CHAPTER 2
AIR QUALITY AND HEALTH EFFECTS

Introduction

Ambient Air Quality Standards

Comparison to Other U.S. Areas

Current Air Quality Summary

INTRODUCTION

In this chapter, year 2001 air quality in the South Coast Air Basin (Basin), and in the portion of the Salton Sea Air Basin (SSAB) monitored by the South Coast Air Quality Management District (District), is compared to state and federal ambient air quality standards. For those pollutants for which the Basin is in nonattainment of the federal standards, maps have been included which compare the year 2001 air quality in different areas of the Basin.[1] Nationwide air quality for 2001 is also briefly summarized in this chapter. A comparison of air quality in the Basin to other U.S. and California urban areas is presented in the following pages.

AMBIENT AIR QUALITY STANDARDS

Ambient air quality standards for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter (PM10 and PM2.5), and lead have been set by both the California state and federal governments. The state has also set standards for sulfate and visibility. The ambient air quality standards for each of these pollutants and their effects on health are summarized in Table 2-1.

In 2001, the Basin exceeded the federal standards for ozone, PM10 and PM2.5 on a total of 58 days. Despite the substantial improvement over historical air quality in the past few decades, some areas in the Basin still exceed the 1-hour federal standard for ozone more frequently than any other area of the U.S. In 2001, nine out of ten locations in the nation that exceeded the standard most frequently were located in the Basin and the Basin is currently the only area in the nation classified as "extreme" nonattainment for ozone. The Basin is also among the few areas in the nation that still is classified as nonattainment for carbon monoxide. (The Basin has technically met the CO standards in 2002 and the District will request reclassification as attainment in the next few years.)

COMPARISON TO OTHER U.S. AREAS

The Basin's severe air pollution problem is a consequence of the combination of emissions from the nation's second largest urban area and meteorological conditions which are adverse to the dispersion of those emissions. The average wind speed for Los Angeles is the lowest of the nation's ten largest urban areas. In addition, the summertime maximum mixing height (an index of how well pollutants can be dispersed vertically in the atmosphere) in Southern California averages the lowest in the U.S. The Southern California area is also an area with abundant sunshine, which drives the photochemical reactions which form pollutants such as ozone.

[1] Complete data for the year 2002 is not available at this time.

TABLE 2-1

Ambient Air Quality Standards*

AIR POLLUTANT	STATE STANDARD CONCENTRATION/ AVERAGING TIME	FEDERAL PRIMARY STANDARD CONCENTRATION/ AVERAGING TIME	MOST RELEVANT EFFECTS
Ozone	0.09 ppm, 1-hr. avg. >	0.12 ppm, 1-hr avg.> 0.08 ppm, 8-hr avg.>	(a) Short-term exposures: (1) Pulmonary function decrements and localized lung edema in humans and animals. (2) Risk to public health implied by alterations in pulmonary morphology and host defense in animals; (b) Long-term exposures: Risk to public health implied by altered connective tissue metabolism and altered pulmonary morphology in animals after long-term exposures and pulmonary function decrements in chronically exposed humans; (c) Vegetation damage; (d) Property damage
Carbon Monoxide	9.0 ppm, 8-hr avg. > 20 ppm, 1-hr avg. >	9 ppm, 8-hr avg.> 35 ppm, 1-hr avg.>	(a) Aggravation of angina pectoris and other aspects of coronary heart disease; (b) Decreased exercise tolerance in persons with peripheral vascular disease and lung disease; (c) Impairment of central nervous system functions; (d) Possible increased risk to fetuses
Nitrogen Dioxide	0.25 ppm, 1-hr avg. >	0.053 ppm, ann. avg.>	(a) Potential to aggravate chronic respiratory disease and respiratory symptoms in sensitive groups; (b) Risk to public health implied by pulmonary and extra-pulmonary biochemical and cellular changes and pulmonary structural changes; (c) Contribution to atmospheric discoloration
Sulfur Dioxide	0.04 ppm, 24-hr avg.> 0.25 ppm, 1-hr. avg. >	0.03 ppm, ann. avg.> 0.14 ppm, 24-hr avg.>	(a) Bronchoconstriction accompanied by symptoms which may include wheezing, shortness of breath and chest tightness, during exercise or physical activity in persons with asthma
Suspended Particulate Matter (PM_{10})**	30 $\mu g/m^3$, ann. geometric mean > 50 $\mu g/m^3$, 24-hr average>	50 $\mu g/m^3$, ann. arithmetic mean > 150$\mu g/m^3$, 24-hr avg.>	(a) Excess deaths from short-term exposures and exacerbation of symptoms in sensitive patients with respiratory disease; (b) Excess seasonal declines in pulmonary function, especially in children; (c) Increased risk of premature death from heart or lung diseases in elderly
Suspended Particulate Matter ($PM_{2.5}$)**		15 $\mu g/m^3$, ann. arithmetic mean > 65 $\mu g/m^3$, 24-hr avg.>	
Sulfates	25 $\mu g/m^3$, 24-hr avg. ≥		(a) Decrease in ventilatory function; (b) Aggravation of asthmatic symptoms; (c) Aggravation of cardio-pulmonary disease; (d) Vegetation damage; (e) Degradation of visibility; (f) Property damage
Lead	1.5 $\mu g/m^3$, 30-day avg. ≥	1.5 $\mu g/m^3$, calendar quarter>	(a) Increased body burden; (b) Impairment of blood formation and nerve conduction
Visibility-Reducing Particles	In sufficient amount such that the extinction coefficient is greater than 0.23 inverse kilometers (to reduce the visual range to less than 10 miles) at relative humidity less than 70 percent, 8-hour average (10am - 6pm)		Visibility impairment on days when relative humidity is less than 70 percent

* For readers' convenience in picking out standards quickly, concentration appears first; e.g. "0.12 ppm, 1-hr avg. >" means 1-hr avg. > 0.12 ppm.

** New and stricter state standards for PM are proposed and adopted by ARB. They include: PM10 annual average of 20 $\mu g/m^3$ and new PM2.5 annual average of 12 $\mu g/m^3$.

In the Basin, high concentrations of ozone are normally recorded during the spring and summer months. By contrast, high concentrations of carbon monoxide are generally recorded in late fall and winter. High PM10 and PM2.5 concentrations can occur throughout the year, but occur most frequently in fall and winter. Although there are changes in emissions by season, the observed variations in pollutant concentrations are largely a result of seasonal differences in weather conditions.

In the year 2001, the federal standard for ozone was exceeded at one or more Basin locations on 10 percent of days (36 days). The federal PM10 standard was exceeded on 4 percent of the days sampled (2 days) and the federal PM2.5 standard was exceeded on 6 percent of the days sampled (23 days) [2]. For the first time since monitoring began, the federal carbon monoxide standards were not exceeded in the Basin in the year 2001. The Basin is among the few locations in the nation still exceeding carbon monoxide standards in the recent years.

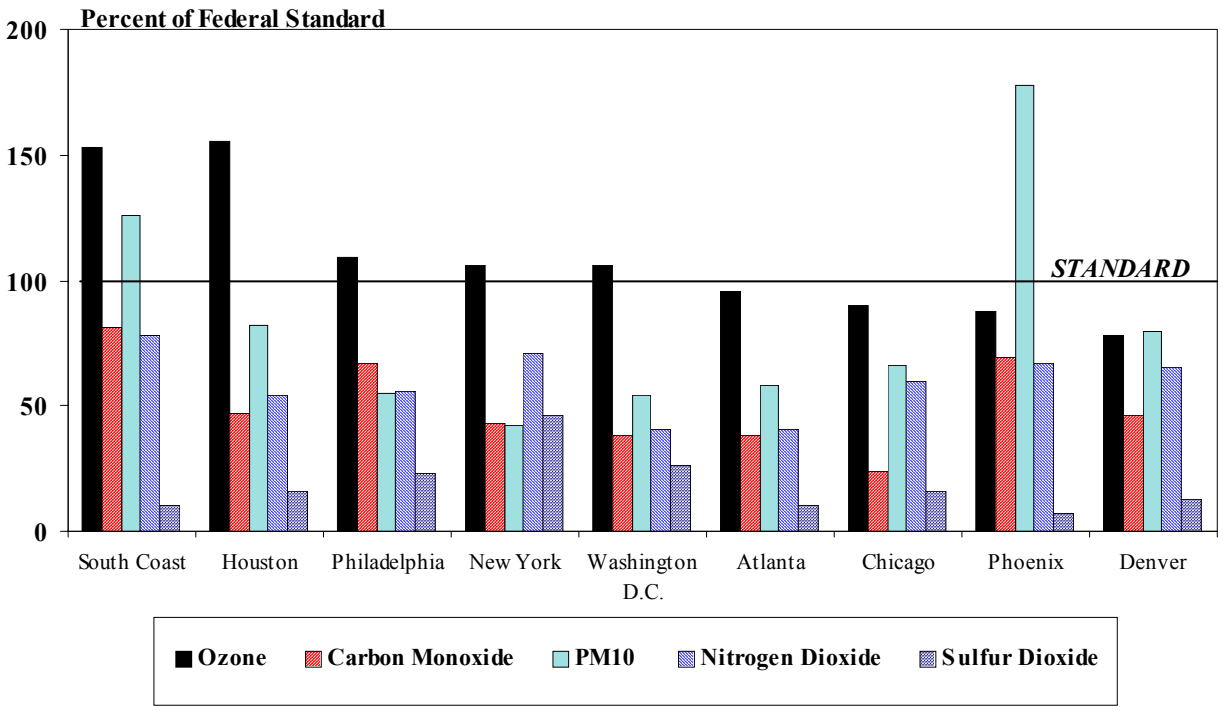
Figure 2-1 shows maximum pollutant concentrations in 2001 for the South Coast Air Basin compared to other urban areas in the U.S. and California. Maximum concentrations in some of these other large U.S. urban areas exceeded the federal ozone or PM10 standards. In California, all of the other large urban areas shown in Figure 2-1 exceeded the ozone standard. The PM10 standard was exceeded in one of the areas shown. None of the areas shown in Figure 2-1 exceeded the carbon monoxide standard.

In 2001, the Houston metropolitan area recorded the highest maximum 1-hour average ozone concentration in the nation (0.194 ppm). The highest concentration in the Basin was more than one and a half times the federal standard (0.190 ppm). Houston, like Los Angeles, is an area with abundant sunshine which creates favorable conditions for the photochemical reactions that yield ozone and other photochemical pollutants.

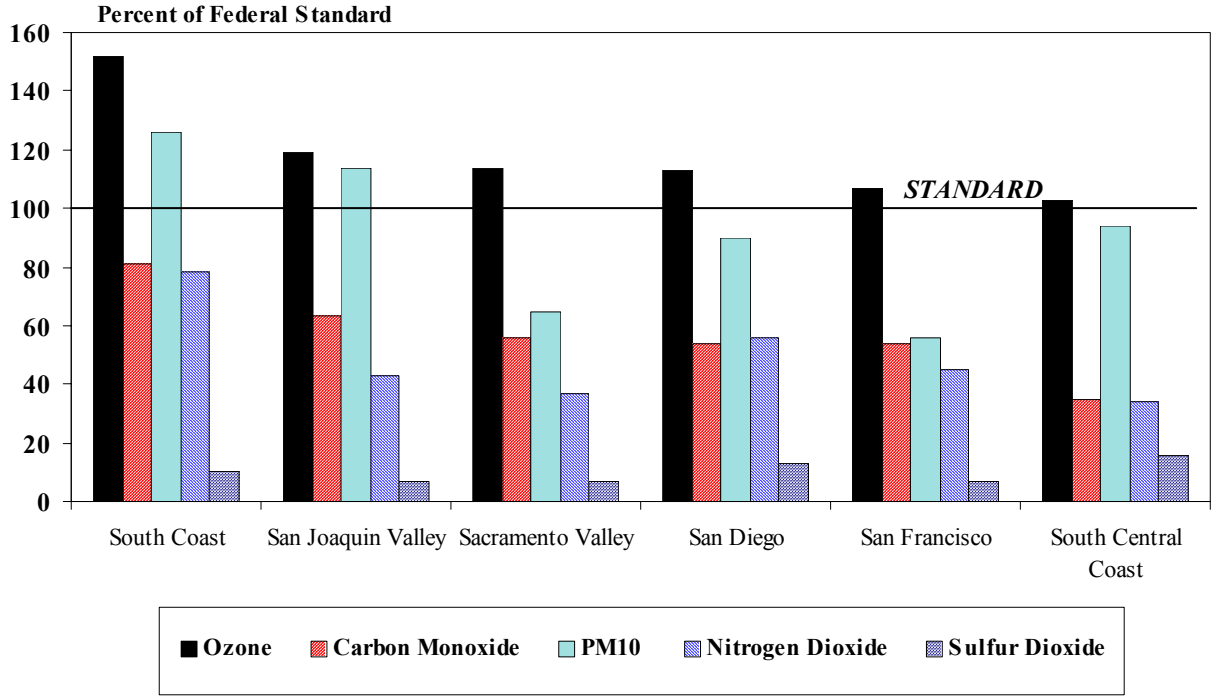
In California, the San Joaquin Valley, Sacramento Valley and San Diego Air Basins exceeded the 1-hour ozone standard by smaller margin than the South Coast Air Basin. San Francisco and South Central Coast Basins barely exceeded the standard. San Diego and South Central Coast Air Basins, located immediately south and north of the South Coast Air Basin, respectively, are subject to ozone transport from the South Coast Air Basin.

Maximum annual average PM10 concentrations exceeded the federal annual average PM10 standard in the Basin and Phoenix and in the San Joaquin Valley Air Basin.

[2] Particulate matter exceedances may have been higher since PM_{10} samples are collected only every 6 days (except for two sites at which samples are collected every 3 days); $PM_{2.5}$ samples are collected every 3 days at most sites except for a few sites which are sampled every day. The gaseous pollutants such as ozone and carbon monoxide are sampled continuously.



A) South Coast Air Basin Compared to Major U.S. Metropolitan Areas



B) South Coast Air Basin Compared to Other Air Basins in California

FIGURE 2-1

2001 Air Quality
Maximum Pollutant Concentrations as Percentages of the Federal Standard

In the year 2001, no location in the Basin or any other area of the U.S. exceeded the nitrogen dioxide standards. The Los Angeles county portion of the Basin was the last area of the U.S. to exceed the federal standard for nitrogen dioxide, but has remained in compliance since 1991. Sulfur dioxide concentrations in the Basin continued to remain well below federal standards. Concentrations of sulfur dioxide in urban areas in the Eastern U.S. have generally been higher than those in the Basin due to the use of fuels such as coal which have relatively high sulfur content.

CURRENT AIR QUALITY SUMMARY

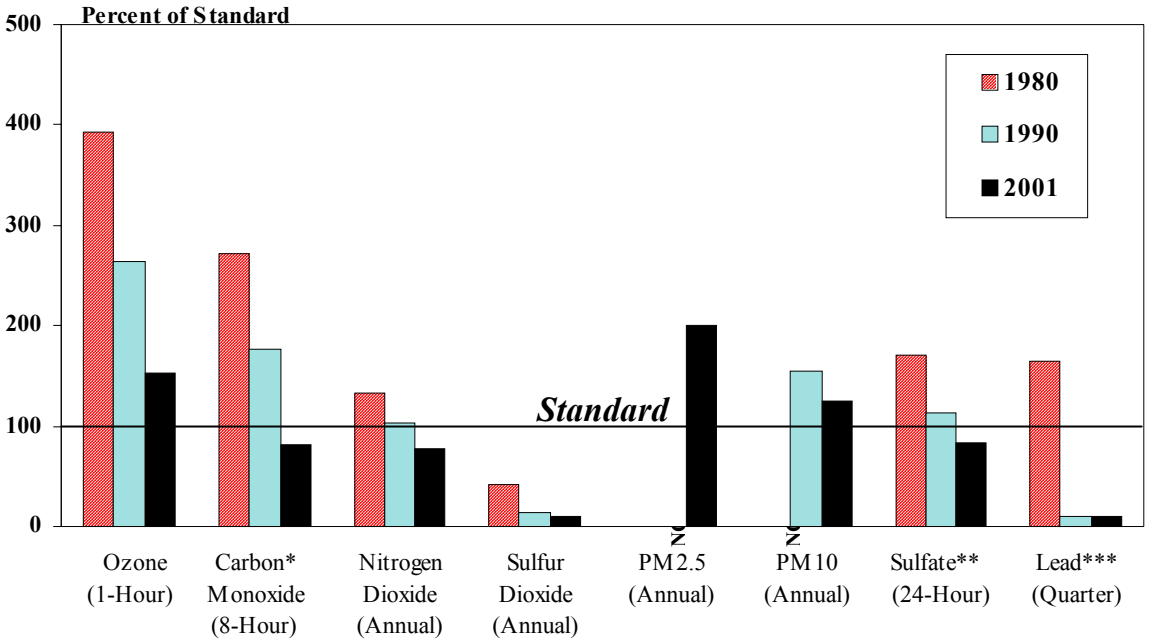
Figure 2-2 shows the maximum pollutant concentrations in the Basin for 2001 as percentages of the federal standards compared to the years 1990 and 1980. In 2001, the maximum ozone, PM10 and PM2.5 concentrations exceeded federal standards by wide margins. Maximum 1-hour and 8-hour average ozone concentrations recorded (0.190 ppm in East San Gabriel Valley and 0.144 ppm in Central and East San Bernardino Valley areas) were 152 and 169 percent of the federal standard, respectively. Maximum 24-hour average and annual average PM10 concentrations (219 $\mu g/m^3$ recorded in Banning Airport area and 63.1 $\mu g/m^3$ recorded in the Metropolitan Riverside County area) were 146 and 125 percent of the federal 24-hour and annual average standards, respectively. Maximum 24-hour average and annual average PM2.5 concentrations (98.0 $\mu g/m^3$ and 31.1 $\mu g/m^3$, both recorded in Metropolitan Riverside County area) were, respectively, 150 and 201 percent of the federal 24-hour and annual average standards, respectively. Carbon monoxide concentration did not exceed the standards in 2001[3]. The highest 8-hour average carbon monoxide concentration recorded (7.71 ppm in the South Central Los Angeles County area) was 81 percent of the federal carbon monoxide standard.

Concentrations of other pollutants remained below the standards. The maximum annual average nitrogen dioxide concentration (0.0419 ppm recorded in the East San Fernando Valley area) was 78 percent of the federal standard, and the maximum annual average sulfur dioxide concentration (0.0031 ppm recorded in Southwest Coastal Los Angeles County area) was 10 percent of the federal standard. The maximum sulfate concentration recorded (20.6 $\mu g/m^3$ in Southwest Coastal Los Angeles County area) was 82 percent of the state sulfate standard. The maximum quarterly average lead concentration recorded at any District air monitoring station was 8 percent of the federal standard. However, higher concentration of lead (32 percent of the standard) was recorded at special monitoring sites immediately adjacent to stationary sources (in Central Los Angeles area).

[3] Preliminary data from 2002 indicates one violation of CO, which is allowed under the Clean Air Act for attainment classification purpose.

Figure 2-3 shows the percent of days on which the federal standards were exceeded in 2001 at the Basin locations which exceeded most frequently compared to previous years. The federal ozone standard was exceeded on a maximum of 26 days (seven percent of days in the Central San Bernardino Mountains area). Exceedances of the federal 24-hour PM10 standard were recorded on a maximum of one day (two percent of days sampled at each of the locations in Banning Airport and Southwest San Bernardino Valley area), and the federal 24-hour PM2.5 standard was exceeded on a maximum of 19 days (6 percent of days sampled, in Metropolitan Riverside County area).

Detailed analyses of current air quality and statistics for all monitoring areas are contained in Appendix II. The following sections present summary information on health effects and how frequently, and by how much of a margin, different areas of the Basin and SSAB exceeded the federal and state ambient air quality standards in 2001.



* Carbon monoxide standard was exceeded in 2002.
** There is no federal standard for sulfate.
*** Higher lead concentrations were recorded at special monitoring sites immediately adjacent to sources.

FIGURE 2-2

Maximum Pollutant Concentrations as Percent of Federal Standards

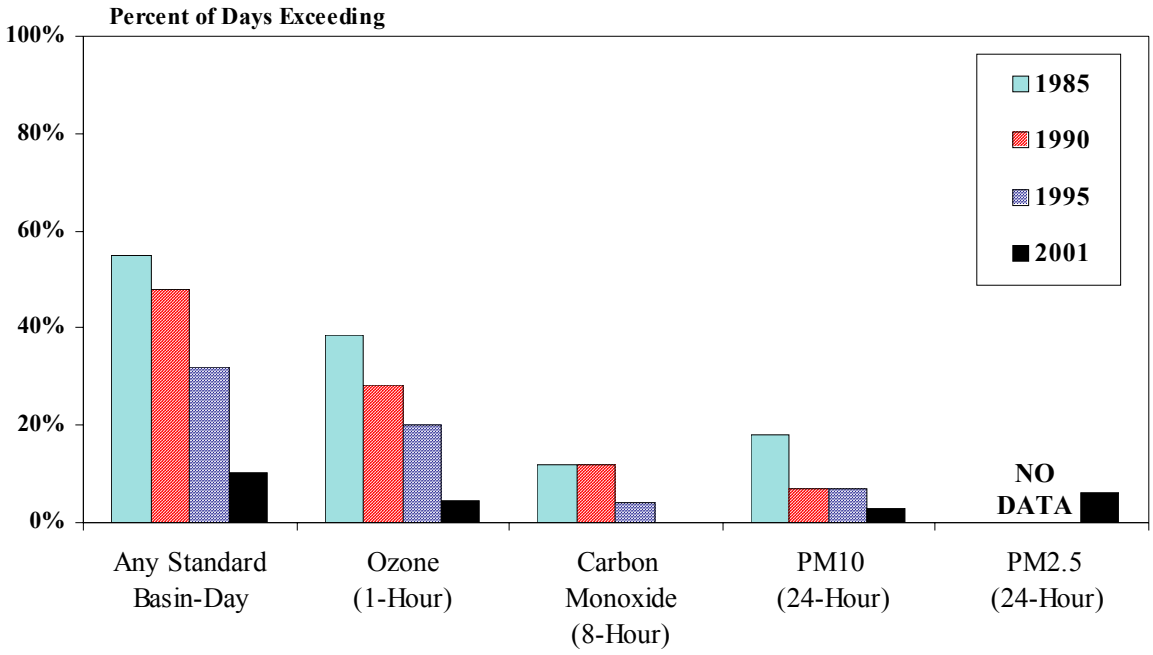


FIGURE 2-3

Percent of Days Exceeding Federal Standards at Most Affected Locations

Ozone (O_3) Specific Information

Health Effects

Individuals exercising outdoors, children and people with preexisting lung disease such as asthma and chronic pulmonary lung disease are considered to be the most susceptible sub-groups for ozone effects. Short-term exposures (lasting for a few hours) to ozone at levels typically observed in Southern California can result in breathing pattern changes, reduction of breathing capacity, increased susceptibility to infections, inflammation of the lung tissue, and some immunological changes. Elevated ozone levels are associated with increased school absences. In recent years, a correlation between elevated ambient ozone levels and increases in daily hospital admission rates, as well as mortality, has also been reported. An increased risk for asthma has been found in children who participate in multiple sports and live in high ozone communities.

Ozone exposure under exercising conditions is known to increase the severity of the above mentioned observed responses. Animal studies suggest that exposures to a combination of pollutants which include ozone may be more toxic than exposure to ozone alone. Although lung volume and resistance changes observed after a single exposure diminish with repeated exposures, biochemical and cellular changes appear to persist, which can lead to subsequent lung structural changes.

Air Quality

In 2001, the South Coast Air Quality Management District regularly monitored ozone concentrations at 28 locations in the Basin and SSAB. All areas monitored were below the stage 1 episode level (0.20 ppm), but the maximum concentrations in the Basin exceeded the health advisory level (0.15 ppm). Maximum ozone concentrations in the SSAB areas monitored by the District were lower than in the Basin and were below the health advisory level. Tables 2-2 and 2-3 show maximum 1-hour and 8-hour ozone concentrations by air basin and county.

TABLE 2-2

2001 Maximum 1-Hour Ozone Concentrations by Basin and County

Basin/County	Maximum 1-Hr Avg. ppm	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	0.190	152	East San Gabriel Valley
Orange	0.125	100	Saddleback Valley
Riverside	0.152	122	Perris Valley
San Bernardino	0.184	147	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	0.137	110	Coachella Valley

TABLE 2-3

2001 Maximum 8-Hour Ozone Concentrations by Basin and County

Basin/County	Maximum 8-Hr Avg. ppm	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	0.135	159	East San Gabriel Valley
Orange	0.098	115	Saddleback Valley
Riverside	0.136	160	Perris Valley
San Bernardino	0.144	169	Central San Bernardino Valley, East San Bernardino Valley
Salton Sea Air Basin			
Riverside	0.114	134	Coachella Valley

The number of days exceeding the federal standard varied widely by area. Figure 2-4 shows the number of days exceeding the 1-hour ozone federal standard in different areas of the Basin. Areas along or nearby the coast did not exceed the federal standard, due in large part to the prevailing sea breeze which transports polluted air inland before high ozone concentrations can be reached. The standard was exceeded most frequently in the inland valleys extending from East San Gabriel Valley through the Riverside-San Bernardino area, and in the adjacent mountains. The Central San Bernardino Mountains

area recorded the greatest number of exceedances of the state standard (88 days), federal standard (26 days) and health advisory level (12 days).

Figure 2-5 shows the distribution of the number of days exceeding the federal standard for 8-hour average ozone concentration in the Basin for the year 2001. The number of exceedances of the 8-hour federal ozone standard was also lowest at the coastal areas, increasing to a peak in the Riverside-San Bernardino Valley and adjacent mountain areas.

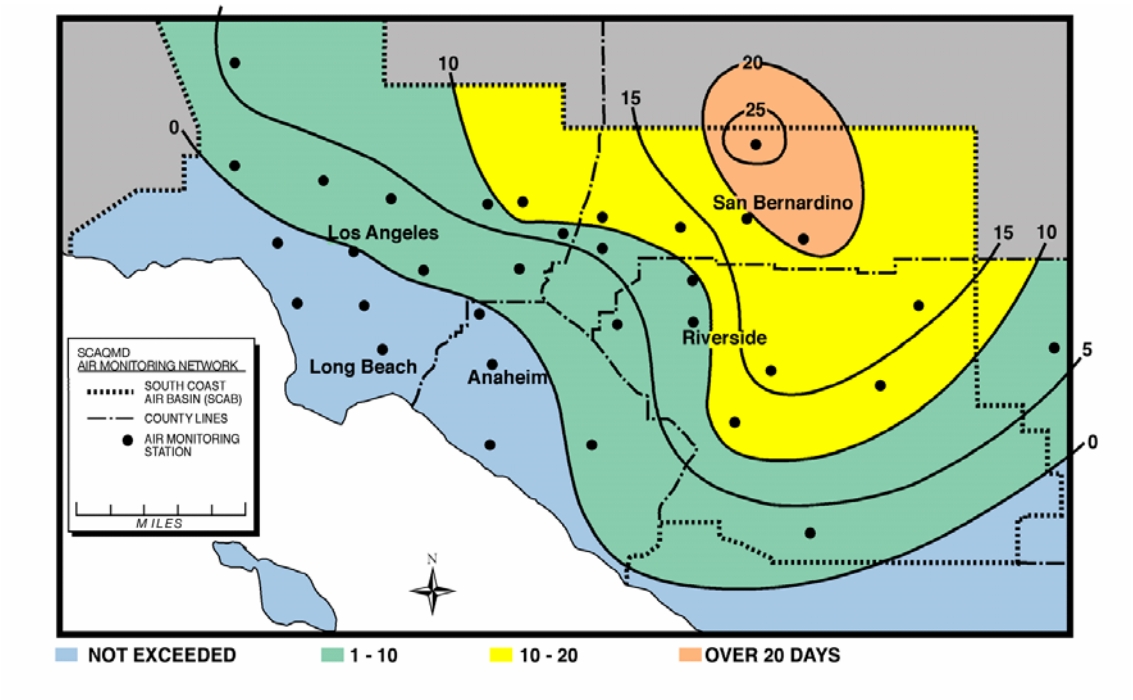


FIGURE 2-4

Ozone -2001
Number of Days Exceeding the Federal Standard
(1-hour average ozone > 0.12 ppm)

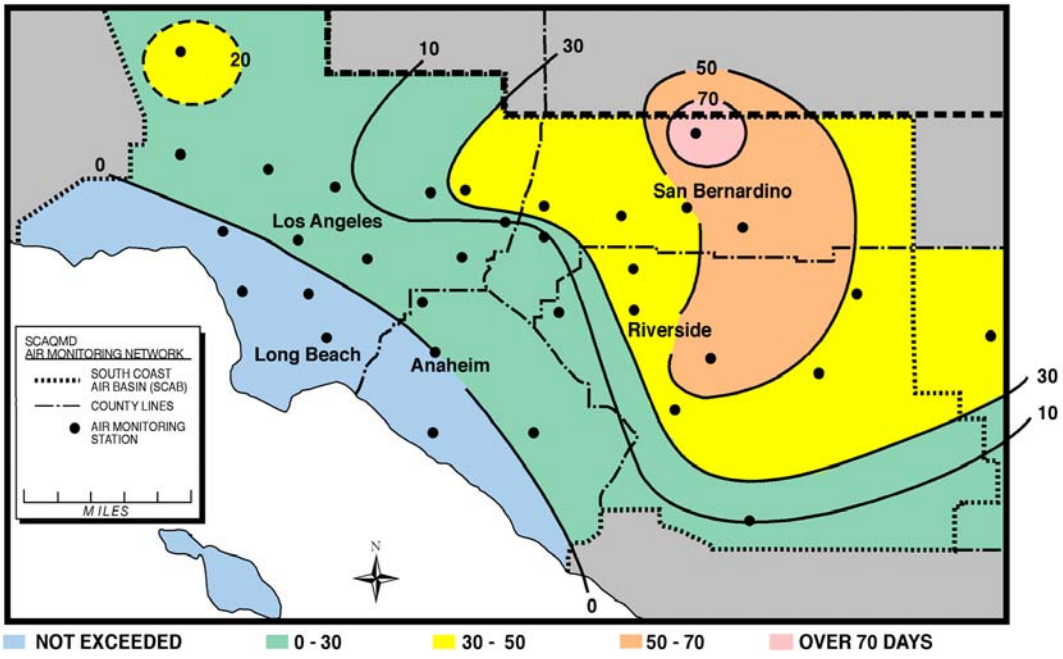


FIGURE 2-5
Ozone -2001
Number of Days Exceeding the Federal Standard
(8-hour average ozone > 0.08 ppm)

Carbon Monoxide (CO) Specific Information

Health Effects

Individuals with a deficient blood supply to the heart are the most susceptible to the adverse effects of CO exposure. The effects observed include earlier onset of chest pain with exercise, and electrocardiograph changes indicative of worsening oxygen supply to the heart.

Inhaled CO has no direct toxic effect on the lungs, but exerts its effect on tissues by interfering with oxygen transport by competing with oxygen to combine with hemoglobin present in the blood to form carboxyhemoglobin (COHb). Hence, conditions with an increased demand for oxygen supply can be adversely affected by exposure to CO. Individuals most at risk include patients with diseases involving heart and blood vessels, fetuses (unborn babies), and patients with chronic hypoxemia (oxygen deficiency) as seen in high altitudes.

Reduction in birth weight and impaired neurobehavioral development has been observed in animals chronically exposed to CO resulting in COHb levels similar to those observed in smokers. Recent studies have found increased risks for adverse birth outcomes with exposure to elevated CO levels. These include pre-term births and heart abnormalities. Additional research is needed to confirm these results.

Air Quality

Carbon monoxide concentrations were measured at 23 locations in the Basin and neighboring SSAB areas in 2001. Table 2-4 shows the 2001 maximum 8-hour average concentrations of carbon monoxide by air basin and county.

Figure 2-6 shows the distribution of the maximum 8-hour average carbon monoxide concentrations in the Basin in 2001. Higher concentrations were limited to the areas of Los Angeles County where vehicular traffic is most dense, with the maximum concentration (7.71 ppm) recorded in the South Central Los Angeles County area. The Basin recorded the 6th highest maximum 8-hour average carbon monoxide concentration in the nation in 2001 and is one of the few areas in the country still designated as nonattainment for carbon monoxide.

TABLE 2-4

2001 Maximum Carbon Monoxide Concentrations by Basin and County

Basin/County	Maximum 8-Hr Avg. ppm	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	7.7	81	South Central L.A. County
Orange	4.7	49	Central Orange County, North Orange County
Riverside	4.5	47	Metropolitan Riverside County
San Bernardino	3.3	35	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	1.5	16	Coachella Valley

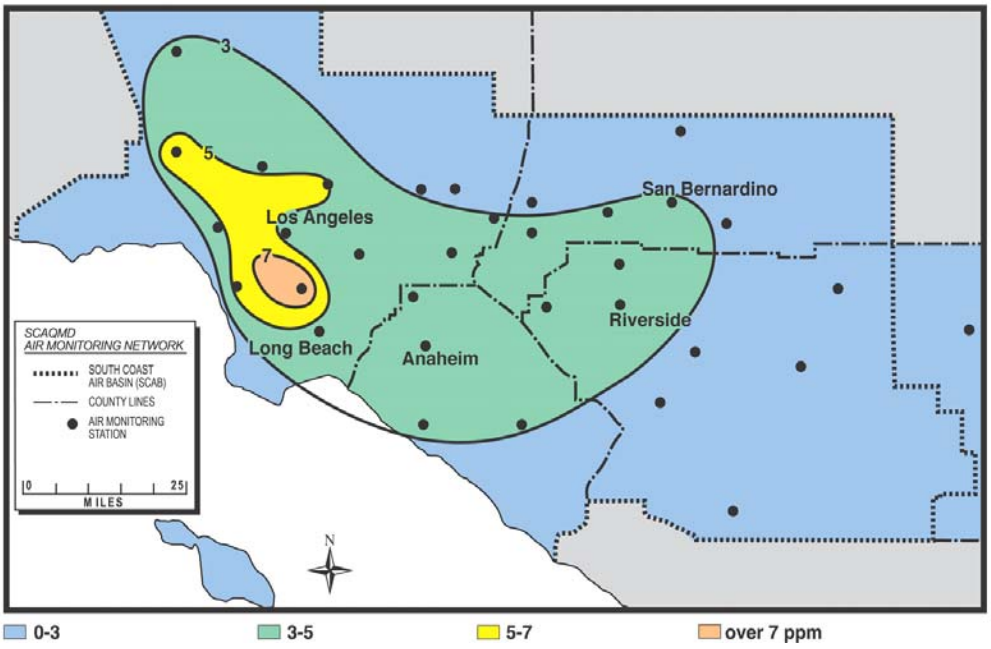


FIGURE 2-6

Carbon Monoxide - 2001
Maximum 8-Hour Average Concentration, ppm
(Federal Standard = 8-hour average CO > 9 ppm)

Particulate Matter (PM10 and PM2.5) Specific Information

Health Effects

A consistent correlation between elevated ambient fine particulate matter (PM10 and PM2.5) levels and an increase in mortality rates, respiratory infections, number and severity of asthma attacks and the number of hospital admissions has been observed in different parts of the United States and various areas around the world. In recent years, some studies have reported an association between long-term exposure to air pollution dominated by fine particles and increased mortality, reduction in life-span, and an increased mortality from lung cancer.

Daily fluctuations in fine particulate matter concentration levels have also been related to hospital admissions for acute respiratory conditions in children, to school and kindergarten absences, to a decrease in respiratory lung volumes in normal children and to increased medication use in children and adults with asthma. Recent studies show lung function growth in children is reduced with long-term exposure to particulate matter.

The elderly, people with pre-existing respiratory and/or cardiovascular disease and children appear to be more susceptible to the effects of PM10 and PM2.5.

Air Quality, PM10

The South Coast Air Quality Management District monitored PM10 concentrations at 18 locations in 2001. Maximum 24-hour and annual average concentrations are shown in Tables 2-5 and 2-6.

Higher concentrations associated with high winds in the desert areas were recorded in the Coachella Valley area of Salton Sea Air Basin. The data for samples collected on these high-wind days were excluded in accordance with U.S. EPA's Natural Event Policy.

Figure 2-7 shows the 2001 annual average PM10 concentrations in different areas of the Basin. The federal annual PM10 standard was exceeded at only a few locations in the District in the areas of Riverside and San Bernardino Counties in and around the Metropolitan Riverside County area and further inland in San Bernardino Valley areas. The federal 24-hour standard was also exceeded at two locations in Riverside and San Bernardino counties. The much more stringent state standards were exceeded in all areas of the Basin monitored in 2001.

TABLE 2-5

2001 Maximum 24-hour Average PM10 Concentrations by Basin and County

Basin/County	Maximum 24-Hr Avg. $\mu g/m^3$	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	106	70	East San Gabriel Valley
Orange	93	62	Central Orange County
Riverside	219	146	Banning Airport
San Bernardino	166	110	Southwest San Bernardino Valley
Salton Sea Air Basin			
Riverside*	149*	99*	Coachella Valley

*Adjusted for high-wind days in accordance with U.S. EPA's Natural Event Policy.

TABLE 2-6

2001 Maximum Annual Average PM10 Concentrations by Basin and County

Basin/County	Annual Average $\mu g/m^3$	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	45.3	90	East San Gabriel Valley
Orange	36.0	79	Central Orange County
Riverside	63.1	125	Metropolitan Riverside County
San Bernardino	52.4	104	Southwest San Bernardino Valley
Salton Sea Air Basin			
Riverside*	50.2*	99*	Coachella Valley

*Adjusted for the high-wind days in accordance with U.S. EPA's Natural Event Policy.

Air Quality, PM2.5

The South Coast Air Quality Management District began regular monitoring of PM2.5 in 1999 following the EPA's adoption of the national PM2.5 standards in 1997. In 2001, PM2.5 concentrations were monitored at 18 locations throughout the District. Maximum 24-hour and annual average concentrations are shown in Tables 2-7 and 2-8. Both 24-hour and annual PM2.5 standards were exceeded at most locations in the Basin.

TABLE 2-7

2001 Maximum 24-hour Average PM2.5 Concentrations by Basin and County

Basin/County	Maximum 24-Hr Avg. $\mu g/m^3$	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	94.7	145	East San Fernando Valley
Orange	70.8	108	Central Orange County
Riverside	98.0	150	Metropolitan Riverside County
San Bernardino	78.5	120	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	44.7	68	Coachella Valley

TABLE 2-8

2001 Maximum Annual Average PM2.5 Concentrations by Basin and County

Basin/County	Annual Average $\mu g/m^3$	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	26.1	168	South San Gabriel Valley
Orange	22.4	145	Central Orange County
Riverside	31.1	201	Metropolitan Riverside County
San Bernardino	26.2	169	Southwest San Bernardino Valley, Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	12.2	79	Coachella Valley

Figure 2-8 shows the distribution of annual average PM2.5 concentrations in different areas of the Basin. Similar to PM10 concentrations, PM2.5 concentrations were higher in the inland valley areas of San Bernardino and Metropolitan Riverside counties. However, PM2.5 concentrations were also high in Los Angeles county and central Orange county. The high PM2.5 concentrations in Los Angeles and Orange counties are due to the secondary formation of smaller particulates resulting from mobile and stationary source activities. In contrast to PM10, PM2.5 concentrations were low in the Coachella Valley area of SSAB. PM10 concentrations are normally higher in the desert areas due to windblown and fugitive dust emissions.

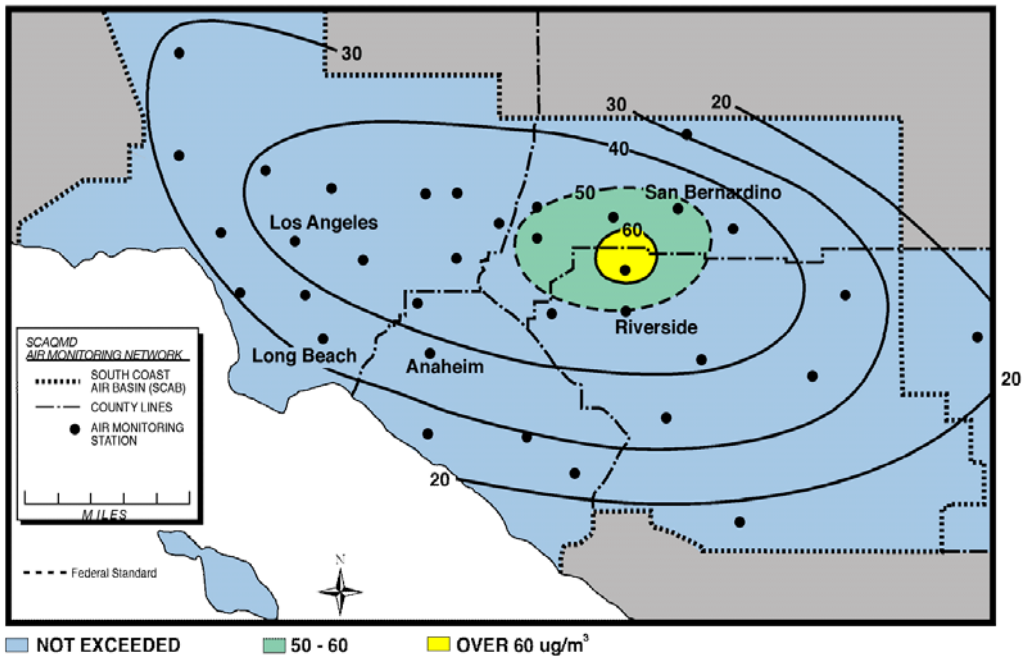


FIGURE 2-7

PM10 - 2001
Annual Average Concentration Compared to Federal Standard
(Federal standard = 50 µg/m^3, annual arithmetic mean)

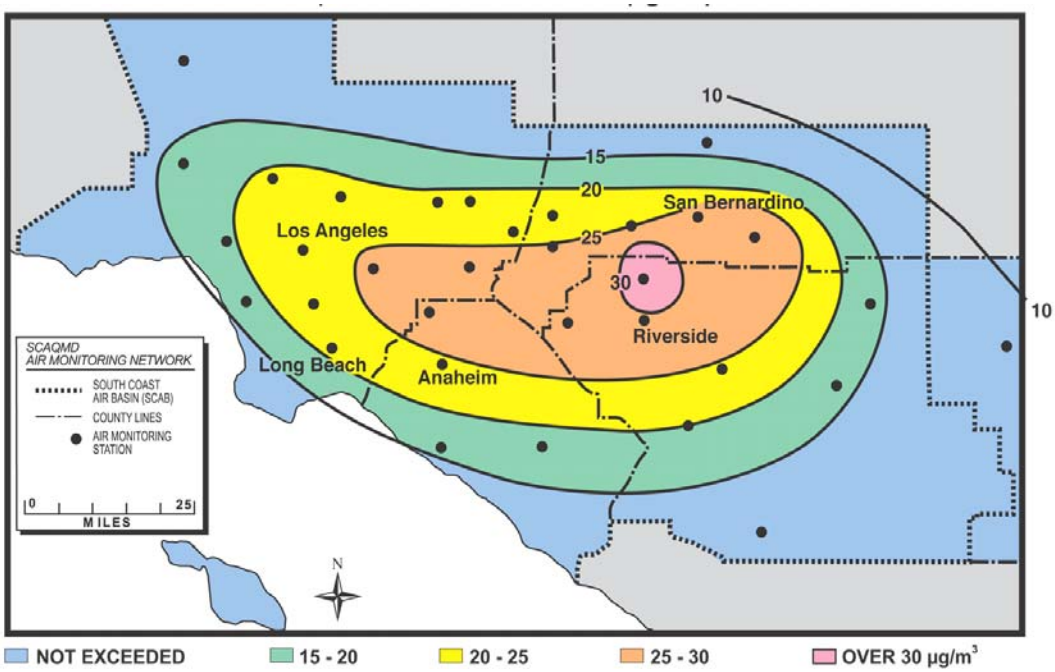


FIGURE 2-8

PM2.5 - 2001
Annual Average Concentration Compared to Federal Standard
(Federal standard = 15 µg/m^3, annual arithmetic mean)

Nitrogen Dioxide (NO_2) Specific Information

Health Effects

Population-based studies suggest that an increase in acute respiratory illness, including infections and respiratory symptoms in children (not infants), is associated with long-term exposures to NO_2 at levels found in homes with gas stoves, which are higher than ambient levels found in Southern California. Increase in resistance to air flow and airway contraction is observed after short-term exposure to NO_2 in healthy subjects. Larger decreases in lung functions are observed in individuals with asthma and/or chronic obstructive pulmonary disease (e.g., chronic bronchitis, emphysema) than in healthy individuals, indicating a greater susceptibility of these sub-groups.

In animals, exposure to levels of NO_2 considerably higher than ambient concentrations results in increased susceptibility to infections, possibly due to the observed changes in cells involved in maintaining immune functions. The severity of lung tissue damage associated with high levels of ozone exposure increases when animals are exposed to a combination of ozone and NO_2.

Air Quality

In 2001, nitrogen dioxide concentrations were monitored at 23 locations. No area of the Basin or SSAB exceeded the federal or state standards for nitrogen dioxide. Maximum annual average concentrations for 2001 are shown in Table 2-9. The Basin has not exceeded the federal standard for nitrogen dioxide since 1991, when the Los Angeles County portion of the Basin recorded the last exceedance of the standard in any U.S. county.

The state standard was not exceeded at any District monitoring location in 2001. The highest 1-hour average concentration recorded (0.25 ppm in East San Fernando Valley) was 96 percent of the state standard.

TABLE 2-9

2001 Maximum Nitrogen Dioxide Concentrations by Basin and County

Basin/County	Maximum Annual Avg. ppm	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	0.0419	78	East San Fernando Valley
Orange	0.0293	55	Central Orange County
Riverside	0.0247	46	Metropolitan Riverside County
San Bernardino	0.0384	72	Northwest San Bernardino Valley
Salton Sea Air Basin			
Riverside	0.0175	33	Coachella Valley

Sulfur Dioxide (SO_2) Specific Information

Health Effects

Exposure of a few minutes to low levels of SO_2 can result in airway constriction in some asthmatics. All asthmatics are sensitive to the effects of SO_2. In asthmatics, increase in resistance to air flow, as well as reduction in breathing capacity leading to severe breathing difficulties, are observed after acute exposure to SO_2. In contrast, healthy individuals do not exhibit similar acute responses even after exposure to higher concentrations of SO_2.

Animal studies suggest that despite SO_2 being a respiratory irritant, it does not cause substantial lung injury at ambient concentrations. However, very high levels of exposure can cause lung edema (fluid accumulation), lung tissue damage, and sloughing off of cells lining the respiratory tract.

Some population-based studies indicate that the mortality and morbidity effects associated with fine particles show a similar association with ambient SO_2 levels. In these studies, efforts to separate the effects of SO_2 from those of fine particles have not been successful. It is not clear whether the two pollutants act synergistically or one pollutant alone is the predominant factor.

Air Quality

No exceedances of federal or state standards for sulfur dioxide occurred in 2001 at any of the nine District locations monitored. Though sulfur dioxide concentrations remain well

below the standards, sulfur dioxide is a precursor to sulfate, which is a component of fine particulate matter, PM10 and PM2.5. Standards for PM10 and PM2.5 were both exceeded in 2001. Maximum concentrations of sulfur dioxide for 2001 are shown in Table 2-10. Sulfur dioxide was not measured at SSAB sites in 2001. Historical measurements showed concentrations to be well below standards and monitoring has been discontinued.

TABLE 2-10

2001 Maximum Sulfur Dioxide Concentrations by Basin and County

Basin/County	Maximum 24-hr Avg. ppm	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	0.012	8	Southwest Coastal Los Angeles County, South Coastal Los Angeles County
Orange	0.007	5	North Coastal Orange County
Riverside	0.011	8	Metropolitan Riverside County
San Bernardino	0.010	7	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	N.D.		

N.D. = No Data. Historical measurements indicate concentrations are well below standards.

Sulfates ($SO_4^=$) Specific Information

Health Effects

Most of the health effects associated with fine particles and sulfur dioxide at ambient levels are also associated with sulfates. Thus, both mortality and morbidity effects have been observed with an increase in ambient sulfate concentrations. However, efforts to separate the effects of sulfates from the effects of other pollutants have generally not been successful.

Clinical studies of asthmatics exposed to sulfuric acid suggest that adolescent asthmatics are possibly a subgroup susceptible to acid aerosol exposure. Animal studies suggest that acidic particles such as sulfuric acid aerosol and ammonium bisulfate are more toxic than non-acidic particles like ammonium sulfate. Whether the effects are attributable to acidity or to particles remains unresolved.

Air Quality

In 2001, the state sulfate standard was not exceeded anywhere in the Basin. Maximum concentrations by air basin and county are shown in Table 2-11. No sulfate data were obtained at SSAB stations in 2001. Historical sulfate data showed concentrations in the SSAB areas to be well below the standard, and measurements have been discontinued.

TABLE 2-11

2001 Maximum Sulfate Concentrations by Basin and County

Basin/County	Maximum 24-hr Avg. $\mu g/m^3$	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	20.6	82	Southwest Coastal Los Angeles County
Orange	N.D.		
Riverside	10.7	43	Metropolitan Riverside Co.
San Bernardino	11.5	46	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	N.D.		

N.D. = No Data. Historical measurements indicate concentrations are well below standards.

Lead (Pb) Specific Information

Health Effects

Fetuses, infants, and children are more sensitive than others to the adverse effects of lead exposure. Exposure to low levels of lead can adversely affect the development and function of the central nervous system, leading to learning disorders, distractibility, inability to follow simple commands, and lower intelligence quotient. In adults, increased lead levels are associated with increased blood pressure.

Lead poisoning can cause anemia, lethargy, seizures and death. It appears that there are no direct effects of lead on the respiratory system. Lead can be stored in the bone from early-age environmental exposure, and elevated blood lead levels can occur due to breakdown of bone tissue during pregnancy, hyperthyroidism (increased secretion of hormones from the thyroid gland) and osteoporosis (breakdown of bony tissue). Fetuses and breast-fed babies can be exposed to higher levels of lead because of previous environmental lead exposure of their mothers.

Air Quality

The federal and state standards for lead were not exceeded in any area of the District in 2001. There have been no violations of the standards at the District's regular air monitoring stations since 1982, as a result of removal of lead from gasoline. However, special monitoring stations immediately adjacent to stationary sources of lead have recorded exceedances of the standards in very localized areas of the Basin as recently as 1991 for the federal standard and 1994 for the state standard. Table 2-12 shows the maximum concentrations recorded in 2001. The highest quarterly average lead concentration (0.49 $\mu g/m^3$ in Central Los Angeles), measured at special monitoring sites immediately adjacent to stationary sources of lead, was 32 percent of the federal standard.

The maximum monthly average lead concentration at the regular monitoring stations (0.23 $\mu g/m^3$ in the South Central Los Angeles County area) was 15 percent of the state standard. The maximum at the special monitoring sites immediately adjacent to sources (0.57 $\mu g/m^3$ in Central Los Angeles) was 38 percent of the standard.

TABLE 2-12

2001 Maximum Lead Concentrations by Basin and County

Basin/County	Maximum Quarterly Average $\mu g/m^3$	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	0.12	8	South Central Los Angeles County
Orange	N.D.		
Riverside	0.03	2	Metropolitan Riverside County
San Bernardino	0.04	3	Northwest San Bernardino Valley, Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	N.D.		

N.D. = No Data. Historical measurements indicate concentrations are well below standards.

Summary

In 2001, the Basin exceeded federal and state standards for ozone, PM10 and PM2.5. The Salton Sea Air Basin areas continued to exceed standards for ozone and PM10.

The Basin exceeded one or more federal standards on 58 days. Maximum concentrations of PM2.5 exceeded the federal standard by the widest margin. Ozone and PM10

concentrations exceeded the federal standards by a smaller margin. In 2001, for the first time since its monitoring, carbon monoxide concentration did not exceed the standards anywhere in the Basin. Maximum concentrations for nitrogen dioxide, sulfur dioxide sulfate and lead continued to remain below the state and federal standards.