CHAPTER 2

AIR QUALITY AND HEALTH EFFECTS

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INTRODUCTION

In this chapter, year 2005 air quality in both the South Coast Air Basin (Basin) and 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. More monitoring stations have been added since the last AQMP for most pollutants. For those pollutants for which the Basin is in nonattainment of the federal standards, maps have been included which compare the year 2005 air quality in different areas of the Basin. Nationwide air quality for 2005 is also briefly summarized in this chapter. A comparison of air quality in the Basin to that of other U.S. and California urban areas is presented in the following pages. Appendix II provides more information on current air quality and air quality trends, as well as more information on specific monitoring station data.

Although the federal 1-hour ozone standard was revoked by the U.S. EPA and replaced by the 8-hour average ozone standard, statistics presented in this chapter refer to both standards for purposes of historical comparison.

AMBIENT AIR QUALITY STANDARDS

Ambient air quality standards for ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM10 and PM2.5), and lead (Pb) 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 2005, the Basin exceeded the federal standards for ozone, PM10 or PM2.5 on a total of 89 days at one or more locations; this compares to 128 days in 2003 and 94 days in 2004 (based on the current 8-hour average federal standard for ozone). Despite the substantial improvement in air quality over the past few decades, some areas in the Basin still exceed the National Ambient Air Quality Standard (NAAQS) for ozone more frequently than any other area of the U.S. In 2005, the location in the nation most frequently exceeding the federal standard levels for ozone was within the Basin. Also, five of the ten locations in the nation that most frequently exceeded the 8-hour average federal ozone standard level were located in the District. The Basin has technically met the CO standards since 2003. Redesignation for attainment for the federal CO standard has been requested, but is still pending 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. > 0.07 ppm, 8-hr avg.>	0.08 ppm, 8-hr avg.>	(a) Pulmonary function decrements and localized lung edema in humans and animals; (b) Risk to public health implied by alterations in pulmonary morphology and host defense in animals; (c) Increased mortality risk; (d) 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; (e) Vegetation damage; (f) 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.>	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 (PM10)	20 µg/m^3, ann. arithmetic mean > 50 µg/m^3, 24-hr average>	50 µg/m^3, ann. arithmetic mean > 150µg/m^3, 24-hr avg.>	(a) Exacerbation of symptoms in sensitive patients with respiratory or cardiovascular disease; (b) Declines in pulmonary function growth in children; (c) Increased risk of premature death from heart or lung diseases in the elderly
Suspended Particulate Matter (PM2.5)	12 µg/m^3, ann. arithmetic mean >	15 µg/m^3, ann. arithmetic mean > 65 µg/m^3, 24-hr avg.>	
Sulfates	25 µg/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 µg/m^3, 30-day avg. ≥	1.5 µg/m^3, calendar quarter>	(a) Learning disabilities; (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 the readers' convenience in identifying standards quickly, concentration appears first; e.g. "0.12 ppm, 1-hr avg. >" means 1-hr avg. > 0.12 ppm.

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.

In the Basin, high concentrations of ozone are normally recorded during the spring and summer months. In contrast, higher 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.

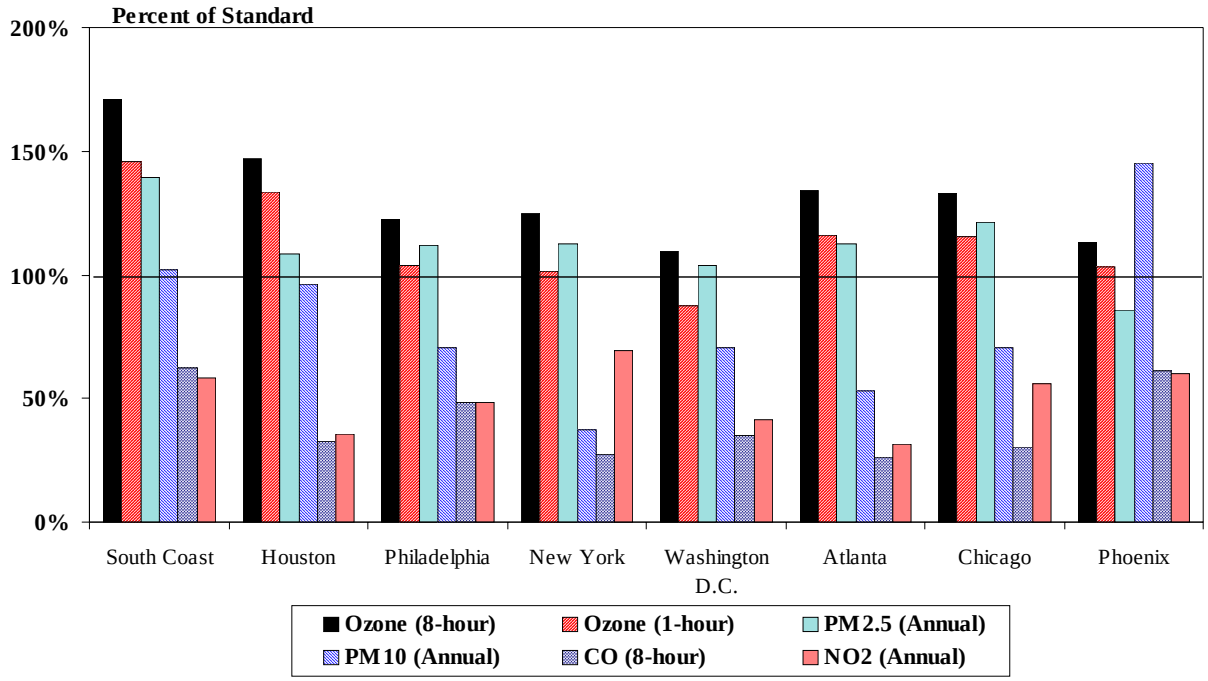
In the year 2005, the 1-hour[1] and 8-hour average federal standard levels for ozone were exceeded at one or more Basin locations on 30 and 84 days, respectively. The federal PM2.5 24-hour standard was exceeded on 6 days sampled[2]. Other criteria pollutants did not exceed the ambient air quality standards.

Figures 2-1A and 2-1B show maximum pollutant concentrations in 2005 for the South Coast Air Basin compared to other urban areas in the U.S. and California. Maximum concentrations in all of these areas exceeded the federal 8-hour ozone standard. The PM10 standard was exceeded in the Basin and in one of the other U.S. urban areas shown (Phoenix). The PM2.5 standard was exceeded in most of the large U.S. urban areas and many California air basins. None of the areas shown in Figure 2-1 exceeded the carbon monoxide standard or nitrogen dioxide standards.

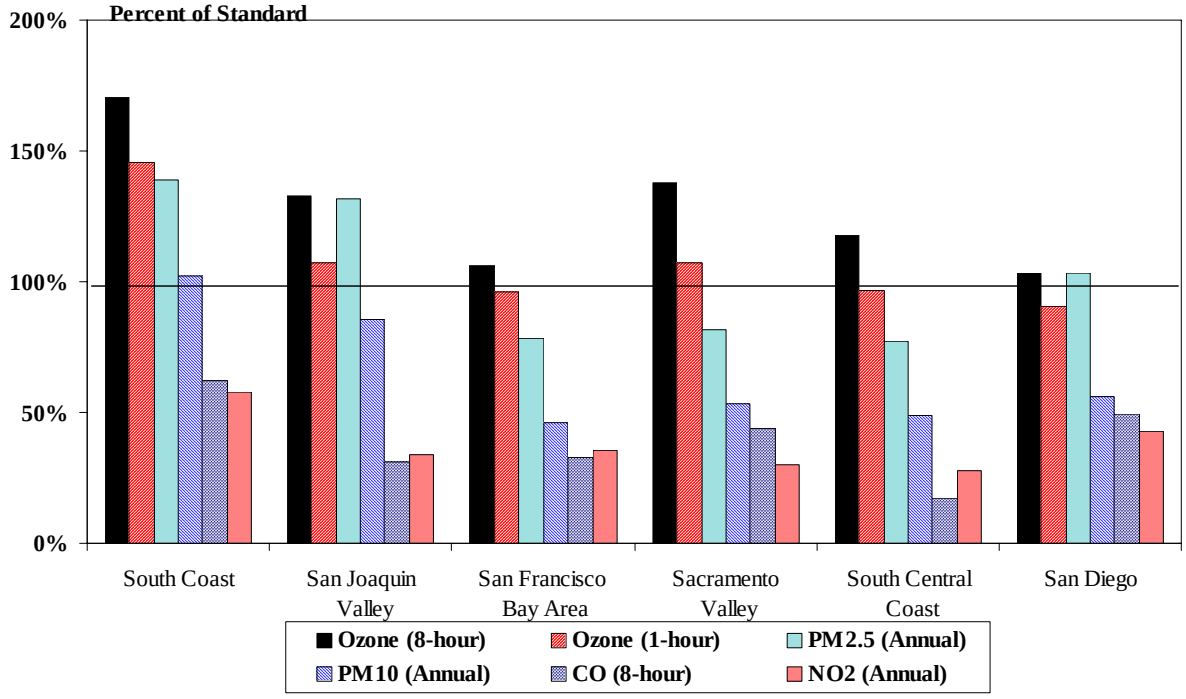
In 2005, the Central San Bernardino Mountains area in the Basin recorded the highest maximum 1-hour and 8-hour average ozone concentrations in the nation (0.182 and 0.145 ppm, respectively). The highest 8-hour average concentration was more than one and a half times the federal standard. In 2005, eight out of ten areas with the highest maximum

[1] The federal 1-hour ozone standard has been revoked by U.S. EPA. The information is included in this chapter for comparison purposes.

[2] Particulate matter exceedances may have been higher since PM10 samples are collected every 6 days (except for two sites at which samples are collected every 3 days); PM2.5 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 other Major U.S. Metropolitan Areas



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

FIGURE 2-1
2005 Air Quality
Maximum Pollutant Concentrations as Percentages of the Federal Standard

8-hour average concentrations in the nation were located in the Basin. Outside California, the area with the next-highest ozone concentration is Houston, Texas. Like Los Angeles, Houston is an area with abundant sunshine which creates favorable conditions for the photochemical reactions that yield ozone and other photochemical pollutants.

The urban areas shown in Figure 2-1B exceeded the ozone standard but by a smaller margin than the South Coast Air Basin. 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.

In the year 2005, 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

In 2005, the maximum ozone, PM10 and PM2.5 concentrations continued to exceed federal standards by wide margins. Maximum 1-hour and 8-hour average ozone concentrations (0.182 ppm and 0.145 ppm, both recorded in Central San Bernardino Mountains areas) were 146 and 171 percent of the federal standard, respectively. Maximum 24-hour average and annual average PM10 concentrations (131 $\mu g/m^3$ recorded in South Coastal Los Angeles County area and 52.0 $\mu g/m^3$ recorded in the Metropolitan Riverside County area) were 87 and 103 percent of the federal 24-hour and annual average standards, respectively. Maximum 24-hour average and annual average PM2.5 concentrations (132.7 $\mu g/m^3$ recorded in East San Gabriel Valley area and 21.0 $\mu g/m^3$ recorded in Metropolitan Riverside County area) were 203 and 139 percent of the federal 24-hour and annual average standards, respectively.

Carbon monoxide concentrations did not exceed the standards in 2005. The highest 8-hour average carbon monoxide concentration recorded (5.9 ppm in the South Central Los Angeles County area) was 62 percent of the federal carbon monoxide standard. The maximum annual average nitrogen dioxide concentration (0.0313 ppm recorded in the Northwest San Bernardino Valley area) was 59 percent of the federal standard. Concentrations of other pollutants remained well below the federal standards.

Figure 2-2 shows the maximum pollutant concentrations in the Basin as percentages of the federal standards for the past two decades.

Figures 2-3A and 2-3B show the number of days on which the federal 1-hour and 8-hour ozone standards were exceeded at the Basin locations which had the most frequent exceedances for the years 1995 to 2005. In the early- and mid-1990s, the short-term 1-hour federal ozone standard (which has been revoked) was exceeded most frequently in the East San Gabriel Valley and Santa Clarita Valley areas located in the northern portion of Los Angeles County, extending to the northwest valleys. As emissions were reduced, resulting in a fewer number of days exceeding the ozone standard throughout the Basin, the areas with the highest exceedances shifted towards the eastern portions of the Basin, including the East San Bernardino Valley and Central San Bernardino Mountains areas, mainly due to reduced reactivity of the pollutant cloud and the longer time required to form ozone. The Santa Clarita Valley area and the eastern portions of the San Bernardino Valleys and Mountains remained as the areas mostly affected by the hourly high ozone concentrations in the Basin for the most recent years.

The highest daily long-term 8-hour average ozone concentration, however, has been consistently recorded in the East San Bernardino Valley and Central San Bernardino Mountains areas since the 1990s. The Central San Bernardino Mountains area has remained as the most affected area in terms of the number of days exceeding the 8-hour federal standard in recent years and the area shows a slower downtrend as compared to the East San Gabriel Valley area where the highest number of exceedances used to occur in the 1980s (Figure 2-3B).

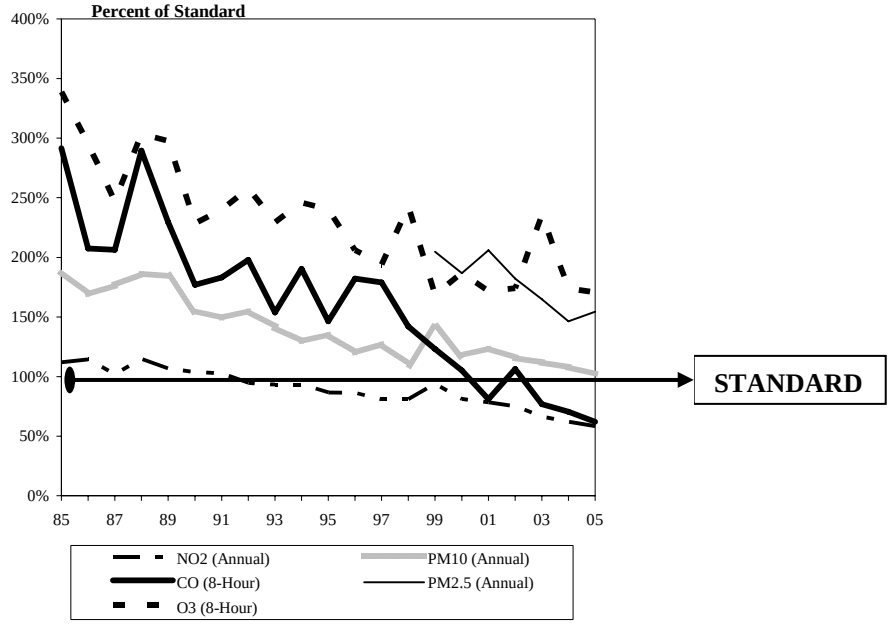
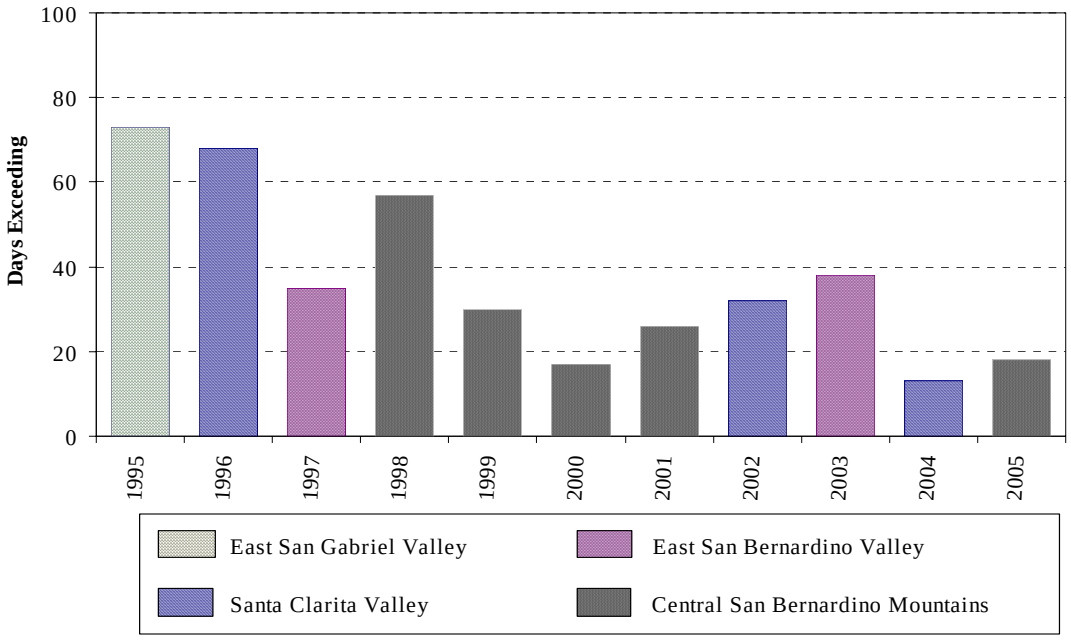
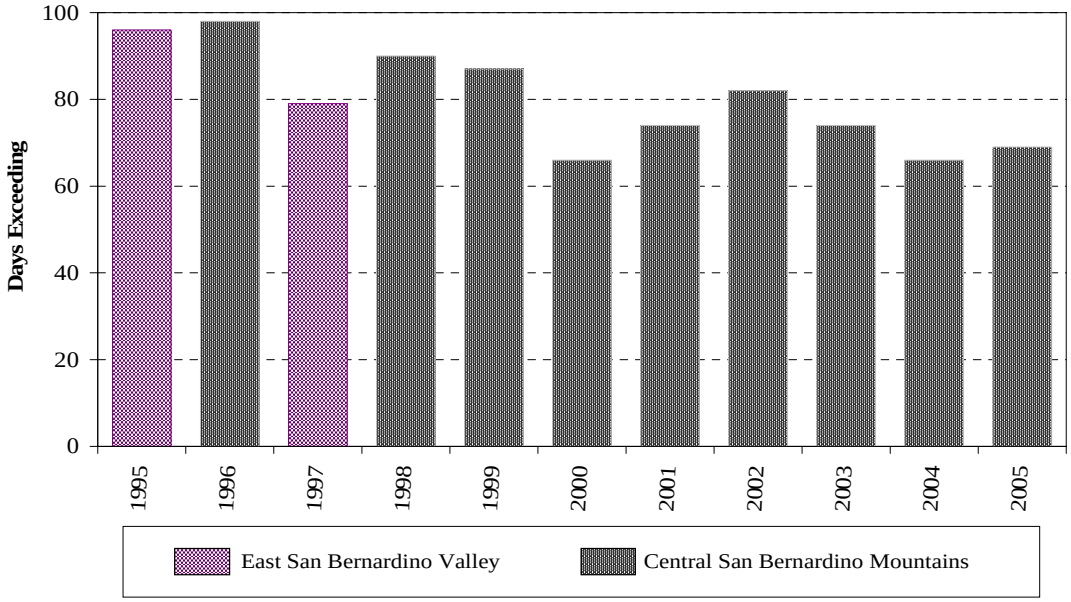


FIGURE 2-2
Maximum Pollutant Concentrations as Percent of Federal Standards



A) 1-Hour



B) 8-Hour

FIGURE 2-3
Location that Exceeded the Federal Ozone Standards
the Most Days in Each Year

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 2005, the District regularly monitored ozone concentrations at 29 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.

The number of days exceeding the federal standards for ozone in the Basin varies widely by area. Figures 2-4 and 2-5 show the number of days exceeding the 1-hour and 8-hour ozone federal standards in different areas of the Basin in 2005. The 1-hour federal standard was not exceeded in areas along or near the coast, 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 Central San Bernardino Mountains extending from Central San Bernardino Valleys through the Riverside-San Bernardino area in the east, and in the Santa Clarita Valleys in the west. The Central San Bernardino Mountains area recorded the greatest number of exceedances of the state standard (80 days), 1-hour and 8-hour federal standards (18 days and 69 days, respectively) and health advisory level (7 days).

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.

TABLE 2-2

2005 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	0.173	138	Santa Clarita Valley
Orange	0.125	100	Saddleback Valley
Riverside	0.149	119	Lake Elsinore
San Bernardino	0.182	146	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	0.139	111	Coachella Valley

TABLE 2-3

2005 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	0.141	166	Santa Clarita Valley
Orange	0.085	100	Saddleback Valley
Riverside	0.131	154	Banning Airport
San Bernardino	0.145	171	Central San Bernardino Mountains
Salton Sea Air Basin			
Riverside	0.095	112	Coachella Valley

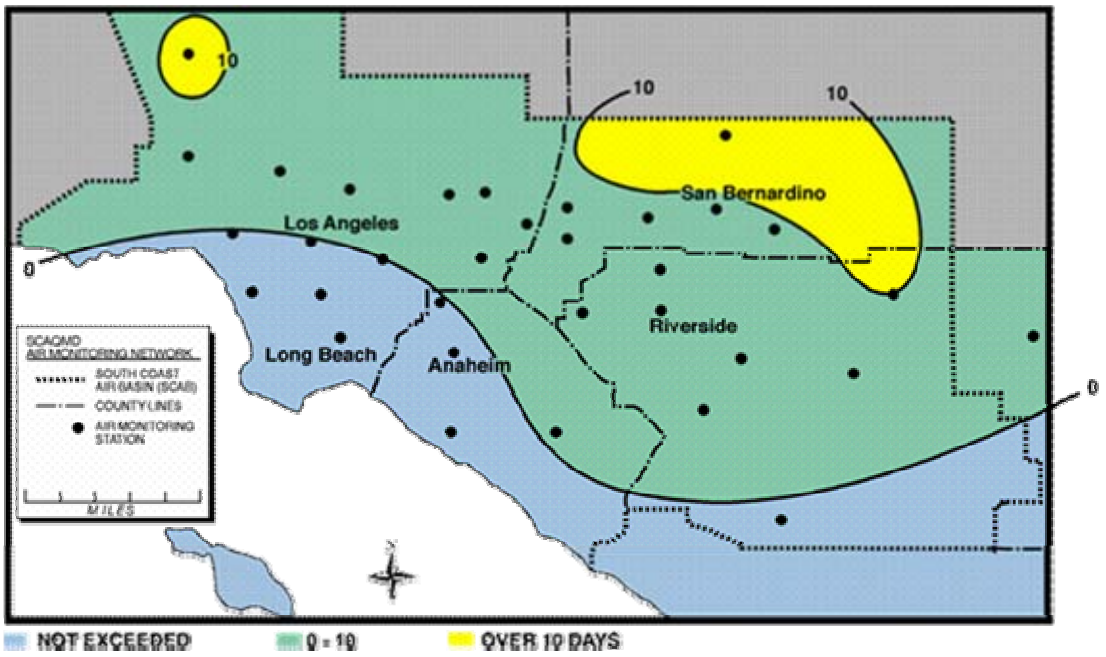


FIGURE 2-4
Ozone - 2005
Number of Days Exceeding the Federal Standard
(1-hour average ozone > 0.12 ppm)

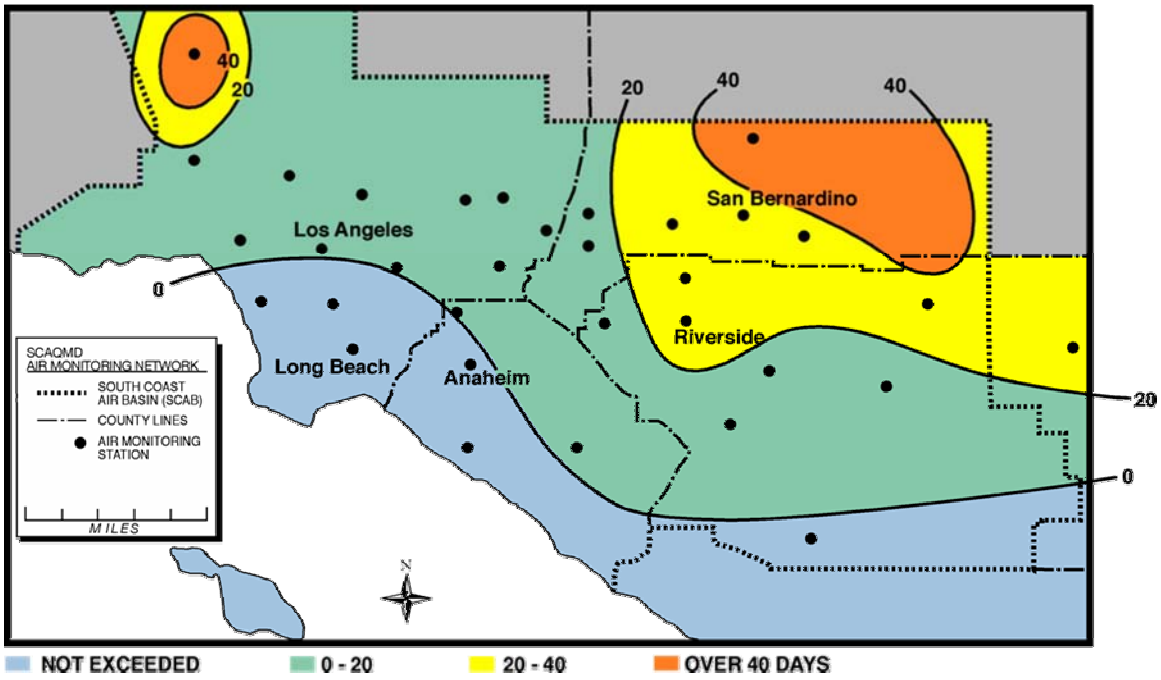


FIGURE 2-5
Ozone - 2005
Number of Days Exceeding the Federal Standard
(8-hour average ozone > 0.08 ppm)

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, studies have reported an association between long-term exposure to air pollution dominated by fine particles (PM2.5) 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, to school and kindergarten absences, to a decrease in respiratory function 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 District monitored PM10 concentrations at 20 locations in 2005. Maximum 24-hour and annual average concentrations are shown in Tables 2-4 and 2-5.

Figure 2-6 shows the 2005 annual average PM10 concentrations in different areas of the Basin. The federal annual PM10 standard was exceeded at only one location in the District in 2005. Highest PM10 concentrations were recorded in 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 not exceeded at any of the locations monitored in 2005. The much more stringent state standards were exceeded in most areas.

TABLE 2-4

2005 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	131	87	South Coastal Los Angeles County
Orange	65	43	Central Orange County
Riverside	123	81	Metropolitan Riverside County
San Bernardino	108	72	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	106	70	Coachella Valley

TABLE 2-5

2005 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	43.4	86	South Coastal Los Angeles County
Orange	28.2	56	Central Orange County
Riverside	52.0	103	Metropolitan Riverside County
San Bernardino	50.0	99	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	45.7	90	Coachella Valley

Air Quality, PM2.5

The District began regular monitoring of PM2.5 in 1999 following the U.S. EPA's adoption of the national PM2.5 standards in 1997. In 2005, PM2.5 concentrations were monitored at 19 locations throughout the District. Maximum 24-hour and annual average concentrations are shown in Tables 2-6 and 2-7. Maximum 24-hour average concentration has increased at some locations compared to 2001, the basis of the 2003 AQMP air quality data. The PM2.5 annual average concentrations and the highest 98^{th} percentile PM2.5 concentrations (which the federal 24-hour PM2.5 standard is based on), however, are lower than 2001 levels at all locations monitored.

TABLE 2-6

2005 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	132.7	203	East San Gabriel Valley
Orange	54.7	84	Central Orange County
Riverside	98.7	151	Metropolitan Riverside County
San Bernardino	106.3	162	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	44.4	68	Coachella Valley

TABLE 2-7

2005 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	18.1	120	Central Los Angeles
Orange	14.7	97	Central Orange County
Riverside	21.0	139	Metropolitan Riverside County
San Bernardino	18.9	125	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	10.5	70	Coachella Valley

Figure 2-7 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 the metropolitan area of Los Angeles county. The high PM2.5 concentrations in Los Angeles county are mainly 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.

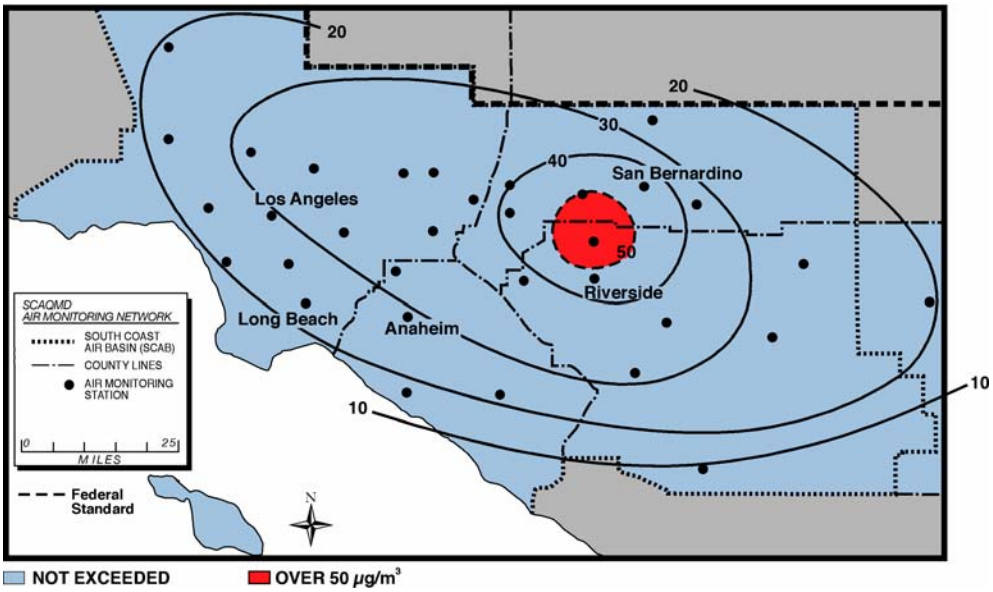


FIGURE 2-6

PM10 - 2005

Annual Average Concentration Compared to Federal Standard

(Federal standard = 50 µg/m^3, annual arithmetic mean)

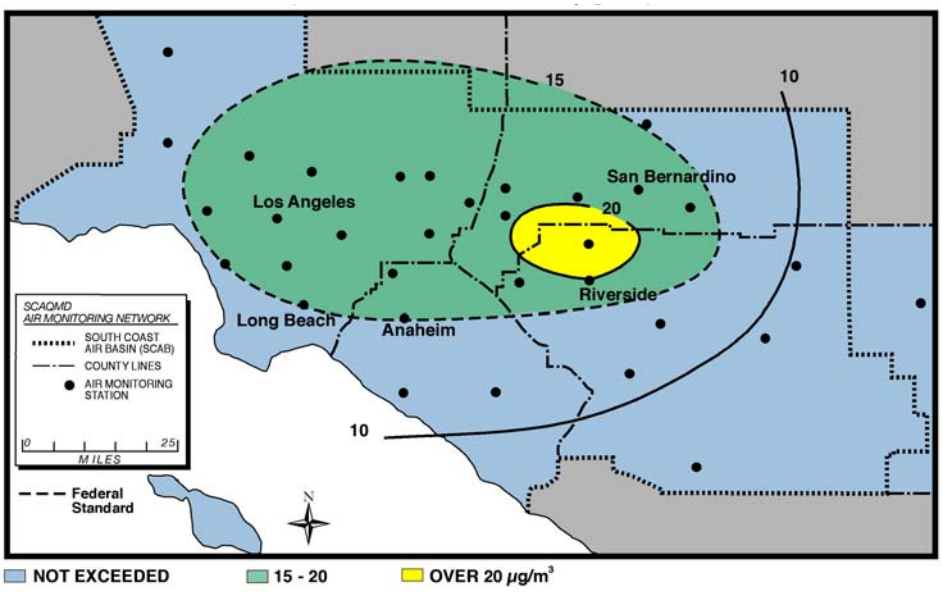


FIGURE 2-7

PM2.5 - 2005

Annual Average Concentration Compared to Federal Standard

(Federal standard = 15 µg/m^3, annual arithmetic mean)

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.

Reductions in birth weight and impaired neurobehavioral development have 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.

Air Quality

Carbon monoxide concentrations were measured at 25 locations in the Basin and neighboring SSAB areas in 2005. Table 2-8 shows the 2005 maximum 8-hour average concentrations of carbon monoxide by air basin and county.

In 2005, no areas exceeded the carbon monoxide air quality standards. The highest concentrations of carbon monoxide continued to be recorded in the areas of Los Angeles County where vehicular traffic is most dense, with the maximum concentration (5.9 ppm) recorded in the South Central Los Angeles County area. All areas continued to remain below the federal standard level since 2003.

TABLE 2-8

2005 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	5.9	62	South Central L.A. County
Orange	3.3	35	North Coastal Orange County
Riverside	2.6	27	Metropolitan Riverside County
San Bernardino	3.4	36	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	1.0	11	Coachella Valley

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.

More recent studies have found associations between NO_2 exposures and cardiopulmonary mortality, decreased lung function, respiratory symptoms and emergency room asthma visits.

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 2005, nitrogen dioxide concentrations were monitored at 24 locations. No area of the Basin or SSAB exceeded the federal or state standards for nitrogen dioxide. Maximum

annual average concentrations for 2005 are shown in Table 2-9. The Basin has not exceeded the federal standard for nitrogen dioxide (0.0534 ppm) since 1991, when the Los Angeles County portion of the Basin recorded the last exceedance of the standard in any U.S. county.

The nitrogen dioxide state standard was not exceeded at any District monitoring location in 2005. The highest 1-hour average concentration recorded (0.13 ppm in Central Los Angeles) was 50 percent of the state standard.

TABLE 2-9

2005 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	0.0312	58	South Central Los Angeles County; Pomona/Walnut Valley
Orange	0.0249	47	North Orange County
Riverside	0.0222	41	Metropolitan Riverside County
San Bernardino	0.0313	59	Northwest San Bernardino Valley
Salton Sea Air Basin			
Riverside	0.0120	22	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 higher 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 2005 at any of the seven 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 2005. Maximum concentrations of sulfur dioxide for 2005 are shown in Table 2-10. Sulfur dioxide was not measured at SSAB sites in 2005. Historical measurements showed concentrations to be well below standards and monitoring has been discontinued.

TABLE 2-10

2005 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	9	Southwest Coastal LA County
Orange	0.008	6	North Coastal Orange County
Riverside	0.011	8	Metropolitan Riverside County
San Bernardino	0.004	3	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 2005, 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 2005. Historical sulfate data showed concentrations in the SSAB areas to be well below the standard, and measurements have been discontinued.

TABLE 2-11

2005 Maximum Sulfate Concentrations by Basin and County

Basin/County	Maximum 24-hr Avg. µg/m^3	Percent of Federal Standard	Area
South Coast Air Basin			
Los Angeles	17.3	69	South Central Los Angeles
Orange	N.D.		
Riverside	10.3	41	Metropolitan Riverside County
San Bernardino	10.9	44	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	N.D.		

N.D. = No Data. Historical measurements indicate concentrations are well below standards.
State standard = 25 µg/m^3

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 2005. 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 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 2005. The maximum monthly and quarterly average lead concentration (0.44 $\mu g/m^3$ and 0.34 $\mu g/m^3$ in Central Los Angeles), measured at special monitoring sites immediately adjacent to stationary sources of lead were 29 and 23 percent of the state and federal standards, respectively.

TABLE 2-12

2005 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	0.03	2	South Central Los Angeles County
Orange	N.D.		
Riverside	0.02	1	Metropolitan Riverside County
San Bernardino	0.02	1	Northwest San Bernardino Valley
Salton Sea Air Basin			
Riverside	N.D.		

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

Summary

In 2005, 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. Maximum concentrations of PM2.5 and ozone exceeded the federal standards by the widest margins nationwide. In 2005, carbon monoxide concentrations did not exceed the standards anywhere in the Basin for the third consecutive year. Maximum concentrations for nitrogen dioxide, sulfur dioxide, sulfate, and lead continued to remain below the state and federal standards.