the foliage of trees and other plants can also decrease the aesthetic value of ornamental species as well as the natural beauty of national parks and recreation areas.

In 1997, EPA revised the national ambient air quality standards for ozone by replacing the 1-hour ozone 0.12 parts per million (ppm) standard with a new 8-hour 0.08 ppm standard. The revision was set such that the 1-hour standard will no longer apply once an area has air quality data meeting the 1-hour standard. EPA is beginning to track trends in 8-hour levels of ozone, although areas that do not meet the new 8-hour standard will not be designated "nonattainment" until the year 2000.

Ambient ozone trends are influenced by year-to-year changes in meteorological conditions, population growth, loadings of VOC and NOx in the atmosphere, and by changes in emissions due to ongoing control measures. Between 1988 and 1997, ambient ozone concentrations decreased 19 percent based on the pre-existing standard.

In order to address ozone pollution, EPA has traditionally focused its control strategies on reducing emissions of VOC in nonattainment areas. However, EPA and state agencies recognize a need for an aggressive program to reduce regional emissions of NOx. In 1998, EPA issued a rule to significantly reduce regional emissions of NOx in 22 states and the District of Columbia, and, in turn, reduce the regional transport of ozone.

National trends in NOx and VOC emissions underscore the importance of this new approach to control NOx emissions. Volatile organic compound emissions decreased 20 percent between 1988 and 1997, while NOx emissions decreased only one percent. VOC emissions from highway vehicles have declined by 38 percent since 1988, while highway vehicle NOx emissions have declined by 8 percent since their peak level in 1994. Further, between 1970 and 1997, emissions of VOCs have decreased 38 percent whereas emissions of NOx have increased 11 percent and NOx emissions from coal-fired power plants have increased 44 percent.

Particulate Matter

Particulate matter (PM) is the general term used for a mixture of solid particles and liquid droplets found in the air. Some particles are large or dark enough to be seen as soot or smoke, while others are so small they can be detected only with an electron microscope (fine particles are less than 2.5 micrometers in diameter; coarse particles are larger than 2.5 micrometers). These particles originate from many different stationary and mobile sources as well as from natural sources. Fine particles ($PM_{2.5}$) result from fuel combustion from motor vehicles, power

generation, and industrial facilities, as well as from residential fireplaces and wood stoves. Coarse particles (PM_{10}) are generally emitted from sources such as vehicles traveling on unpaved roads, materials handling, and crushing and grinding operations, as well as windblown dust. Some particles are emitted directly from their sources, such as smokestacks and cars. In other cases, gases such as sulfur oxide (SO_2), NOx, and VOC interact with other compounds in the air to form fine particles. Their chemical and physical compositions vary depending on location, time of year, and weather.

Inhalable PM includes both fine and coarse particles. These particles can accumulate in the respiratory system and are associated with numerous health effects. Exposure to coarse particles is primarily associated with the aggravation of respiratory conditions such as asthma. Health problems due to inhalation of fine particles have been linked to increases in hospital admissions and emergency room visits for heart and lung problems and even premature death. Sensitive groups that appear to be at greatest risk to such effects include the elderly, individuals with cardiopulmonary diseases, and children. In addition to health problems, PM is the major cause of reduced visibility in many parts of the United States. Airborne particles can also cause damage to paint and building materials.

In 1997, EPA added two new $PM_{2.5}$ standards, set at 15 micrograms per cubic meter (μg/m3) and 65 μg/m3, respectively, for the annual and 24-hour standards. In addition, the form of the 24-hour standard for PM-10 was changed. EPA is beginning to collect data on $PM_{2.5}$ concentrations. Beginning in 2002, based on three years of monitor data, EPA will designate areas as nonattainment that do not meet the new $PM_{2.5}$ standards.

Between 1988 and 1997, nationwide average PM_{10} concentrations decreased 26 percent. Short-term trends between 1996 and 1997 showed a decrease of one percent in monitored PM_{10} concentrations. Emissions of PM_{10} are based on estimates of anthropogenic emissions, including fuel combustion sources, industrial processes, and transportation sources, which account for only 6 percent of the total PM_{10} emissions nationwide. Between 1988 and 1997, nationwide PM_{10} emissions for these sources decreased 12 percent. Emissions of PM_{10} between 1996 and 1997 decreased one percent.

These emissions estimates do not include emissions from natural and miscellaneous sources, such as unpaved and paved roads (which generate fugitive dust), agricultural and forestry activities, wind erosion, wildfires, and managed burning. Furthermore, these emissions estimates also do not account for PM that is secondarily formed in the atmosphere from gaseous pollutants (i.e., SO2 and NOx).