Chapter 5

Toxic Air Contaminant Emissions, Air Quality, and Health Risk

Introduction

This chapter presents a summary of the emissions and air quality data available for selected toxic air contaminants, or TACs. The Health and Safety Code defines a TAC as an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health. There are almost 200 compounds that have been designated as TACs in California. Some of these TACs are groups of compounds which contain many individual substances (e.g., copper compounds, polycyclic aramatic compounds). The summary information includes available data for the ten TACs posing the greatest known health risk in California, based primarily on ambient air quality data. These TACs are acetaldehyde, benzene, 1,3-butadiene, carbon tetrachloride, hexavalent chromium, *para*-dichlorobenzene, formaldehyde, methylene chloride, perchloroethylene, and diesel particulate matter (diesel PM). Besides the ten selected TACs, dioxins are also considered to pose substantial health risk, and a brief discussion on dioxins is presented in this introduction.

Chapter 5 is organized in three major sections. Its introduction provides general information on toxic air contaminants, their emissions, and air quality. Information for the ten selected TACs is summarized for the State as a whole and for each of the five most populous air basins, which are the South Coast Air Basin, the San Francisco Bay Area Air Basin, the San Joaquin Valley Air Basin, the San Diego Air Basin, and the Sacramento Valley Air Basin. The second section provides summaries of statewide emissions, annual average concentrations (calculated as a mean of the monthly means), and average health risks for the ten selected TACs. The third section provides similar information for California's five most populous air basins. Tables of concentration and health risk data for the ten TACs are presented in Appendix C for the State as a whole, each of the five most populous air basins, and for individual sites within these air basins.

It is important to note that the summarized data reflect a spatial average, and ambient concentrations and health risks for individual locations may be higher or lower. In addition, the ambient concentration and health risk information presented here reflect data collected only at sites operated by the ARB, and the information presented in this chapter reflects only the ten TACs for which available data indicate the most substantial health risk. There may be other TACs that pose a substantial risk, but for which sufficient data are not available, or which have not been identified as a concern. Additional information on interpreting air quality data for toxic air contaminants can be found in Chapter 1.

Sources of Toxic Air Contaminant Emissions in California. Similar to the criteria pollutants, toxic air contaminants are emitted from stationary sources, area-wide sources, and mobile sources. The stationary source emissions inventory was developed by the ARB in cooperation with affected industries and the air pollution control and air quality management districts (districts) as part of Assembly Bill 2588, the Air Toxics Hot Spots Information and Assessment Act of 1987 (Hot Spots Program). The ARB developed the emission estimates for area-wide sources and mobile sources.

Emissions of the selected TACs are reported on a statewide basis and for the ten highest-emitting counties in California. Emissions are also included for the five most populous air basins. In general, the inventory base year is 2005. Note, however, that the stationary source emissions inventory uses the best available information for the emission source, although the data may not have been specifically collected for 2005.

Air Quality Monitoring for Toxic Air Contaminants. The ARB maintains a statewide air quality monitoring network for toxic air contaminants. The network was originally designed to measure selected substances in the ambient air to determine if levels were sufficiently high

to be of concern. As a result of this monitoring, the ARB has determined atmospheric concentrations for over 60 individual substances. As shown in Figure 5-1, the ARB currently maintains a network of 17 air quality monitoring stations, measuring ambient concentrations of 64 substances. The number of sites is smaller than in previous years and reflects the closure of several sites during 2000. By closing these sites, additional resources were made available to support monitoring for the ARB community health program. The sites selected for closure generally showed concentrations similar to the statewide average, so their closure has a small overall impact on the statewide annual averages. Other factors considered in selecting sites for closure included the total number of sites in the area and the continuity of the data record.

TAC samples are generally collected once every 12 days, throughout the year. This results in 20,000 to 35,000 individual TAC measurements annually. The TAC data are typically sampled, analyzed, and reported as 24-hour averages. These 24-hour averages provide the basis for the annual average concentrations. The annual average concentrations are then used to support statewide risk assessment.

The ambient TAC air quality trends included in this chapter are based on ambient data collected during 1990 through 2004 except for diesel PM. There are no diesel PM ambient monitoring data because no generally accepted method currently exists. However, the ARB has made some estimates of ambient diesel PM concentrations, based on receptor modeling techniques. These estimates are included for comparison.

To minimize the influences of weather on the trends, three-year average statewide concentrations were used to assess changes in individual TACs over time. The trend is determined by comparing the resulting averages from the beginning and end of the monitoring period. For about half of the ten TACs, the baseline average concentration is for 1990-1992, and the current average concentration is for 2002-2004. However, acetaldehyde and formaldehyde data collected prior to 1996 are underestimated, so their respective baseline average concentration is for 1996-1998. For hexavalent chromium and *para*-dichlorobenzene, monitoring data were available starting in 1992 and 1991, so their baseline averages are for 1992-1994 and 1991-1993, respectively.

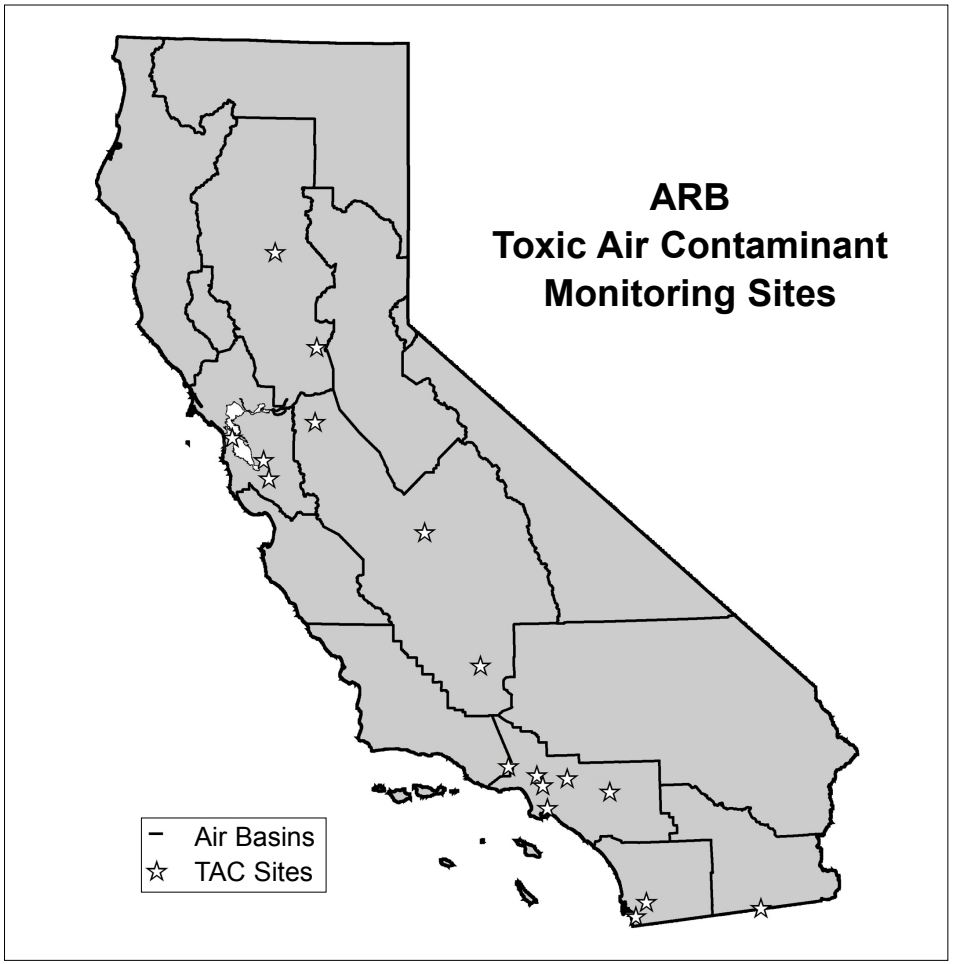

Figure 5-1

Statewide Health Risk and Community Health. In this almanac, health risk is presented on a pollutant-by-pollutant basis and on a cumulative basis, with a focus on cancer risk. The cancer risk estimates are calculated using an annual average concentration calculated as an average of the monthly means multiplied by a unit risk factor. The unit risk factor is expressed as the probability, or risk, of contracting cancer as a result of constant exposure to an ambient concentration of one microgram per cubic meter for 70 years. The potential

impacts for cancer are expressed as the risk of contracting cancer (or excess cancer cases) per million people exposed over a 70-year period. Table 5-1 lists the unit risk factor and the limit of detection (LOD) for each of the ten TACs presented in this almanac. LOD is the lowest concentration of a substance that can be reliably measured, and measurements below the LOD are assumed to be one-half of the LOD. The unit risk factors reflect only the inhalation pathway. The TAC monitoring network is designed to provide air quality data in support of general population exposures. Therefore, the data do not provide information on localized impacts, often referred to as near-source or neighborhood exposures.

Localized impacts may involve exposure to different toxic air contaminants with higher or lower concentrations than those represented by the ambient air monitoring data. The ARB participated in several studies to address localized impacts and community health issues. For example, during October 1999, the ARB initiated a monitoring and evaluation study in the Barrio Logan and Logan Heights neighborhoods of San Diego. In addition, the ARB has conducted monitoring in five other communities in support of the community health program as required by SB 25. Efforts such as these will supplement our existing statewide TAC monitoring network, which was designed for regional rather than neighborhood assessments. Information on these and other studies is available at *www.arb.ca.gov/ch/programs/sb25/sb25.htm*.

Monitoring for Dioxins. Dioxins and furans, collectively referred to as dioxins, are a group of chemicals with similar structures and chemical properties. When found in the environment, dioxins are usually a mixture of these chemicals. Dioxins are byproducts of various industrial and combustion activities, and they can be emitted from vehicles, waste incineration, chemical manufacturing plants, and forest fires. Once released into the environment, dioxins are highly persistent and can accumulate in the tissues of animals and humans.

Dioxins can be inhaled directly, and they can also accumulate in the body from eating dioxins-contaminated vegetation or animals that have eaten such vegetation. Many studies have shown that dioxins can cause cancer and other health problems including birth defects and liver damage.

Toxic Air Contaminant Unit Risk Factors

Toxic Air Contaminant	Unit Risk/Million People*	Limit Of Detection (ppb)
Acetaldehyde	2.7	0.10
Benzene	29	0.05
1,3-Butadiene	170	0.04
Carbon Tetrachloride	42	0.02
Chromium, Hexavalent	150,000	0.06**
para-Dichlorobenzene	11	0.30
Formaldehyde	6	0.10
Methylene Chloride	1	0.10
Perchloroethylene	5.9	0.01
Diesel Particulate Matter	300***	N/A

* The Unit Risk represents the number of excess cancer cases per million people per microgram per cubic meter TAC concentration over a 70-year, lifetime exposure.
** The unit for hexavalent chromium is nanograms per cubic meter.
*** A diesel particulate matter unit risk value of 300 is used as a reasonable estimate in the *"Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles"* (ARB, October 2000).

Table 5-1

The ARB has identified dioxins as a TAC, and U.S. EPA has listed them as hazardous air pollutants. In 1990, the ARB adopted a control measure to reduce emissions of dioxins from medical waste incinerators by 99 percent. At the time, medical waste incinerators were one of the largest known air sources of dioxins in California. As a result of the control measure, the number of medical incinerators in the State dropped sharply, from about 150 to less than 10.

In order to provide information on ambient levels of dioxins and dioxin-like compounds, the ARB has developed the California Ambient Dioxin Air Monitoring Program (CADAMP). This program is modeled, in part, after the U.S. Environmental Protection Agency's National Dioxin Air Monitoring Network (NDAMN) to ensure the data from the two networks can be used interchangeably. The two

networks use the same sampling and analytical techniques; however, CADAMP focuses on dioxins sampling in urban areas while NDAMN emphasizes rural areas nationwide. Ten sampling sites have been deployed in CADAMP, five in the San Francisco Bay Area, four in the South Coast Air Basin, and one in Sacramento. The monitoring started in December 2001, and it will end in July/August 2006. Several of the CADAMP sites are also part of the ARB's Children's Environmental Health Protection Program (SB25). Preliminary data collected as part of this program are currently being analyzed. Data from 2002 and 2003 are available at *www.arb.ca.gov/aqa/dioxin/cadamp.html*. Data from 2004 are expected to be available in early 2006. General information on ARB's dioxins program is available at *www.arb.ca.gov/toxics/dioxins/dioxins.htm*.

Additional Information. Additional emissions and air quality data for the ten TACs in this almanac, as well as many other TACs, may be found by accessing the ARB website at *www.arb.ca.gov/html/aqe&m.htm.* The web data are updated periodically, as new information becomes available. More detailed information on the health effects of these compounds, as well as other TACs, can be found in an ARB report entitled: *"Toxic Air Contaminant Identification List - Summaries,"* dated September 1997. This report can be obtained from the ARB Public Information Office at (916) 322-2990 or by accessing the ARB website at *www.arb.ca.gov/toxics/id/id.htm*.

Acetaldehyde

2005 Statewide Emission Inventory

Acetaldehyde is a federal hazardous air pollutant (HAP). The ARB identified acetaldehyde as a TAC in April 1993 under Assembly Bill 2728. This bill required the ARB to identify all federal HAPs as TACs. In California, acetaldehyde is identified as a carcinogen. This compound also causes chronic non-cancer toxicity in the respiratory system.

Acetaldehyde is both directly emitted into the atmosphere and formed in the atmosphere as a result of photochemical oxidation. Sources of acetaldehyde include emissions from combustion processes such as exhaust from mobile sources and fuel combustion from stationary internal combustion engines, boilers, and process heaters. In California, photochemical oxidation is the largest source of acetaldehyde concentrations in the ambient air. Approximately 24 percent of the statewide acetaldehyde emissions can be attributed to on-road motor vehicles, with an additional 51 percent attributed to other mobile sources such as construction and mining equipment, aircraft, recreational boats, and agricultural equipment. Area-wide sources of emissions, which contribute 22 percent of the statewide acetaldehyde emissions, include the burning of wood in residential fireplaces and wood stoves. Stationary sources contribute three percent of the statewide acetaldehyde emissions. The primary stationary sources are manufacturers of miscellaneous food and kindred products and crude oil and natural gas extraction. The emissions from these sources are from fuel combustion.

Acetaldehyde		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	230	3%
Area-wide Sources	1660	22%
On-Road Mobile	1866	24%
Gasoline Vehicles	905	12%
Diesel Vehicles	960	13%
Other Mobile	3919	51%
Gasoline Fuel	977	13%
Diesel Fuel	2262	29%
Other Fuel	680	9%
Natural Sources	0	0%
Total Statewide	***7675***	***100%***

Table 5-2

2005 Top Ten Counties - Acetaldehyde

The top ten counties account for approximately 46 percent of the statewide acetaldehyde emissions. The South Coast Air Basin has four of the top ten counties: South Coast portion of Los Angeles County (13 percent of the emissions of acetaldehyde statewide), Orange County (four percent), South Coast portion of San Bernardino County (three percent), and South Coast portion of Riverside County (three percent). Collectively, approximately 23 percent of statewide acetaldehyde emissions occur in the South Coast Air Basin. San Diego County accounts for approximately six percent. The five other counties in the top ten for acetaldehyde emissions are: Alameda, Santa Clara, Fresno, Sacramento and Kern (San Joaquin Valley portion). These five counties account for approximately 17 percent of statewide acetaldehyde emissions.

Acetaldehyde			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	992	13%
San Diego	San Diego	497	6%
Alameda	San Francisco Bay Area	334	4%
Orange	South Coast	325	4%
Santa Clara	San Francisco Bay Area	270	4%
Fresno	San Joaquin Valley	251	3%
Sacramento	Sacramento Valley	232	3%
San Bernardino	South Coast	214	3%
Riverside	South Coast	213	3%
Kern	San Joaquin Valley	193	3%

Table 5-3

Acetaldehyde

Statewide Air Quality and Health Risk

The ARB routinely monitors ambient acetaldehyde concentrations throughout its network of toxic monitoring sites. Figure 5-2 presents a trend graph for acetaldehyde for the years 1990 through 2004. The graph shows a general downward trend in acetaldehyde levels with greater variation during 1990-2000 than in 2000-2004. There is a sharp drop in acetaldehyde levels during 1995 and a corresponding increase the following year. Levels between 2000 and 2004 show very little variation although there is a gradual swing between 2000 and 2003.

Although data are shown for all years during 1990 through 2004, the values prior to 1996 are uncertain because the ARB analyzed ambient samples using a method that underestimated the actual concentrations. A method change in 1996 corrected this bias; however, the ARB was unable to develop a correction factor for the earlier data. Although the concentrations and health risk values for years prior to 1996 are lower than expected, they are not directly comparable to data collected during the later years. The data prior to the method change are included here for completeness.

The acetaldehyde trend is based on monitoring data. To minimize the influences of weather on the trend, three-year average statewide concentrations are used to assess the change over time. To do this, the resulting averages at the beginning and the end of the monitoring period were compared. Although acetaldehyde data were collected beginning in 1990, as noted above, data prior to 1996 were unreliable. Therefore, the period 1996-1998 was used as the baseline average for comparison to 2002-2004. The result shows a three percent decrease in acetaldehyde concentration and health risk.

Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2004, there was an estimated five excess cancer cases per million people due to acetaldehyde. On an individual basis, the health risks from acetaldehyde are much lower than they are for some of the other toxic air contaminants. Among the ten compounds presented in this almanac, the health risk from acetaldehyde ranks eighth.

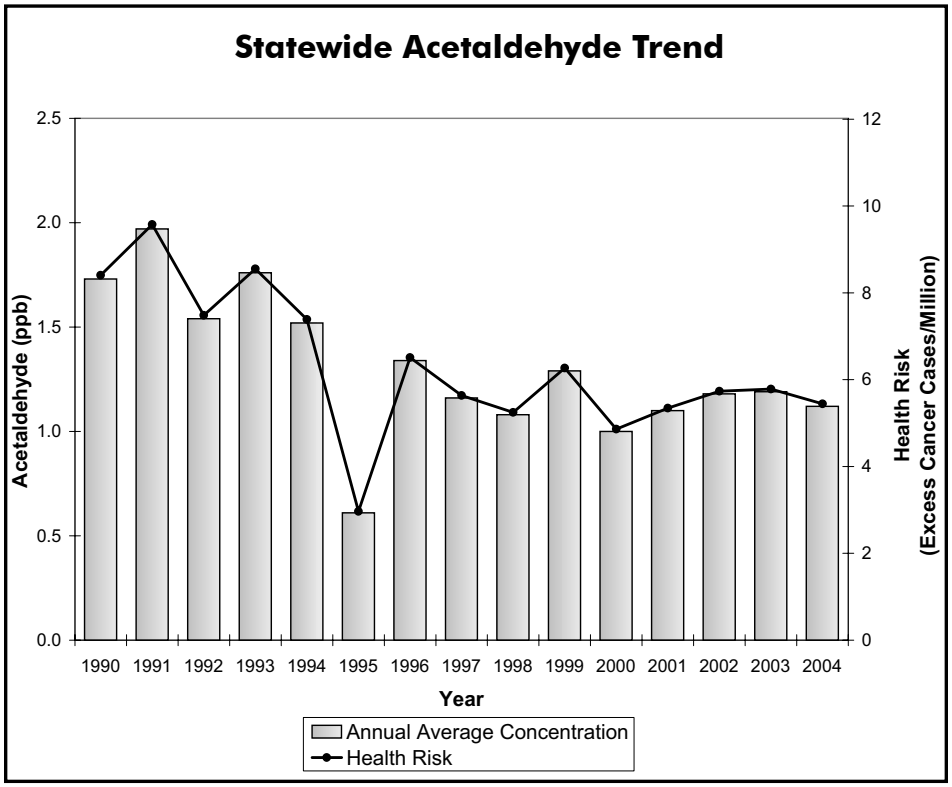

Figure 5-2

It is important to note that the health risk due to acetaldehyde is not spread evenly throughout the State. This is common for almost all pollutants. The data reflect statewide averages, and do not consider local impacts. Therefore, some Californians may be exposed to near-source, or "hot spot" concentrations of acetaldehyde which are above

the statewide annual average concentration. “Hot spot” exposure may increase the potential cancer risk to individuals living near large combustion sources. Information collected under Assembly Bill 2588 (the Air Toxics “Hot Spots” Program) will be used to help determine the priority and need for control of sources of acetaldehyde.

Another factor to consider is that the statewide averages reflect ambient outdoor concentrations. In general, acetaldehyde concentrations are higher indoors than outdoors, due in part to the abundance of combustion sources, such as cigarettes, fireplaces, and woodstoves.

Acetaldehyde is directly emitted and also occurs in the environment as a result of the photochemical oxidation of reactive organic gases (ROG). Over the years, stringent emission standards for new vehicles have resulted in steady declines in directly emitted acetaldehyde due to vehicular emissions. However, its secondary formation can be hard to quantify, and can contribute to fluctuations in ambient levels of acetaldehyde.

Benzene

2005 Statewide Emission Inventory

Benzene is highly carcinogenic and occurs throughout California. The ARB identified benzene as a TAC in January 1985 under California's TAC program (Assembly Bill 1807). In addition to being a carcinogen, benzene also has non-cancer health impacts. Brief inhalation exposure to high concentrations can cause central nervous system depression. Acute effects include central nervous system symptoms of nausea, tremors, drowsiness, dizziness, headache, intoxication, and unconsciousness.

Current estimates show that approximately 85 percent of the benzene emitted in California comes from motor vehicles, including evaporative leakage and unburned fuel exhaust. The predominant sources of total benzene emissions in the atmosphere are gasoline fugitive emissions and gasoline motor vehicle exhaust. Approximately 49 percent of the statewide benzene emissions can be attributed to on-road motor vehicles, with an additional 36 percent attributed to other mobile sources such as recreational boats, off-road recreational vehicles, and lawn and garden equipment. Currently, the benzene content of gasoline is less than one percent. Some of the benzene in the fuel is emitted from vehicles as unburned fuel. Benzene is also formed as a partial combustion product of larger aromatic fuel components. Industry-related stationary sources contribute 13 percent and area-wide sources contribute one percent of the statewide benzene emissions. The primary stationary sources of reported benzene emissions are crude petroleum and natural gas mining, petroleum refining, and electric generation. The primary area-wide sources include residential combustion of various types such as cooking and water heating. The primary natural sources are petroleum seeps that form where oil or natural gas emerge from subsurface sources to the ground or water surface.

Benzene		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	1658	13%
Area-wide Sources	123	1%
On-Road Mobile	6041	49%
Gasoline Vehicles	5779	47%
Diesel Vehicles	261	2%
Other Mobile	4426	36%
Gasoline Fuel	3484	28%
Diesel Fuel	615	5%
Other Fuel	327	3%
Natural Sources	46	0%
Total Statewide	***12293***	***100%***

Table 5-4

2005 Top Ten Counties - Benzene

The top ten counties account for approximately 55 percent of the statewide benzene emissions. The South Coast Air Basin has four of the top ten counties emitting benzene: South Coast portion of Los Angeles County (17 percent of the emissions of benzene statewide), Orange County (six percent), South Coast portion of San Bernardino County (three percent), and South Coast portion of Riverside County (three percent). Collectively, approximately 29 percent of statewide benzene emissions occur in the South Coast Air Basin. Two counties in the San Francisco Air Basin contribute approximately seven percent: Santa Clara County (four percent) and Alameda County (three percent). The four other counties in the top ten for benzene emissions are: San Diego, Kern, Sacramento and Santa Barbara. These four counties account for approximately 19 percent of statewide benzene emissions.

Benzene			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	2141	17%
San Diego	San Diego	849	7%
Kern	San Joaquin Valley	742	6%
Orange	South Coast	726	6%
Santa Clara	San Francisco Bay Area	467	4%
Alameda	San Francisco Bay Area	400	3%
San Bernardino	South Coast	383	3%
Riverside	South Coast	356	3%
Sacramento	Sacramento Valley	343	3%
Santa Barbara	South Central Coast	341	3%

Table 5-5

Benzene

Statewide Air Quality and Health Risk

The ARB has routinely monitored benzene concentrations in the ambient air for more than a decade. To examine the trend in benzene while minimizing the influences of weather on the trend, the statewide average benzene concentration for 1990-1992 was compared to that for 2002-2004. The result is a 74 percent decrease in both concentration and health risk. Figure 5-3 shows the annual average statewide benzene concentrations and the associated health risk from benzene alone. Ambient levels have shown generally steady improvement since 1990.

Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration level over a 70-year lifetime. From these data, it is apparent that benzene poses a substantial health risk. Based on the statewide averages, benzene ranks second highest among the ten TACs presented in this almanac. During 2004, there was an estimated risk of 43 excess cancer cases per million people due to benzene. However, as with all air pollutants, the health risk is not spread evenly throughout the State. In some areas, the health risk is higher than the statewide average, while in other areas the health risk is lower. In general, ambient benzene concentrations and associated health risks tend to be higher in the more urbanized areas.

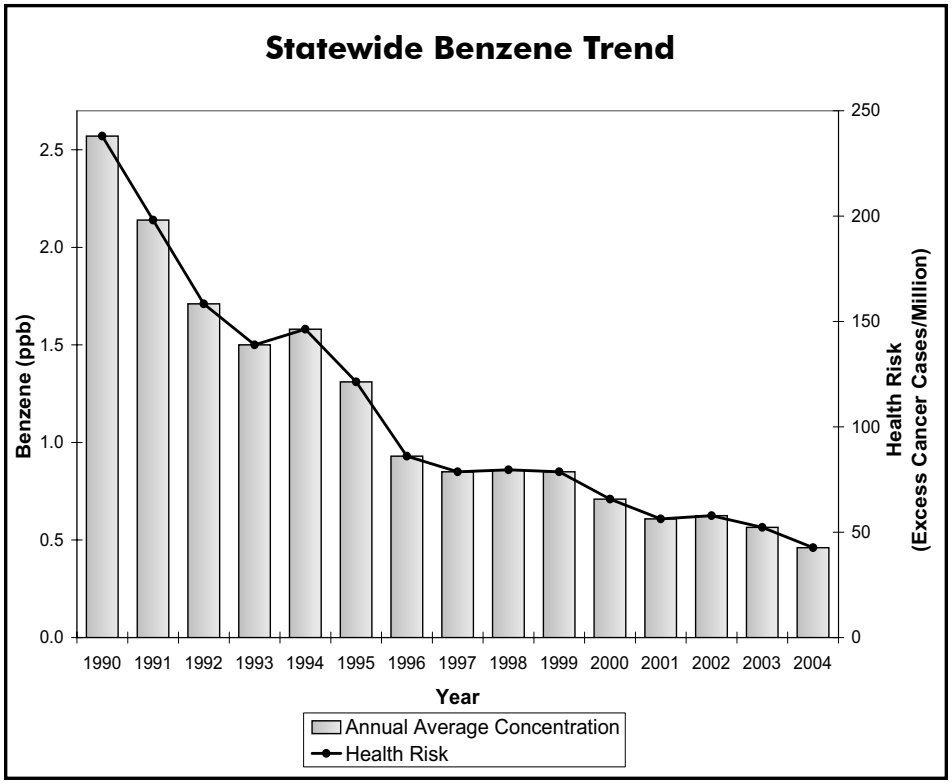

Figure 5-3

It is important to note that the ambient benzene concentrations have been corrected to provide a consistent long-term data record. Prior to 1999, the ARB analyzed samples using a single-point calibration of the gas chromatograph analyzers. While this method was approved by the U.S. EPA, it resulted in low concentrations being under-reported. Beginning January 1, 1999, new and more sophisticated computer software allowed the ARB to switch to a 3-point calibration of the analyzers. This improved measurement technique more accurately characterizes the ambient benzene, especially at low concentrations. However, concentrations measured using the 3-point calibration method are higher than those measured with the single-point calibration method. A year long study showed that the two measurement methods were highly correlated, and the ARB was able to develop a predictive relationship between the two. To avoid discontinuity in the trend data, the pre-1999 benzene data shown in Figure 5-3 have been adjusted according to these predictive equations, and they now reflect the results that would have been produced using the 3-point calibration method. Information about the specific study process and adjustment equations can be found on the "Laboratory Standard Operating Procedures for Ambient Air" page on the ARB website at *www.arb.ca.gov/aaqm/sop/summary/summary.htm.*

The ARB started to use a gas chromatography/mass spectrometry based method to analyze benzene in 2001 to fulfill a lower detection limit requirement for the SB 25 and Neighborhood Assessment Programs. The new method is also in line with the new U.S. EPA Urban Air Toxic Program being developed nationally. Measurements do not change substantially by using the GC/MS method, so no adjustment is needed to prior years' data.

Although the health risk from benzene is still substantial, emissions have been reduced significantly over the last decade, and will be reduced further in California through a progression of regulatory measures and control technologies. The Low Emission Vehicle (LEV) regulations have resulted in a significant reduction in exhaust and evaporative hydrocarbon emissions, including benzene. As the fleet turns over and new LEV technology vehicles are introduced into the fleet, emission reductions will continue. In 1996, the California Phase II Reformulated Gasoline Program was implemented statewide. Fuel reformulation has led to a substantial decrease in the level of benzene from gasoline and vehicle exhaust emissions. Since motor vehicles continue to be the major source of benzene in the State, future efforts to improve fuel formulations, reduce vehicle exhaust emissions, and promote less polluting modes of transportation will likely continue to help reduce benzene emissions.

1,3-Butadiene

2005 Statewide Emission Inventory

The ARB identified 1,3-butadiene as a TAC in 1992. In California, 1,3-butadiene has been identified as a carcinogen. In addition, 1,3-butadiene vapors are mildly irritating to the eyes and mucous membranes and cause neurological effects at very high levels.

Most of the emissions of 1,3-butadiene are from incomplete combustion of gasoline and diesel fuels. Mobile sources account for approximately 85 percent of the total statewide emissions. Vehicles that are not equipped with functioning exhaust catalysts emit greater amounts of 1,3-butadiene than vehicles with functioning catalysts. Approximately 45 percent of the statewide 1,3-butadiene emissions can be attributed to on-road motor vehicles, with an additional 40 percent attributed to other mobile sources such as recreational boats, off-road recreational vehicles, and aircraft. Area-wide sources such as agricultural waste burning and open burning associated with forest management contribute approximately 15 percent. Stationary sources contribute less than one percent of the statewide 1,3-butadiene emissions. The primary stationary sources with reported 1,3-butadiene emissions include petroleum refining, manufacturing of synthetics and man-made materials, and oil and gas extraction. The primary natural sources are wildfires.

1,3-Butadiene		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	25	1%
Area-wide Sources	404	15%
On-Road Mobile	1240	45%
Gasoline Vehicles	1216	44%
Diesel Vehicles	25	1%
Other Mobile	1109	40%
Gasoline Fuel	830	30%
Diesel Fuel	58	2%
Other Fuel	220	8%
Natural Sources	0	0%
Total Statewide	***2778***	***100%***

Table 5-6

2005 Top Ten Counties - 1,3-Butadiene Emissions

The top ten counties account for approximately 49 percent of the statewide 1,3-butadiene emissions. Emission sources in the South Coast Air Basin contribute approximately 26 percent of the statewide total: Los Angeles County (15 percent), Orange County (five percent), Riverside County (three percent), and South Coast portion of San Bernardino County (three percent). San Diego County accounts for approximately seven percent. Two counties in the San Joaquin Valley Air Basin contribute seven percent of the 1,3-butadiene: Tulare County (four percent) and Fresno County (three percent). The other counties in the top ten for 1,3-butadiene emissions are: Santa Clara, Alameda, and Sacramento.

1,3-Butadiene			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	410	15%
San Diego	San Diego	190	7%
Orange	South Coast	139	5%
Tulare	San Joaquin Valley	109	4%
Santa Clara	San Francisco Bay Area	93	3%
San Bernardino	South Coast	78	3%
Alameda	San Francisco Bay Area	77	3%
Fresno	San Joaquin Valley	76	3%
Riverside	South Coast	69	2%
Sacramento	Sacramento Valley	66	2%

Table 5-7

1,3-Butadiene

Statewide Air Quality and Health Risk

The ARB routinely monitors for 1,3-butadiene at its statewide air toxics monitoring network. Figure 5-4 shows the annual average statewide 1,3-butadiene concentrations and the associated health risk from this TAC alone since 1990. The data show a general downward trend, with some variability. To examine the trend in 1,3-butadiene while minimizing the influences of weather, the statewide average 1,3-butadiene concentration for 1990-1992 was compared to that for 2002-2004. The result is a 63 percent decrease in both concentration and health risk. Despite this substantial drop, the health risk from this compound remains relatively high. In 2004, there was an estimated risk of 40 excess cancer cases per million people. Of the ten compounds presented in this almanac, the average statewide health risk from 1,3-butadiene ranks third. Again, it is important to note that the data shown here reflect statewide averages. They do not consider local impacts, which may be higher or lower.

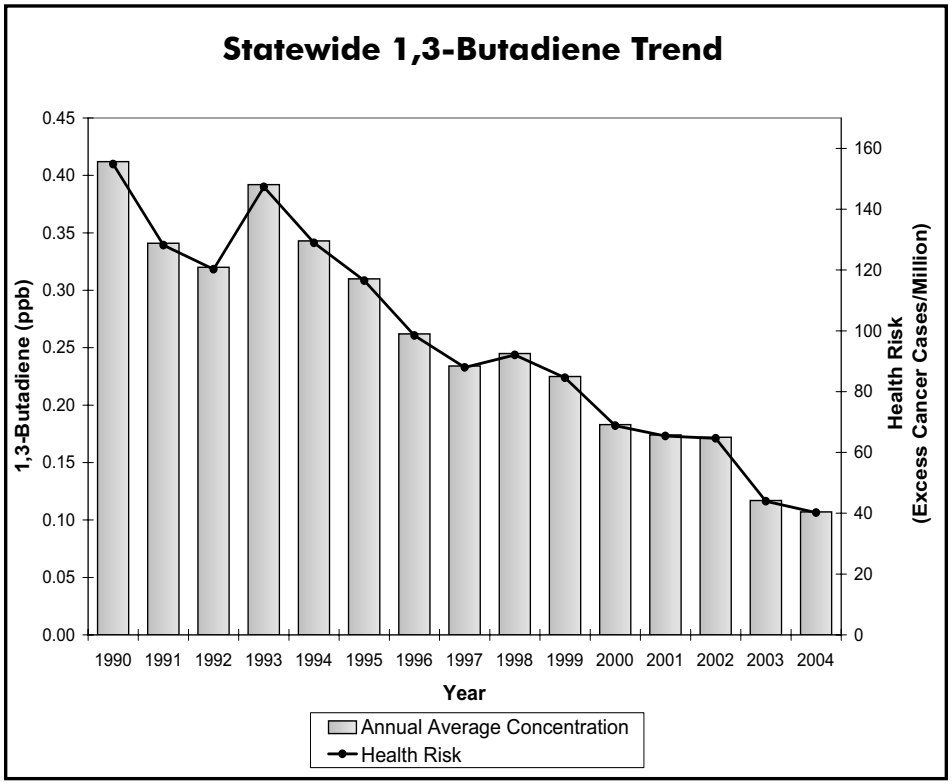

Figure 5-4

Similar to benzene, the ARB analyzed 1,3-butadiene samples using a single-point calibration of the gas chromatograph analyzers prior to 1999. While this method was approved by the U.S. EPA, it resulted in low concentrations being under-reported. Beginning January 1, 1999, new and more sophisticated computer software allowed the ARB to switch to a 3-point calibration of the analyzers. This improved measurement technique more accurately characterizes the ambient 1,3-butadiene, especially at low concentrations. However, concentrations measured using the 3-point calibration method are higher than those measured with the single-point calibration method. A year-long ARB study showed that the two measurement methods were highly correlated, and the ARB was able to develop a predictive relationship between them. To avoid discontinuity in the trend data, the pre-1999 1,3-butadiene data shown in Figure 5-4 have been adjusted according to these predictive equations and now reflect the results that would have been produced using the 3-point calibration method. Information about the specific study process and adjustment equations can be found on the "Laboratory Standard Operating Procedures for Ambient Air" page on the ARB website at *www.arb.ca.gov/aaqm/sop/summary/summary.htm*.

Similar to benzene, the ARB started to use a gas chromatography/mass spectrometry based method to analyze 1,3-butadiene in 2001. This change in method fulfilled a lower detection limit requirement for the SB 25 and Neighborhood Assessment Programs. The new method is also in line with the new U.S. EPA Urban Air Toxic Program being

developed nationally. Measurements do not change substantially by using the GC/MS method, so no adjustment is needed to prior years' data.

In California, the majority of 1,3-butadiene emissions are from incomplete combustion of gasoline and diesel fuels. The ARB adopted Low Emission Vehicles (LEV)/Clean Fuels regulations in 1990 and Phase II reformulated gasoline regulations in 1991. The LEV regulations are expected to continue to reduce 1,3-butadiene emissions from cars and light-duty trucks as the fleet turns over and new low emission vehicles are introduced into the fleet.

Carbon Tetrachloride

2005 Statewide Emission Inventory

The ARB identified carbon tetrachloride as a Toxic Air Contaminant in 1987 under California's TAC program (AB 1807). In California, carbon tetrachloride has been identified as a carcinogen. Carbon tetrachloride is also a central nervous system depressant and mild eye and respiratory tract irritant.

The primary stationary sources reporting emissions of carbon tetrachloride include chemical and allied product manufacturers and petroleum refineries. In the past, carbon tetrachloride was used for dry cleaning and as a grain-fumigant. Usage for these purposes is no longer allowed in the United States. Carbon tetrachloride has not been registered for pesticidal use in California since 1987. Also, the use of carbon tetrachloride in products to be used indoors has been discontinued in the United States. The statewide emissions of carbon tetrachloride are small (about 1.48 tons per year), and background concentrations account for most of the health risk.

Carbon Tetrachloride		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	1.48	100%
Area-wide Sources	0	0%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	***1.48***	***100%***

Table 5-8

2005 Top Ten Counties - Carbon Tetrachloride

The top three counties account for 79 percent of the statewide carbon tetrachloride emissions. Contra Costa County (San Francisco Bay Area Air Basin) accounts for approximately 63 percent, San Diego County accounts for eight percent, and Los Angeles County (South Coast Air Basin Portion) accounts for approximately 8 percent of the emissions of carbon tetrachloride statewide. Carbon tetrachloride emissions in the South Coast Air Basin portion of Los Angeles County have decreased from previous editions of the almanac due to the closure of a major facility in that area. Although the percentages for these counties are high, the emissions are very small (one ton or less per year in each county). The seven other counties in the top ten contribute approximately 19 percent of statewide carbon tetrachloride emissions.

Carbon Tetrachloride			
County	**Air Basin**	**tons/year**	**Percent**
Contra Costa	San Francisco Bay Area	0.93	63%
San Diego	San Diego	0.12	8%
Los Angeles	South Coast	0.11	8%
Riverside	South Coast	0.09	6%
Ventura	South Central Coast	0.05	4%
Sacramento	Sacramento Valley	0.05	3%
San Bernardino	Mojave Desert	0.04	2%
Orange	South Coast	0.02	1%
Kern	Mojave Desert	0.02	1%
San Bernardino	South Coast	0.01	1%

Table 5-9

Carbon Tetrachloride

Statewide Air Quality and Health Risk

The ARB routinely monitors carbon tetrachloride at its statewide air toxics monitoring network. Figure 5-5 shows the annual average statewide concentrations and the associated health risk from carbon tetrachloride alone. As with a number of other TACs, there are several years of incomplete data for carbon tetrachloride. The annual average concentration is available only if there is a full year of data. In 2004, a few months of data were invalidated by the ARB due to problems with laboratory equipment and associated data reliability. Therefore, to compare its health risk among the ten selected TACs, 2003 data were used instead. Based on the data that are available, the ambient concentrations and health risk dropped between 1990 and 1996, and then there was a substantial increase in values for 1998. During 2000 through 2003, values fluctuated slightly, which may be due in part to meteorological fluctuations rather than changes in emissions.

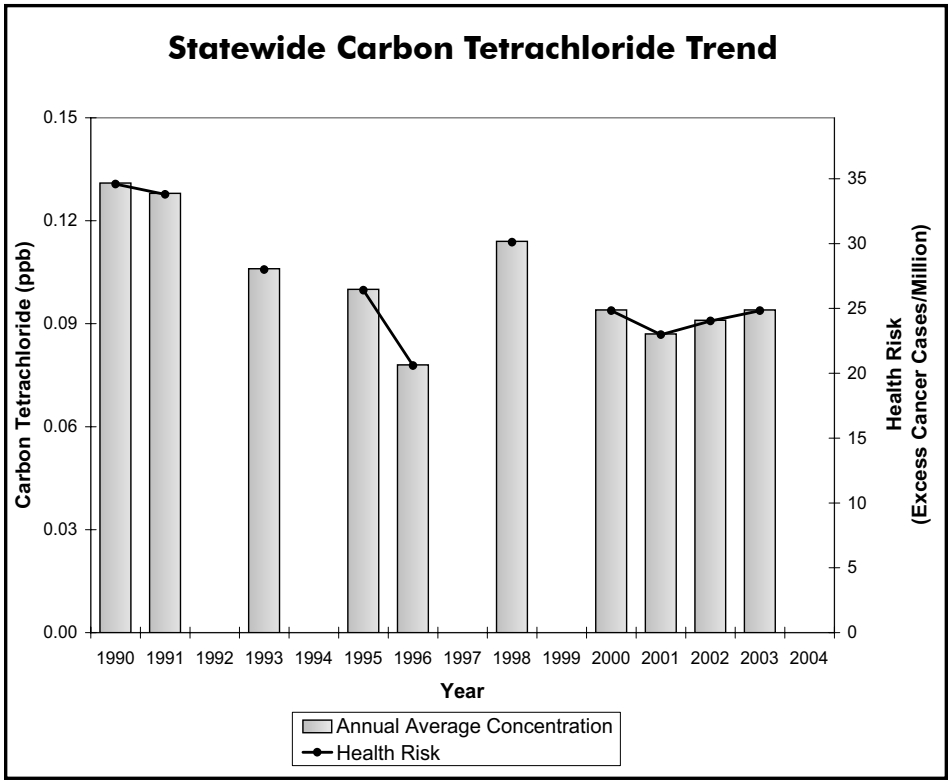

Figure 5-5

To examine the trend in carbon tetrachloride while minimizing the influences of weather on the trend, the statewide average carbon tetrachloride concentration for 1990-1992 was compared to that for 2001-2003. The result is a 29 percent decrease in both concentration and health risk. Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. Using 2003 health risk data, there was an estimated risk of 25 excess cancer cases per million people. The health risk of this TAC ranks fourth among the ten compounds presented in this almanac. As with all air pollutants, the health risk is not spread evenly throughout the State. In some areas, the health risk is higher than the statewide average, while in other areas the health risk is lower.

Unlike many of the other TACs, carbon tetrachloride is emitted primarily by sources other than motor vehicles, and there are virtually no emissions within California. However, because carbon tetrachloride persists in the atmosphere for many years (the estimated atmospheric lifetime is 50 years), background concentrations still pose a health risk.

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Chromium, Hexavalent

2005 Statewide Emission Inventory

Hexavalent chromium was identified as a Toxic Air Contaminant in 1986 under California's TAC program (AB 1807). In California, hexavalent chromium has been identified as a carcinogen. There is epidemiological evidence that exposure to inhaled hexavalent chromium may result in lung cancer. The principal acute effects of hexavalent chromium are renal toxicity, gastrointestinal hemorrhage, and intravascular hemolysis.

Chrome plating is a primary source of hexavalent chromium emissions in the State. Hexavalent chromium emissions from plating have declined significantly from previous editions of the almanac due to many platers switching to the use of trivalent chromium in place of hexavalent chromium. Chromic acid anodizing is another industrial metal finishing process which uses hexavalent chromium. A third source of hexavalent chromium emissions is the firebrick lining of glass furnaces. In California, stationary sources are estimated to emit about one half ton annually of hexavalent chromium. Emissions from these sources were obtained from facilities under the Air Toxics Hot Spots Act of 1987. This act required facilities to estimate toxics and potential toxics emissions, including hexavalent chromium. Approximately 0.13 tons of hexavalent chromium are emitted by gasoline motor vehicles. Other mobile sources such as trains and ships contribute approximately 0.83 tons of hexavalent chromium annually.

Chromium, Hexavalent		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	0.52	35%
Area-wide Sources	0.03	2%
On-Road Mobile	0.13	9%
Gasoline Vehicles	0.13	8%
Diesel Vehicles	< .01	0%
Other Mobile	0.83	55%
Gasoline Fuel	0.16	10%
Diesel Fuel	< .01	1%
Other Fuel	0.67	44%
Natural Sources	0	0%
Total Statewide	***1.50***	***100%***

Table 5-10

2005 Top Ten Counties - Chromium, Hexavalent

Four counties account for approximately 46 percent of the statewide hexavalent chromium emissions: Mojave Desert portion of Kern County (19 percent), San Diego County (16 percent), Mojave Desert portion of San Bernardino County (six percent) and Toulumne County (six percent). Collectively, approximately 25 percent of statewide hexavalent chromium emissions occur in the Mojave Desert Air Basin. Two counties in the San Joaquin Valley Air Basin contribute approximately six percent: Fresno County (three percent), and the San Joaquin Valley portion of Kern County (two percent).

Chromium, Hexavalent			
County	**Air Basin**	**tons/year**	**Percent**
Kern	Mojave Desert	0.29	19%
San Diego	San Diego	0.24	16%
San Bernardino	Mojave Desert	0.09	6%
Tuolumne	Mountain Counties	0.08	6%
Los Angeles	South Coast	0.08	5%
Imperial	Salton Sea	0.06	4%
Fresno	San Joaquin Valley	0.05	3%
Kern	San Joaquin Valley	0.04	3%
Sonoma	North Coast	0.04	3%
Orange	South Coast	0.04	3%

Table 5-11

Chromium, Hexavalent

Statewide Air Quality and Health Risk

Unlike the other TACs discussed in this almanac, hexavalent chromium is the cation of a metal salt rather than a gas. Statewide annual averages and health risk estimates are available for 1992 through 2004. Prior to 1992, a different measurement method was used. With this method, some of the hexavalent chromium was transformed into trivalent chromium on the collection filter. As a result, the hexavalent chromium concentrations were underestimated, and these data are not included in this almanac. Since 1992, a new and more accurate method has been used.

The statewide annual average concentrations and associated health risks are shown in Figure 5-6. Both show a general downward trend, with the exception of 1995. The high 1995 value is driven in part by an extremely high annual average for the Burbank site in the South Coast Air Basin. However, a number of other sites also had higher concentrations in 1995 than in other years. Hexavalent chromium values dropped substantially after 1995, and the decrease coincided with the complete implementation of the chrome plating and the chromate-treated cooling tower control measures. Between 1996 and 2004, values show general improvement, except for slight elevated values in 2000 and 2001.

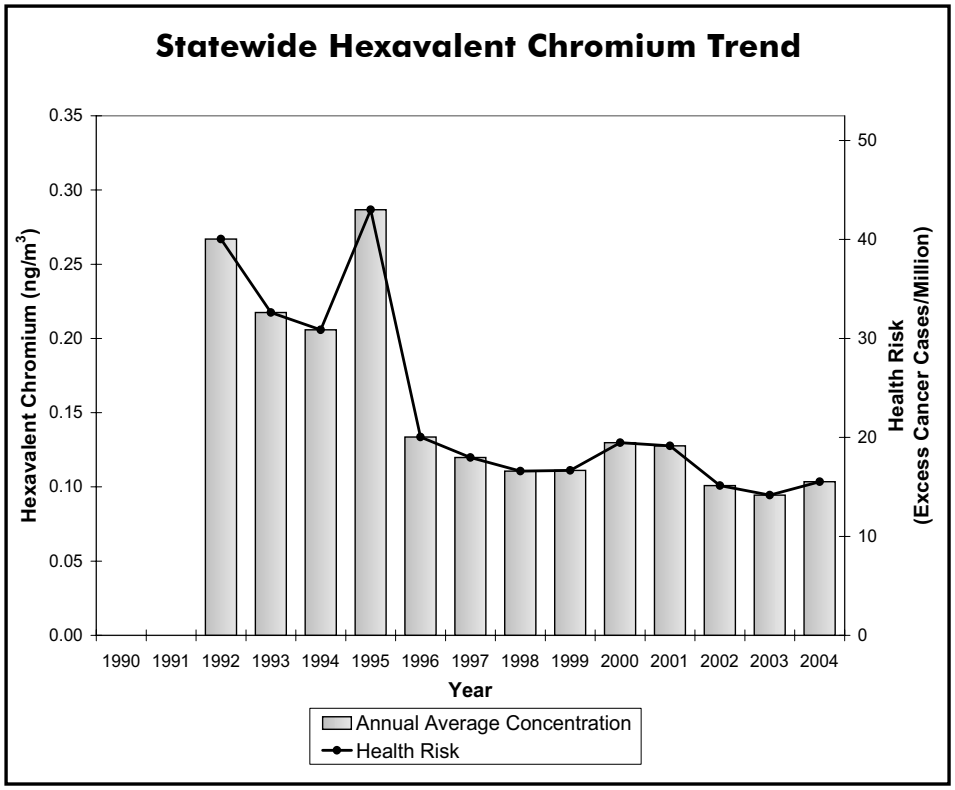

Figure 5-6

To examine the trend in hexavalent chromium while minimizing the influences of weather on the trend, the average hexavalent chromium concentration for 1992-1994 was compared to that for 2002-2004. The result is a 57 percent decrease in both concentration and health risk. In 2004, there were an estimated 16 excess cancer cases per million people, based on the annual average concentration. Based on data for the ten TACs presented in this almanac, hexavalent chromium ranks sixth in terms of health risk. Health risk is based on the annual average concentration and represents the estimated risk of excess cancer cases per million people exposed over a 70-year lifetime at the specified concentration level. It is important to remember that since hexavalent chromium exposure and health impact occur on a neighborhood scale, actual health risk can be higher in some areas than the statewide average, and lower in other areas.

During 1998 through 2001, a very high percentage of the measured values were below the Limit of Detection (LOD), which is the lowest concentration that can be reliably measured. In calculating an annual average, values below the LOD are assumed equal to 0.1 nanograms per cubic meter (ng/m^3), which is one-half the LOD of 0.2 ng/m^3. The one-half of LOD approach applies to all other TACs when their measurements are below their respective LODs. It is a good estimate

for some TACs, however, it is uncertain for hexavalent chromium due to the high number of very low concentrations. This approach continues to apply to hexavalent chromium for consistency. Starting on January 1, 2002, hexavalent chromium is being analyzed by compositing quarterly samples by site. Although the new method decreases the number of samples, it increases the sensitivity of the instrument by lowering the LOD from 0.2 ng/m^3 to 0.06 ng/m^3.

Implementation of a series of control measures has helped reduce ambient concentrations and associated health risks from hexavalent chromium. In 1988, the ARB adopted an airborne toxic control measure to reduce emissions of hexavalent chromium from chrome plating and chromic acid anodizing operations. The control measure reduced hexavalent chromium emissions from these operations by over 90 percent. In the past, compounds containing hexavalent chromium, such as sodium dichromate or lead chromate, were added to cooling tower water to control corrosion in the towers and associated heat exchangers. The ARB adopted a statewide airborne toxic control measure in 1989 that prohibits the use of hexavalent chromium in cooling towers. In September 2001, the ARB approved an air toxic control measure banning the use of both hexavalent chromium and cadmium in motor vehicle and mobile equipment coatings. The measure became effective January 1, 2003, and allows a sell-through period to deplete existing inventories. Statewide, ARB estimates that 99 percent of auto body repair and refinishing facilities already use chromium-free and cadmium-free coatings. However, this rule will ensure additional reductions in hexavalent chromium exposures near those remaining facilities that do not use chromium-free and cadmium-free coatings.

para-Dichlorobenzene

2005 Statewide Emission Inventory

The ARB identified *para*-dichlorobenzene as a TAC in April 1993 under AB 2728. This bill required the ARB to identify, by regulation, all federal hazardous air pollutants as TACs. In California, *para*-dichlorobenzene has been identified as a carcinogen. In addition to the carcinogenic impact, long-term inhalation exposure may affect the liver, skin, and central nervous system in humans.

The primary area-wide sources that have reported emissions of *para*-dichlorobenzene include consumer products such as non-aerosol insect repellants and solid/gel air fresheners. These sources contribute nearly all of the statewide *para*-dichlorobenzene emissions. Stationary sources contribute approximately 1 percent. The primary stationary sources include plating and polishing of fabricated metal products, crude petroleum and natural gas extraction, and sanitary services.

para-Dichlorobenzene		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	8	0%
Area-wide Sources	2383	100%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	***2391***	***100%***

Table 5-12

2005 Top Ten Counties - *para*-Dichlorobenzene

The top ten counties account for approximately 68 percent of the statewide *para*-dichlorobenzene emissions. The South Coast Air Basin has four of the top ten counties: South Coast portion of Los Angeles County (26 percent of the emissions of *para*-dichlorobenzene statewide), Orange County (eight percent), South Coast portion of San Bernardino County (four percent), and South Coast portion of Riverside County (four percent). Collectively, approximately 42 percent of statewide *para*-dichlorobenzene emissions occur in the South Coast Air Basin. San Diego County contributes approximately nine percent. Three counties in the San Francisco Bay Area Air Basin contribute approximately 12 percent: Santa Clara County (five percent), Alameda County (four percent), and Contra Costa County (three percent). The two other counties in the top ten for *para*-dichlorobenzene emissions are Sacramento and Fresno.

para-Dichlorobenzene			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	623	26%
San Diego	San Diego	203	9%
Orange	South Coast	197	8%
Santa Clara	San Francisco Bay Area	116	5%
Alameda	San Francisco Bay Area	100	4%
San Bernardino	South Coast	94	4%
Riverside	South Coast	90	4%
Sacramento	Sacramento Valley	89	4%
Contra Costa	San Francisco Bay Area	67	3%
Fresno	San Joaquin Valley	58	2%

Table 5-13

para-Dichlorobenzene

Statewide Air Quality and Health Risk

The ARB routinely monitors *para*-dichlorobenzene in ambient air, and statewide annual average concentrations and health risk estimates are available for 1991 through 2004, with the exception of 1998 and 1999. No summary data are available for these years because of problems with laboratory equipment and associated data reliability. The trend graph for *para*-dichlorobenzene, shown in Figure 5-7, shows generally constant values throughout 1991 to 1997, with slightly lower values in 1994 and 1996. Following a drop in 2000, there was an upturn in 2001 through 2002. Since 2002, *para*-dichlorobenzene levels have been constant.

Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2004, there was an estimated risk of 10 excess cancer cases per million people from this compound alone. Based on this, *para*-dichlorobenzene ranks seventh out of the ten compounds presented in this almanac. It is important to remember that, as with all air pollutants, the data shown here reflect statewide averages. They do not reflect local impacts, which may be higher or lower.

To examine the trend in *para*-dichlorobenzene while minimzing the annual variation due to meteorology and sampling schedules, the statewide average concentration for 1991-1993 was compared to that for 2002-2004. The result is a 14 percent increase in both the concentration and health risk. The increase can be attributed to a mechanism that ARB's Monitoring and Laboratory Division used for estimating very low concentrations and those that are below the Limit of Detection (LOD).

Similar to hexavalent chromium, a very high percentage of the measured values were below the LOD, which is the lowest concentration that can be reliably measured. A change in the LOD occurred in 2001, and changed the value from 0.2 ppb to 0.3 ppb. In calculating an annual average, values below the LOD are assumed equal to 0.15 parts per billion (ppb), which is one-half the LOD of 0.3 ppb. The one-half of LOD approach applies to all other TACs when their measurements are below the LOD. It is a good estimate for some TACs, however, it is uncertain for *para*-dichlorobenzene due to the large number of samples with very low concentrations. However, for consistency, this approach to values below the LOD continues to apply to *para*-dichlorobenzene.

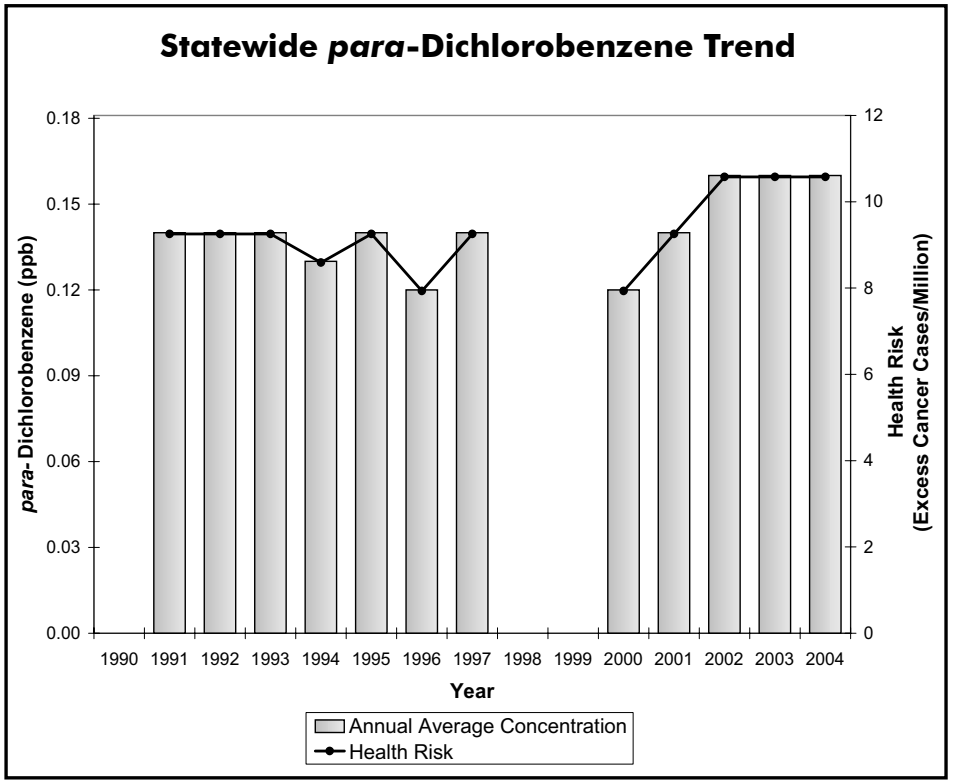

Figure 5-7

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Formaldehyde

2005 Statewide Emission Inventory

The ARB identified formaldehyde as a TAC in 1992 under California's TAC program (AB 1807). In California, formaldehyde has been identified as a carcinogen. Chronic exposure is associated with respiratory symptoms and eye, nose, and throat irritation.

Formaldehyde is both directly emitted into the atmosphere and formed in the atmosphere as a result of photochemical oxidation. Photochemical oxidation is the largest source of formaldehyde concentrations in California ambient air. Formaldehyde is a product of incomplete combustion. One of the primary sources of directly-emitted formaldehyde is vehicular exhaust. Formaldehyde is used in resins, can be found in many consumer products as an antimicrobial agent, and is also used in fumigants and soil disinfectants. About 76 percent of direct formaldehyde emissions are estimated to come from the combustion of fossil fuels from mobile sources. Approximately 26 percent of the total statewide formaldehyde emissions can be attributed to on-road motor vehicles, with an additional 50 percent attributed to other mobile sources such as aircraft, recreational boats, and construction and mining equipment. Area-wide sources contribute approximately 11 percent and stationary sources contribute approximately 13 percent of the statewide formaldehyde emissions. The primary area-wide sources in California of formaldehyde emissions include wood burning in residential fireplaces and wood stoves.

Formaldehyde		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	2474	13%
Area-wide Sources	2014	11%
On-Road Mobile	4999	26%
Gasoline Vehicles	3076	16%
Diesel Vehicles	1922	10%
Other Mobile	9590	50%
Gasoline Fuel	2979	16%
Diesel Fuel	4526	24%
Other Fuel	2085	11%
Natural Sources	0	0%
Total Statewide	***19078***	***100%***

Table 5-14

2005 Top Ten Counties - Formaldehyde

The top ten counties account for approximately 50 percent of the statewide formaldehyde emissions. The South Coast Air Basin has four of the top ten counties emitting formaldehyde: South Coast portion of Los Angeles County (14 percent of the emissions of formaldehyde statewide), Orange County (five percent), South Coast portion of San Bernardino County (three percent), and South Coast portion of Riverside County (three percent). Collectively, approximately 25 percent of statewide formaldehyde emissions occur in the South Coast Air Basin. The six other counties in the top ten for formaldehyde emissions are: San Diego, Kern, Alameda, Santa Clara, Santa Barbara, and Fresno. These six counties account for approximately 25 percent of statewide formaldehyde emissions.

Formaldehyde			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	2664	14%
San Diego	San Diego	1240	6%
Kern	San Joaquin Valley	1184	6%
Orange	South Coast	908	5%
Alameda	San Francisco Bay Area	711	4%
Santa Clara	San Francisco Bay Area	647	3%
Santa Barbara	South Central Coast	585	3%
Fresno	San Joaquin Valley	558	3%
Riverside	South Coast	529	3%
San Bernardino	South Coast	522	3%

Table 5-15

Formaldehyde

Statewide Air Quality and Health Risk

The ARB routinely monitors formaldehyde concentrations in the ambient air throughout its monitoring network, and statewide annual average concentrations and associated health risk are available for 1990 through 2004. However, values prior to 1996 are uncertain because the data were based on a method that underestimated the actual concentrations. A method change in 1996 corrected this problem, but a correction factor could not be developed for the earlier data. While the data prior to the method change are included here for completeness, they are not directly comparable to data collected during the later years. The trend graph for formaldehyde, shown in Figure 5-8, shows a great deal of variability with a general upward trend.

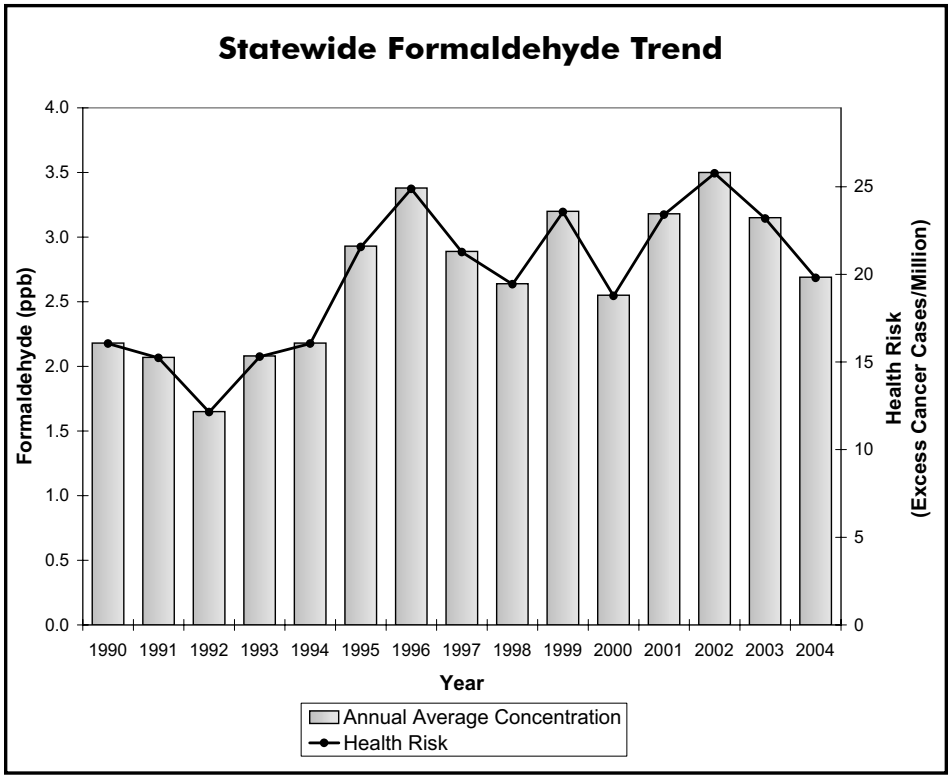

Figure 5-8

To examine the trend in formaldehyde using available data while minimizing the influences of weather on the trend, the statewide average formaldehyde concentration for 1996-1998 was compared to that for 2002-2004 (since formaldehyde data prior to 1996 are not reliable). The result is a slight (five percent) increase in both concentration and health risk. Note that health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2004, there was an estimated risk of 20 excess cancer cases per million people from formaldehyde alone. Based on data for all ten TACs presented in this almanac, formaldehyde ranks fifth in terms of health risk. As with other TACs, the health risk is not spread evenly throughout the State, so in some areas the health risk is higher than the statewide average while in other areas, the health risk is lower.

Although formaldehyde is emitted by both stationary and mobile sources, mobile sources are, by far, the largest contributors. The ARB adopted the Low Emissions/Clean Fuels Regulations in 1990, and these regulations are expected to continue to reduce formaldehyde emissions from cars and light-duty trucks. Formaldehyde, similar to acetaldehyde, can also be formed in the environment as a result of the photochemical oxidation of reactive organic gases. This secondary contribution can be hard to quantify and can also contribute to fluctuations observed in the ambient levels of formaldehyde.

Formaldehyde also poses a problem for indoor air quality, and its concentrations indoors are generally higher. This is because many building materials, consumer products, and fabrics emit formaldehyde. As a result, indoor formaldehyde levels are expected to remain higher

than outdoor levels because of new materials brought into homes, as a consequence of remodeling or purchasing new furnishings. Other indoor combustion sources such as wood and gas stoves, kerosene heaters, and cigarettes also contribute to indoor formaldehyde levels, although intermittently.

Methylene Chloride

2005 Statewide Emission Inventory

The ARB identified methylene chloride as a Toxic Air Contaminant in 1987 under California's TAC program. In California, methylene chloride has been identified as a carcinogen. In addition, chronic exposure can lead to bone marrow, hepatic, and renal toxicity.

Methylene chloride is used as a solvent, a blowing and cleaning agent in the manufacture of polyurethane foam and plastic fabrication, and as a solvent in paint stripping operations. Although methylene chloride is used in some aerosol consumer products (e.g., aerosol paints and automotive products), most consumer product manufacturers have voluntarily phased out its use. Paint removers account for the largest use of methylene chloride in California, where methylene chloride is the main ingredient in many paint stripping formulations. Plastic product manufacturers, manufacturers of synthetics, and aircraft and parts manufacturers are stationary sources reporting emissions of methylene chloride. These sources contribute approximately 45 percent of the statewide methylene chloride emissions. Area-wide sources contribute approximately 55 percent. The primary area-wide sources include consumer products such as paint removers and strippers and automotive brake cleaners.

Methylene Chloride		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	2977	45%
Area-wide Sources	3580	55%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	***6557***	***100%***

Table 5-16

2005 Top Ten Counties - Methylene Chloride

The top ten counties account for approximately 76 percent of the statewide methylene chloride emissions. The South Coast Air Basin has four of the top ten counties emitting methylene chloride: South Coast portion of Los Angeles County (33 percent of the emissions of methylene chloride statewide), Orange County (14 percent), South Coast portion of San Bernardino County (four percent), and South Coast portion of Riverside County (three percent). Collectively, approximately 56 percent of statewide methylene chloride emissions occur in the South Coast Air Basin. Two counties in the San Francisco Bay Area Air Basin contribute approximately seven percent: Santa Clara County (four percent), and Alameda County (three percent). The four other counties in the top ten for methylene chloride emissions are: San Diego, Sacramento, Ventura and Fresno. Together, these three counties account for approximately 13 percent of statewide methylene chloride emissions.

Methylene Chloride			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	2137	33%
Orange	South Coast	933	14%
San Diego	San Diego	370	6%
Santa Clara	San Francisco Bay Area	263	4%
San Bernardino	South Coast	239	4%
Alameda	San Francisco Bay Area	212	3%
Riverside	South Coast	196	3%
Sacramento	Sacramento Valley	179	3%
Ventura	South Central Coast	161	2%
Fresno	San Joaquin Valley	129	2%

Table 5-17

Methylene Chloride

Statewide Air Quality and Health Risk

The ARB routinely monitors methylene chloride in the ambient air. The trend graph in Figure 5-9 shows an overall downward trend with some variability, particularly during the early years. The drop in 2001 was substantial, and the downward trend has continued between 2002 and 2004 with minor drops. To examine the trend in methylene chloride while minimizing the influences of weather on the trend, the statewide average methylene chloride concentration for 1990-1992 was compared to that for 2002-2004. The result is a 74 percent decrease in both concentration and health risk.

Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2004, there was an estimated risk from methylene chloride of less than one excess cancer case per million people. Of the ten compounds presented in this almanac, methylene chloride presents the lowest health risk, on a statewide basis. However, any level of risk is a concern from a public health standpoint.

In California, paint removers account for the largest use of methylene chloride, which is the primary ingredient in paint stripping formulations used for industrial, commercial, military, and domestic applications. Because methylene chloride is also a constituent in many consumer products, including aerosol paints and automotive products, short-term indoor concentrations may be several orders of magnitude higher than the ambient concentrations. Many manufacturers of consumer products are voluntarily phasing-out their use of methylene chloride. In addition, in the case of aerosol paints, use will be restricted by a provision in the ARB's "Regulation for Reducing Volatile Organic Compound (VOC) Emissions from Aerosol Coating Products," adopted in March 1995. These regulations should help to further reduce ambient concentrations and health risks.

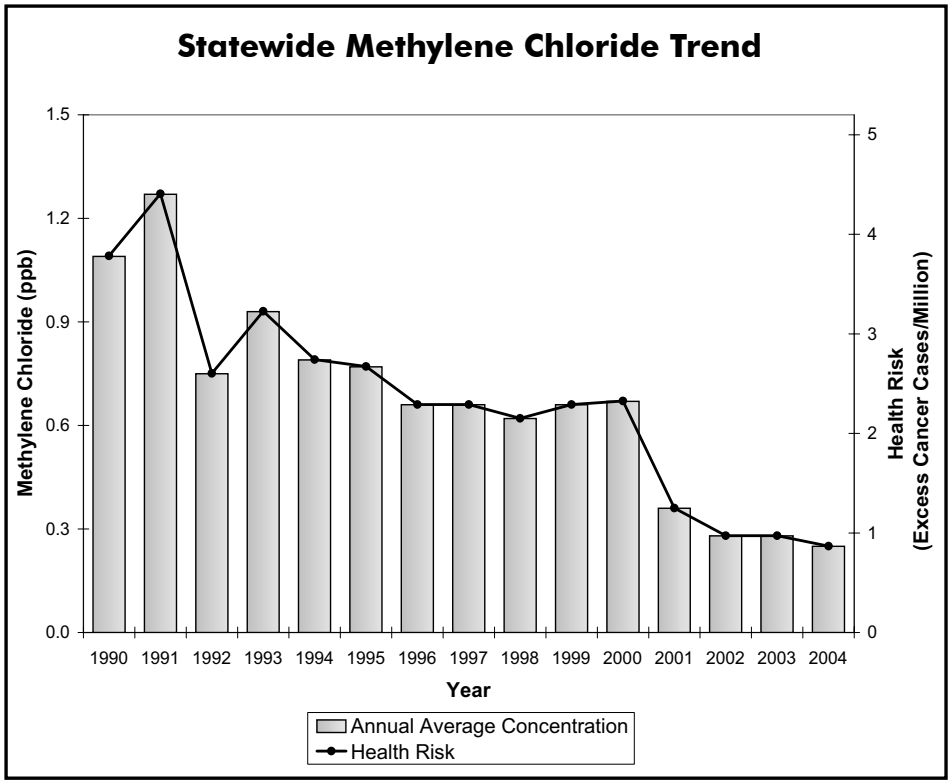

Figure 5-9

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Perchloroethylene

2005 Statewide Emission Inventory

The ARB identified perchloroethylene as a Toxic Air Contaminant in 1991 under California's TAC program (AB 1807). In California, perchloroethylene has been identified as a carcinogen. Perchloroethylene vapors are irritating to the eyes and respiratory tract. Following chronic exposure, workers have shown signs of liver toxicity, as well as kidney dysfunction and neurological effects.

Perchloroethylene is used as a solvent, primarily in dry cleaning operations. Perchloroethylene is also used in degreasing operations, paints and coatings, adhesives, aerosols, specialty chemical production, printing inks, silicones, rug shampoos, and laboratory solvents. In California, the stationary sources that have reported emissions of perchloroethylene are dry cleaning plants, aircraft part and equipment manufacturers, and fabricated metal product manufacturers. These stationary sources account for 61 percent of the statewide emissions of perchloroethylene. Area-wide sources contribute approximately 39 percent. The primary area-wide sources include consumer products such as automotive brake cleaners and tire sealants and inflators.

Perchloroethylene		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	3264	61%
Area-wide Sources	2096	39%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	***5361***	***100%***

Table 5-18

2005 Top Ten Counties - Perchloroethylene

The top ten counties account for approximately 67 percent of the statewide perchloroethylene emissions. The South Coast Air Basin has four of the top ten counties emitting perchloroethylene: South Coast portion of Los Angeles County (23 percent of the emissions of perchloroethylene statewide), Orange County (eight percent), South Coast portion of San Bernardino County (four percent), and South Coast portion of Riverside County (three percent). Collectively, approximately 38 percent of statewide perchloroethylene emissions occur in the South Coast Air Basin. San Diego County contributes approximately 12 percent. The five other counties in the top ten for perchloroethylene emissions are: Sacramento, Santa Clara, Alameda, Fresno, and San Joaquin. These five counties account for approximately 16 percent of statewide perchloroethylene emissions.

Perchloroethylene			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	1224	23%
San Diego	San Diego	657	12%
Orange	South Coast	420	8%
Sacramento	Sacramento Valley	261	5%
San Bernardino	South Coast	185	3%
Fresno	San Joaquin Valley	183	3%
Riverside	South Coast	182	3%
Santa Clara	San Francisco Bay Area	178	3%
Alameda	San Francisco Bay Area	167	3%
San Joaquin	San Joaquin Valley	119	2%

Table 5-19

Perchloroethylene

Statewide Air Quality and Health Risk

The ARB routinely monitors perchloroethylene concentrations in the ambient air. Although the trend graph for perchloroethylene in Figure 5-10 shows some variability, during the earlier years, there is an overall downward trend. To examine the trend in perchloroethylene over the monitoring period of record and to minimize the influences of weather on the trend, the statewide perchloroethylene concentration for 1990-1992 was compared to that for 2002-2004. The result is a 76 percent decrease in both concentration and health risk. For 1999, complete and representative data are not available. During 2004, there was an estimated risk of two excess cancer cases per million people. Based on this, perchloroethylene ranks ninth out of the ten compounds presented in this almanac. Health risk is based on the annual average concentration and represents the estimated risk of excess cancer cases per million people exposed over a 70-year lifetime at the specified concentration level.

When the ARB identified perchloroethylene as a TAC in October 1991, it was estimated that 60 percent of perchloroethylene came from dry cleaning operations. Examination of industry practices suggested the potential for significant reductions of emissions. The ARB focused control efforts on that industry and adopted a control measure governing the use of perchloroethylene in dry cleaning operations in October 1993. The final deadline for compliance was 1998. In addition to requiring emission controls, the ARB has worked with industry to provide training for industry personnel on improved practices and methods for reducing emissions. In the near future, the most significant factor affecting emissions will most likely be a continued reduction as more dry cleaning operations modify or replace older equipment. In the long-term, population growth in California may lead to increased demand for services and products using perchloroethylene, which may increase emissions from dry cleaners. However, the ARB has developed control measures that prohibit the use of perchloroethene in automotive products, aerosol adhesives, and aerosol coatings.

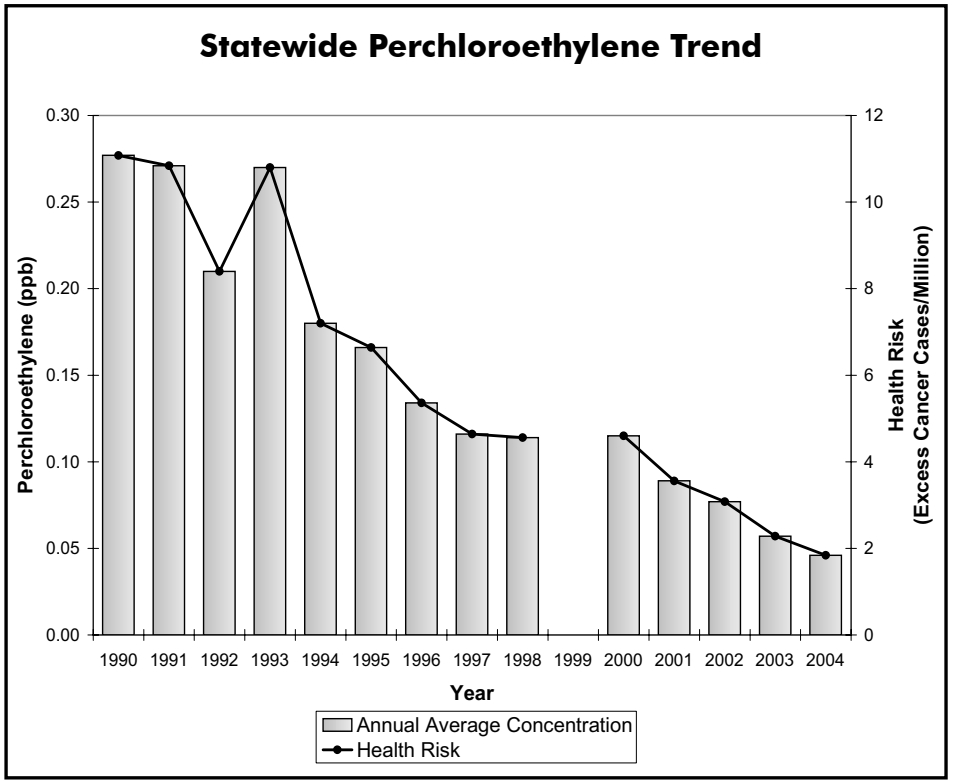

Figure 5-10

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Diesel Particulate Matter

2005 Statewide Emission Inventory

The ARB identified the particulate matter (PM) emissions from diesel-fueled engines as a TAC in August 1998 under California's TAC program. In California, diesel engine exhaust has been identified as a carcinogen. Most researchers believe that diesel exhaust particles contribute the majority of the risk.

Diesel PM is emitted from both mobile and stationary sources. In California, on-road diesel-fueled vehicles contribute approximately 19 percent of the statewide total, with an additional 77 percent attributed to other mobile sources such as construction and mining equipment, agricultural equipment, and transport refrigeration units. Stationary sources, contributing about five percent of emissions, include shipyards, warehouses, heavy equipment repair yards, and oil and gas production operations. Emissions from these sources are from diesel-fueled internal combustion engines. Stationary sources that report diesel PM emissions also include heavy construction (except highway), manufacturers of asphalt paving materials and blocks, and electrical generation.

Readers may note that the stationary source diesel PM emission estimates differ from those presented in previous editions of the almanac and in the ARB's October 2000 report entitled: "Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles" (Diesel Risk Reduction Plan). This is because they incorporate more recent data and have been calculated with updated methodologies developed for new regulations. These regulations are those that were recommended in the Diesel Risk Reduction Plan. The on-road mobile source emissions cited in the Diesel Risk Reduction Plan are based on an earlier version of EMFAC2001 (EMFAC1.99(f) 6/26/00), whereas the current estimates are based on EMFAC2002 (V2.02). The other mobile inventory includes revised estimates for ship diesel PM emissions. In 2005 ARB staff improved the methodology for estimating ship emissions by developing a consistent statewide methodology that incorporates more recent data on ship activities and emission factors. This has resulted in about a 119 percent increase in the estimates for ship emissions as compared to estimates developed with previous methodologies."

Diesel PM		
Emissions Source	**tons/year**	**Percent State**
Stationary Sources	1427	5%
Area-wide Sources	0	0%
On-Road Mobile	5790	19%
Gasoline Vehicles	0	0%
Diesel Vehicles	5790	19%
Other Mobile	23785	77%
Gasoline Fuel	0	0%
Diesel Fuel and Residual Oil	23785	77%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	***31002***	***100%***

Table 5-20

2005 Top Ten Counties - Diesel Particulate Matter

The top ten counties account for approximately 56 percent of the statewide diesel particulate matter emissions. The South Coast Air Basin has four of the top ten counties emitting diesel particulate matter: South Coast portion of Los Angeles County (18 percent of the emissions of diesel particulate matter statewide), Orange County (seven percent), South Coast portion of Riverside County (four percent), and the South Coast portion of San Bernardino County (three percent). Collectively, approximately 32 percent of statewide diesel particulate matter emissions occur in the South Coast Air Basin. San Diego County contributes approximately six percent, and Fresno County contributes approximately four percent. Three counties in the San Francisco Bay Area Air Basin contribute 11 percent: Alameda (four percent), Santa Clara (four percent), and San Francisco (three percent).

Diesel PM			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	4654	15%
San Diego	San Diego	1798	6%
Orange	South Coast	1376	4%
Alameda	San Francisco Bay Area	1369	4%
Fresno	San Joaquin Valley	977	3%
Riverside	South Coast	966	3%
Santa Clara	San Francisco Bay Area	875	3%
San Bernardino	South Coast	750	2%
Sacramento	Sacramento Valley	745	2%
Kern	San Joaquin Valley	726	2%

Table 5-21

Diesel Particulate Matter

Statewide Air Quality and Health Risk

The exhaust from diesel-fueled engines is a complex mixture of gases, vapors, and particles, many of which are known human carcinogens. More than 40 diesel exhaust components are listed by the State and federal governments as toxic air contaminants or hazardous air pollutants. Most researchers believe that diesel PM contributes the majority of the risk from exposure to diesel exhaust because the particles carry many of the harmful organics and metals present in the exhaust.

Unlike the other toxic air contaminants presented in this almanac, the ARB does not monitor diesel PM because there is no routine method for monitoring ambient concentrations. However, the ARB made a preliminary estimation of diesel PM concentrations for the State's 15 air basins and for the State as a whole using a PM-based exposure method. The method uses the ARB emission inventory's PM_{10} database, ambient PM_{10} monitoring data, and the results from several studies with chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate statewide outdoor concentrations of diesel PM. The ARB subsequently updated the original statewide estimates based on the ratio between the previous estimate for 1990 and the most recent diesel PM emission inventory for the year 1990. The details of the methodology are described in Appendix VI to the ARB report entitled: *"Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles,"* (Risk Reduction Plan or Plan) dated October 2000.

The updated statewide population-weighted average diesel PM concentrations and health risk for various years are shown in Figure 5-11. The average statewide concentration for 1990 was estimated at 3.0 micrograms per cubic meter ($\mu g/m^3$). This is associated with a health risk of 900 excess cancer cases per million people exposed over a 70-year lifetime. The estimates for 2000 show a 40 percent drop from 1990, with a concentration of 1.8 $\mu g/m^3$ and an associated health risk of 540 excess cancer cases per million people. In addition, the ARB

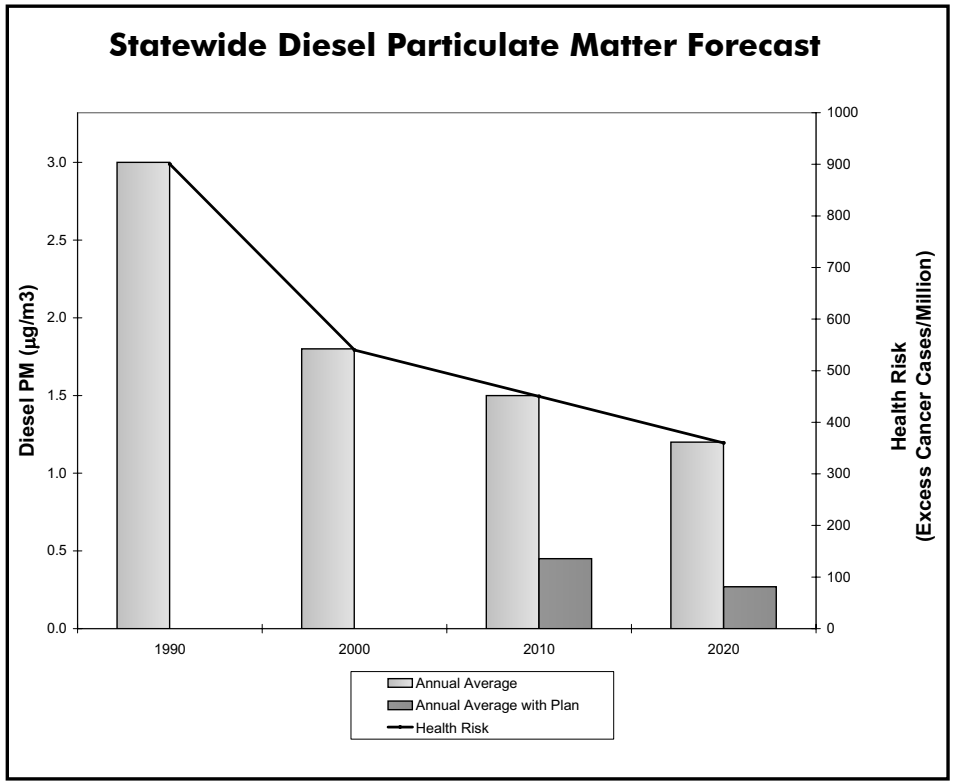


Figure 5-11

estimated population-weighted concentrations for 2010 and 2020. Two estimates are given for each of these years: one reflecting the estimated ambient concentrations without implementing the Risk Reduction Plan and one reflecting the estimated ambient concentrations with implementation of control measures in the Risk Reduction Plan. These future year estimates are based on linear extrapolations from the 1990 emissions inventory and linear rollback techniques. It is important to note that the estimated risk from diesel PM is higher than the risk from all other toxic air contaminants combined, and this TAC poses the most significant risk to California's citizens. In fact,

the ARB estimates that 70 percent of the known statewide cancer risk from outdoor air toxics is attributable to diesel PM.

The Risk Reduction Plan provides a mechanism for combating the diesel PM problem. Without implementing the Plan, concentrations in 2010 and 2020 are estimated to drop by only about 17 percent and 33 percent, respectively, from the estimated year 2000 level. However, the goal of the Plan is to reduce concentrations by 75 percent by 2010 and 85 percent by 2020. The key elements of the Plan are to clean up existing engines through engine retrofit emission control devices, to adopt stringent standards for new diesel engines, and to lower the sulfur content of diesel fuel to protect new, and very effective, advanced technology emission control devices on diesel engines. When fully implemented, the Risk Reduction Plan will significantly reduce emissions from both old and new diesel-fueled motor vehicles and from stationary sources that burn diesel fuel. In addition to these strategies, the ARB continues to promote the use of alternative fuels and electrification. As a result of these actions, diesel PM concentrations and associated health risks should continue to decline.

South Coast Air Basin

2005 Emission Inventory by Compound

Acetaldehyde

Approximately 92 percent of the emissions of acetaldehyde are from mobile sources.

Benzene

The primary sources of benzene emissions in the South Coast Air Basin are mobile sources (approximately 92 percent).

South Coast - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	51	3%	1%
Area-wide Sources	90	5%	1%
On-Road Mobile	647	37%	8%
Gasoline Vehicles	314	18%	4%
Diesel Vehicles	332	19%	4%
Other Mobile	955	55%	12%
Gasoline Fuel	281	16%	4%
Diesel Fuel	629	36%	8%
Other Fuel	45	3%	1%
Natural Sources	0	0%	0%
Total	1743	100%	23%
Total Statewide	**7675**		

Table 5-22

South Coast - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	248	7%	2%
Area-wide Sources	46	1%	0%
On-Road Mobile	2116	59%	17%
Gasoline Vehicles	2026	56%	16%
Diesel Vehicles	90	3%	1%
Other Mobile	1196	33%	10%
Gasoline Fuel	1007	28%	8%
Diesel Fuel	171	5%	1%
Other Fuel	18	0%	0%
Natural Sources	0	0%	0%
Total	3606	100%	29%
Total Statewide	**12293**		

Table 5-23

1,3-Butadiene

Approximately 99 percent of the emissions of 1,3-butadiene are from mobile sources.

South Coast - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	8	1%	0%
Area-wide Sources	2	0%	0%
On-Road Mobile	429	62%	15%
Gasoline Vehicles	420	60%	15%
Diesel Vehicles	9	1%	0%
Other Mobile	256	37%	9%
Gasoline Fuel	238	34%	9%
Diesel Fuel	16	2%	1%
Other Fuel	1	0%	0%
Natural Sources	0	0%	0%
Total	695	100%	25%
Total Statewide	**2778**		

Table 5-24

Carbon Tetrachloride

Stationary sources, such as chemical manufacturers and petroleum refineries, account for all of the emissions of carbon tetrachloride.

South Coast - Carbon Tetrachloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.24	100%	16%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.24	100%	16%
Total Statewide	**1.48**		

Table 5-25

Chromium, Hexavalent

Approximately 35 percent of the hexavalent chromium emissions are from stationary sources such as chrome platers, aircraft and parts manufacturing, and fabricated metal product manufacturing.

South Coast - Chromium, Hexavalent			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.06	35%	4%
Area-wide Sources	< .01	1%	0%
On-Road Mobile	0.05	31%	3%
Gasoline Vehicles	0.05	31%	3%
Diesel Vehicles	< .01	1%	0%
Other Mobile	0.05	33%	4%
Gasoline Fuel	0.05	31%	3%
Diesel Fuel	< .01	1%	0%
Other Fuel	< .01	1%	0%
Natural Sources	0	0%	0%
Total	0.16	100%	11%
Total Statewide	**1.52**		

Table 5-26

para-Dichlorobenzene

Most of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

South Coast - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	< 1	0%	0%
Area-wide Sources	1004	100%	42%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	1004	100%	42%
Total Statewide	**2391**		

Table 5-27

Formaldehyde

Approximately 85 percent of the formaldehyde emissions are from mobile sources.

South Coast - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	482	10%	3%
Area-wide Sources	188	4%	1%
On-Road Mobile	1734	37%	9%
Gasoline Vehicles	1069	23%	6%
Diesel Vehicles	665	14%	3%
Other Mobile	2220	48%	12%
Gasoline Fuel	861	19%	5%
Diesel Fuel	1259	27%	7%
Other Fuel	100	2%	1%
Natural Sources	0	0%	0%
Total	4623	100%	24%
Total Statewide	**19078**		

Table 5-28

Methylene Chloride

Approximately 57 percent of the emissions of methylene chloride are from stationary sources such as plastic product manufacturers, manufacturers of synthetics, and aircraft and parts manufacturers.

South Coast - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	2003	57%	31%
Area-wide Sources	1502	43%	23%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	3505	100%	53%
Total Statewide	**6557**		

Table 5-29

Perchloroethylene

Approximately 56 percent of the emissions of perchloroethylene are from dry cleaning plants, manufacturers of aircraft parts and fabricated metal parts, and other stationary sources.

South Coast - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	1134	56%	21%
Area-wide Sources	878	44%	16%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	2012	100%	38%
Total Statewide	**5361**		

Table 5-30

Diesel Particulate Matter

Approximately 97 percent of emissions of diesel particulate matter are from mobile sources.

South Coast - Diesel PM			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	212	3%	1%
Area-wide Sources	0	0%	0%
On-Road Mobile	2101	27%	7%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	2101	27%	7%
Other Mobile	5433	70%	18%
Gasoline Fuel	0	0%	0%
Diesel Fuel	5433	70%	18%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	7746	100%	25%
Total Statewide	**31002**		

Table 5-31

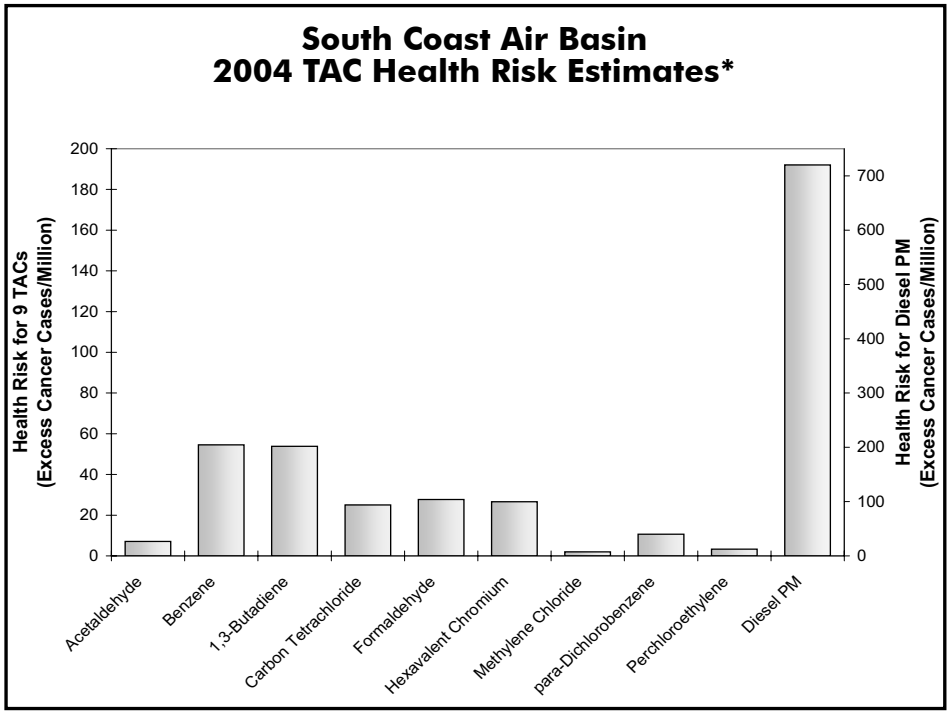
South Coast Air Basin

Air Quality and Health Risk

From 1990 through 2004, the ARB monitored ambient toxics concentrations at seven sites in the South Coast Air Basin. Data are available for most of the years at sites located in Burbank, Los Angeles, North Long Beach, and Riverside. Measurements for 1990 through 1997 are also available from a site at Upland. In addition, there are data for 1998 at a site in Fontana. During December 1999, monitoring activities for most of the TACs at Fontana were relocated to Azusa. Annual average concentration and associated health risk are not available for the year during which the site was moved because neither site had a full year of data.

Annual average concentrations and associated health risks for the top ten TACs individually as well as their cumulative health risk for the South Coast Air Basin, are provided in Table 5-32. Data for individual sites are provided in Appendix C. Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to analyze these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years, however, these data are included here for completeness.

Figure 5-12 shows 2004 health risks posed by the top ten TACs individually for the South Coast Air Basin. As indicated on the graph, the health risk data reflect the year of 2004, except for diesel PM and carbon tetrachloride. The health risk for diesel PM reflects the year 2000, the most recent year for which estimated data are available. Carbon tetrachloride data are not available for 2004 due to problems with laboratory equipment and associated data reliability, so 2003 data are used instead. It is important to note that health risks shown here are based on an annual average concentration for all sites in the air basin. The health risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.



** Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2004.*

Figure 5-12

Diesel PM poses the greatest health risk among the ten TACs. The estimates for diesel PM was based on receptor modeling techniques. In the South Coast Air Basin, the estimated health risk from diesel PM was 720 excess cancer cases per million people in 2000. Although the health risk is higher than the statewide average, it represents a 33 percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for 1990-1992 time period was compared to that for 2002-2004. The health risks of 1,3-butadiene and benzene have been reduced by 66 percent and 76 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 60 percent and 78 percent, respectively. Overall, in the South Coast Air Basin, all TACs have shown improvement since 1990, but their health risks are still higher than the statewide levels. It is important to note that there may be other compounds that pose a significant health risk but are not monitored. Reductions in ambient TAC concentrations and health risks should continue, as new rules and regulations are implemented to control toxic air contaminants.

In addition to the routine monitoring, a special study was conducted at two sites located in the Boyle Heights and Wilmington areas of Los Angeles between February 2001 and May 2002 (Boyle Heights) and between May 2001 and July 2002 (Wilmington). Monitoring included both TACs and criteria air pollutants. Limited monitoring of a few pollutants was conducted at two satellite sites in Boyle Heights from March 2001 through October 2001, and at one satellite site in Wilmington from November 2001 through May 2002. The Boyle Heights and Wilmington communities are both located near major freeways. The Wilmington community is also located near oil refineries and port facilities. Although not included in this almanac, data from Boyle Heights, Wilmington, and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at *www.arb.ca.gov/ch/programs/sb25/sb25.htm*.

South Coast Air Basin

Annual Average Concentrations and Health Risks

South Coast Air Basin Toxic Air Contaminants-Annual Average Concentrations and Health Risks																
TAC*	**Conc./Risk**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Acetaldehyde	Annual Avg	2.46	3	2.46	2.67	2.3	0.97	2.08	1.77	1.54	1.63	1.26	1.47	1.41	1.47	1.46
	Health Risk	12	15	12	13	11	5	10	9	7	8	6	7	7	7	7
Benzene	Annual Avg	3.42	2.91	2.61	2.17	2.4	1.89	1.45	1.34	1.25	1.2	0.97	0.86	0.769	0.745	0.589
	Health Risk	317	269	242	201	222	175	134	124	116	111	90	80	71	69	55
1,3-Butadiene	Annual Avg	0.53	0.45	0.50	0.57	0.50	0.46	0.39	0.38	0.35	0.33	0.25	0.25	0.21	0.15	0.14
	Health Risk	200	170	187	212	187	173	146	142	133	123	94	94	79	55	54
Carbon Tetrachloride	Annual Avg	0.14	0.13		0.11		0.10	0.08		0.11		0.10	0.09	0.09	0.09	
	Health Risk	36	35		28		27	21		30		25	23	24	25	
Chromium, Hexavalent	Annual Avg			0.39	0.29	0.29	0.46	0.18	0.17	0.15	0.14	0.18		0.179	0.158	0.177
	Health Risk			59	43	43	69	27	25	22	22	27		27	24	27
para-Dichlorobenzene	Annual Avg		0.17	0.19	0.17	0.13	0.17	0.11	0.13			0.13	0.15	0.16	0.17	0.16
	Health Risk		11	13	11	8	11	7	9			9	10	11	11	11
Formaldehyde	Annual Avg	2.92	3.08	2.22	3.22	3.14	3.57	5.06	4.47	3.79	4.06	3.13	4.13	4.16	3.83	3.76
	Health Risk	22	23	16	24	23	26	37	33	28	30	23	30	31	28	28
Methylene Chloride	Annual Avg	1.86	1.51	0.9	1.23	1.1	1.28	0.95	1.14	0.85	0.92	0.83	0.63	0.57	0.59	0.57
	Health Risk	6	5	3	4	4	4	3	4	3	3	3	2	2	2	2
Perchloroethylene	Annual Avg	0.58	0.55	0.41	0.45	0.39	0.36	0.32	0.27	0.26		0.21	0.18	0.15	0.11	0.08
	Health Risk	23	22	16	18	16	15	13	11	10		8	7	6	4	3
Diesel PM**	*Annual Avg*	*(3.6)*					*(2.7)*					*(2.4)*				
	Health Risk	*(1080)*					*(810)*					*(720)*				
Average Basin Risk* **	Without Diesel PM	616	550	548	554	514	505	398	357	349	297	285	253	258	225	187
	With Diesel PM	***(1696)***					***(1315)***					***(1005)***				

* Concentrations for Hexavalent Chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

** Diesel PM concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years.

*** Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics*.

Table 5-32

San Francisco Bay Area Air Basin
2005 Emission Inventory by Compound

Acetaldehyde

Approximately 77 percent of the emissions of acetaldehyde are from mobile sources. Area-wide sources such as residential wood combustion and agricultural burning contribute approximately 22 percent.

Benzene

Mobile sources are the primary sources of benzene emissions in the San Francisco Bay Area Air Basin (approximately 91 percent).

San Francisco Bay Area - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	19	1%	0%
Area-wide Sources	293	22%	4%
On-Road Mobile	355	26%	5%
Gasoline Vehicles	177	13%	2%
Diesel Vehicles	178	13%	2%
Other Mobile	687	51%	9%
Gasoline Fuel	120	9%	2%
Diesel Fuel	414	31%	5%
Other Fuel	153	11%	2%
Natural Sources	0	0%	0%
Total	1355	100%	18%
Total Statewide	**7675**		

Table 5-33

San Francisco Bay Area - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	146	7%	1%
Area-wide Sources	38	2%	0%
On-Road Mobile	1202	60%	10%
Gasoline Vehicles	1153	58%	9%
Diesel Vehicles	48	2%	0%
Other Mobile	611	31%	5%
Gasoline Fuel	437	22%	4%
Diesel Fuel	113	6%	1%
Other Fuel	62	3%	1%
Natural Sources	0	0%	0%
Total	1997	100%	16%
Total Statewide	**12293**		

Table 5-34

1,3-Butadiene

Essentially all of the emissions of 1,3-butadiene are from mobile sources.

San Francisco Bay Area - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	1	0%	0%
Area-wide Sources	2	1%	0%
On-Road Mobile	250	60%	9%
Gasoline Vehicles	245	59%	9%
Diesel Vehicles	5	1%	0%
Other Mobile	161	39%	6%
Gasoline Fuel	103	25%	4%
Diesel Fuel	11	3%	0%
Other Fuel	47	11%	2%
Natural Sources	0	0%	0%
Total	414	100%	15%
Total Statewide	**2778**		

Table 5-35

Carbon Tetrachloride

Stationary sources, such as chemical and petroleum refineries, account for all of the emissions of carbon tetrachloride.

San Francisco Bay Area - Carbon Tetrachloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.94	100%	63%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.94	100%	63%
Total Statewide	**1.48**		

Table 5-36

Chromium, Hexavalent

Approximately 70 percent of the hexavalent chromium emissions are from other mobile sources. Stationary sources such as electrical generation and fabricated metal product manufacturing contribute approximately four percent.

San Francisco Bay Area - Chromium, Hexavalent			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	< .01	5%	0%
Area-wide Sources	< .01	1%	0%
On-Road Mobile	0.02	24%	2%
Gasoline Vehicles	0.02	24%	2%
Diesel Vehicles	< .01	0%	0%
Other Mobile	0.07	70%	5%
Gasoline Fuel	0.02	22%	1%
Diesel Fuel	< .01	1%	0%
Other Fuel	0.05	47%	3%
Natural Sources	0	0%	0%
Total	0.10	100%	7%
Total Statewide	**1.52**		

Table 5-37

para-Dichlorobenzene

Emissions of *para*-dichlorobenzene are essentially all from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

San Francisco Bay Area - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	3	1%	0%
Area-wide Sources	454	99%	19%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	456	100%	19%
Total Statewide	**2391**		

Table 5-38

Formaldehyde

Approximately 82 percent of the formaldehyde emissions are from mobile sources.

San Francisco Bay Area - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	207	6%	1%
Area-wide Sources	383	12%	2%
On-Road Mobile	962	30%	5%
Gasoline Vehicles	605	19%	3%
Diesel Vehicles	356	11%	2%
Other Mobile	1657	52%	9%
Gasoline Fuel	367	11%	2%
Diesel Fuel	829	26%	4%
Other Fuel	461	14%	2%
Natural Sources	0	0%	0%
Total	3208	100%	17%
Total Statewide	**19078**		

Table 5-39

Methylene Chloride

Approximately 72 percent of the emissions of methylene chloride are from area-wide sources.

San Francisco Bay Area - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	269	28%	4%
Area-wide Sources	687	72%	10%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	956	100%	15%
Total Statewide	**6557**		

Table 5-40

Perchloroethylene

Approximately 55 percent of the emissions of perchloroethylene are from such stationary sources as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

San Francisco Bay Area - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	331	45%	6%
Area-wide Sources	400	55%	7%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	730	100%	14%
Total Statewide	**5361**		

Table 5-41

Diesel Particulate Matter

Emissions of diesel particulate matter are primarily from mobile sources.

San Francisco Bay Area - Diesel PM			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	74	2%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	1075	24%	3%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	1075	24%	3%
Other Mobile	3403	75%	11%
Gasoline Fuel	0	0%	0%
Diesel Fuel	3403	75%	11%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	4552	100%	15%
Total Statewide	**31002**		

Table 5-42

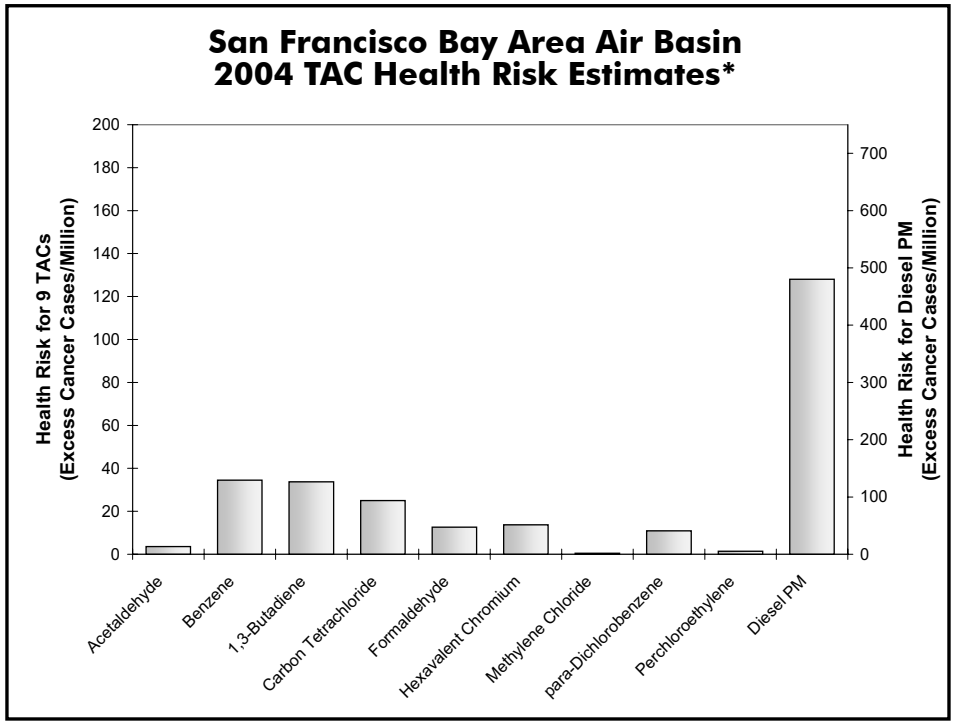
San Francisco Bay Area Air Basin

Air Quality and Health Risk

From 1990 through 2004, the ARB monitored ambient TAC concentrations at six sites in the San Francisco Bay Area Air Basin. Data for the entire time period are available from sites located in Fremont and San Francisco. The San Jose-Fourth Street site has measurements from 1990 through 2001; this site was relocated to San Jose-Jackson Street in mid-2002. Data are also available from a site at Concord from 1990 through 1999. In addition, there was a monitor at Richmond from 1990 through April 1997. This site was relocated to San Pablo and began sampling there in May 1997. At the end of February 2000, TAC monitoring was discontinued at the Concord and San Pablo sites, and additional data from these sites will not be available. Annual average concentration and associated health risk are unavailable for the year during a site move because neither site has a full year of data.

Annual average concentrations and health risks for the top ten TACs individually, as well as their cumulative health risk for the San Francisco Bay Area Air Basin are given in Table 5-43. Data for individual sites are provided in Appendix C. Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to analyze these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during later years, however, these data are included here for completeness.

Figure 5-13 shows 2004 health risks for the top ten TACs individually for the San Francisco Bay Area Air Basin. As indicated on the graph, the health risk data reflect the year 2004 except for diesel PM and carbon tetrachloride. The health risk for diesel PM reflects the year 2000, the most recent year for which estimated data are available. Carbon tetrachloride data for 2004 are not available due to problems with laboratory equipment and associated data reliability, so 2003 data are used instead. It is important to note that health risks shown here are based on an annual average concentration for all sites in the air basin. The health risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.



** Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2004.*

Figure 5-13

Diesel PM poses the greatest health risk among the ten TACs. The estimates for diesel PM was based on receptor modeling techniques. In the San Francisco Bay Area Air Basin, the estimated health risk for diesel PM in 2000 was 480 excess cancer cases per million people exposed for 70 years. The estimate is slightly lower than the estimat-

ed statewide value for the same year, and it represents a 36 percent drop between 1990 and 2000.

Trends and health risk for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average for 1990-1992 time period was compared to that for 2002-2004. 1,3-butadiene and benzene pose the greatest risk among these nine TACs, and since 1990, their levels have been reduced by 65 percent and 77 percent, respectively. Methylene chloride and perchloroethylene also show significant reductions of 85 percent and 79 percent, respectively. However, *para*-dichlorobenzene and formaldehyde have increased by 26 and four percent, respectively. The increase in *para*-dichlorobenzene can be attributed to a mechanism that ARB's Monitoring and Laboratory Division used for estimating very low concentrations and those that are below the limit of detection.

In addition to the routine monitoring, a special study was conducted at two sites, located in the Crockett and Fruitvale/Oakland areas of the San Francisco Bay Area Air Basin between October 2001 and May 2003 (Crockett) and between November 2001 and April 2003 (Fruitvale). Monitoring included both TACs and criteria air pollutants. The Crockett community is located near high-risk facilities, including mobile source emissions. Oil refineries and major oil storage facilities are located in nearby cities to Crockett. Crockett is also the location of a major food processing operation and a heavy-rail transfer facility. The Fruitvale community lies between two major freeways that are a significant source of vehicular emissions. The Fruitvale area is also downwind of several industrial operations that are sources of pollution. Although not included in this almanac, data from Crockett, Fruitvale, and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at *www.arb.ca.gov/ch/programs/sb25/sb25.htm*.

San Francisco Bay Area Air Basin
Annual Average Concentrations and Health Risks

San Francisco Bay Area Air Basin Toxic Air Contaminants-Annual Average Concentrations and Health Risks																
TAC*	**Conc./Risk**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Acetaldehyde	Annual Avg	1.3	1.4	1.03	1.31	1.17	0.42	0.83	0.73	0.65	0.76	0.68	0.73	0.63	0.74	0.74
	Health Risk	6	7	5	6	6	2	4	4	3	4	3	4	3	4	4
Benzene	Annual Avg	2.18	1.82	1.49	1.49	1.4	1.26	0.71	0.61	0.71	0.6	0.56	0.425	0.454	0.439	0.372
	Health Risk	202	169	138	138	129	116	66	56	66	55	52	39	42	41	34
1,3-Butadiene	Annual Avg	0.36	0.29	0.28	0.37	0.29	0.28	0.22	0.19	0.22	0.17	0.15	0.13	0.14	0.10	0.09
	Health Risk	135	108	103	138	108	104	82	70	82	64	56	50	51	37	34
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.11		0.10	0.08				0.09	0.09	0.09	0.10	
	Health Risk	34	33		29		26	21				25	23	24	25	
Chromium, Hexavalent	Annual Avg			0.23	0.2	0.19	0.25	0.13	0.12	0.1	0.1	0.12		0.074	0.096	0.091
	Health Risk			34	29	29	37	19	17	15	15	18		11	14	14
para-Dichlorobenzene	Annual Avg		0.12	0.12	0.12	0.11	0.13	0.14	0.12			0.11	0.14	0.15	0.15	0.17
	Health Risk		8	8	8	7	8	9	8			7	9	10	10	11
Formaldehyde	Annual Avg	1.87	1.73	1.43	1.56	1.66	2.06	2.62	1.85	1.76	2.09	1.77	2.32	2.57	2.22	1.71
	Health Risk	14	13	11	11	12	15	19	14	13	15	13	17	19	16	13
Methylene Chloride	Annual Avg	1.04	2.32	0.65	0.72	0.59	0.6	0.58	0.55			0.53	0.27	0.22	0.22	0.14
	Health Risk	4	8	2	2	2	2	2	2			2	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.20	0.23	0.17	0.13	0.08	0.09	0.07	0.07			0.08	0.06	0.05	0.04	0.04
	Health Risk	8	9	7	5	3	4	3	3			3	2	2	2	1
Diesel PM**	*Annual Avg*	*(2.5)*					*(1.9)*					*(1.6)*				
	Health Risk	*(750)*					*(570)*					*(480)*				
Average Basin Risk* **	Without Diesel PM	403	355	308	366	296	314	225	174	179	153	179	144	162	149	111
	With Diesel PM	***(1153)***					***(884)***					***(659)***				

* Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

** Diesel PM concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years.

*** Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics.*

Table 5-43

San Joaquin Valley Air Basin
2005 Emission Inventory by Compound

Acetaldehyde

Approximately 78 percent of the emissions of acetaldehyde are from mobile sources. Area-wide sources such as residential wood combustion account for approximately 16 percent.

Benzene

The primary sources of benzene emissions in the San Joaquin Valley Air Basin are mobile sources (approximately 63 percent) and stationary sources (approximately 36 percent).

San Joaquin Valley - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	70	6%	1%
Area-wide Sources	185	16%	2%
On-Road Mobile	268	24%	3%
Gasoline Vehicles	102	9%	1%
Diesel Vehicles	166	15%	2%
Other Mobile	614	54%	8%
Gasoline Fuel	86	8%	1%
Diesel Fuel	375	33%	5%
Other Fuel	154	14%	2%
Natural Sources	0	0%	0%
Total	1136	100%	15%
Total Statewide	**7675**		

Table 5-44

San Joaquin Valley - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	653	36%	5%
Area-wide Sources	13	1%	0%
On-Road Mobile	674	37%	5%
Gasoline Vehicles	629	35%	5%
Diesel Vehicles	45	2%	0%
Other Mobile	478	26%	4%
Gasoline Fuel	312	17%	3%
Diesel Fuel	102	6%	1%
Other Fuel	64	4%	1%
Natural Sources	< 1	0%	0%
Total	1820	100%	15%
Total Statewide	**12293**		

Table 5-45

1,3-Butadiene

Approximately 64 percent of the emissions of 1,3-butadiene are from mobile sources.

San Joaquin Valley - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	3	1%	0%
Area-wide Sources	155	35%	6%
On-Road Mobile	138	32%	5%
Gasoline Vehicles	134	31%	5%
Diesel Vehicles	4	1%	0%
Other Mobile	142	32%	5%
Gasoline Fuel	74	17%	3%
Diesel Fuel	10	2%	0%
Other Fuel	58	13%	2%
Natural Sources	0	0%	0%
Total	439	100%	16%
Total Statewide	**2778**		

Table 5-46

Carbon Tetrachloride

Emissions of carbon tetrachloride are all from stationary sources such as chemical and allied product manufacturers.

San Joaquin Valley - Carbon Tetrachloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	< .01	100%	1%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	< .01	100%	1%
Total Statewide	**1.48**		

Table 5-47

Chromium, Hexavalent

Approximately 62 percent of the hexavalent chromium emissions are from stationary sources such as chrome platers, aircraft and parts manufacturing, and fabricated metal product manufacturing.

San Joaquin Valley - Chromium, Hexavalent			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.13	62%	8%
Area-wide Sources	< .01	4%	0%
On-Road Mobile	0.01	7%	1%
Gasoline Vehicles	0.01	7%	1%
Diesel Vehicles	< .01	0%	0%
Other Mobile	0.06	27%	4%
Gasoline Fuel	0.01	6%	1%
Diesel Fuel	< .01	1%	0%
Other Fuel	0.04	20%	3%
Natural Sources	0	0%	0%
Total	0.20	100%	13%
Total Statewide	**1.52**		

Table 5-48

para-Dichlorobenzene

Most of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

San Joaquin Valley - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	5	2%	0%
Area-wide Sources	236	98%	10%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	241	100%	10%
Total Statewide	**2391**		

Table 5-49

Formaldehyde

Approximately 65 percent of the formaldehyde emissions are from mobile sources.

San Joaquin Valley - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	979	29%	5%
Area-wide Sources	219	6%	1%
On-Road Mobile	678	20%	4%
Gasoline Vehicles	346	10%	2%
Diesel Vehicles	332	10%	2%
Other Mobile	1507	45%	8%
Gasoline Fuel	260	8%	1%
Diesel Fuel	750	22%	4%
Other Fuel	497	15%	3%
Natural Sources	0	0%	0%
Total	3383	100%	18%
Total Statewide	**19078**		

Table 5-50

Methylene Chloride

Approximately 81 percent of the emissions of methylene chloride are from paint removers/strippers, automotive brake cleaners, and other consumer products.

San Joaquin Valley - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	81	19%	1%
Area-wide Sources	354	81%	5%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	435	100%	7%
Total Statewide	**6557**		

Table 5-51

Perchloroethylene

Approximately 68 percent of the emissions of perchloroethylene are from such stationary sources as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

San Joaquin Valley - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	444	68%	8%
Area-wide Sources	209	32%	4%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	653	100%	12%
Total Statewide	**5361**		

Table 5-52

Diesel Particulate Matter

Emissions of diesel particulate matter are from mobile sources (approximately 88 percent) and stationary sources (approximately 12 percent).

San Joaquin Valley - Diesel PM			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	471	12%	2%
Area-wide Sources	0	0%	0%
On-Road Mobile	915	23%	3%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	915	23%	3%
Other Mobile	2629	65%	8%
Gasoline Fuel	0	0%	0%
Diesel Fuel	2629	65%	8%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	4015	100%	13%
Total Statewide	**31002**		

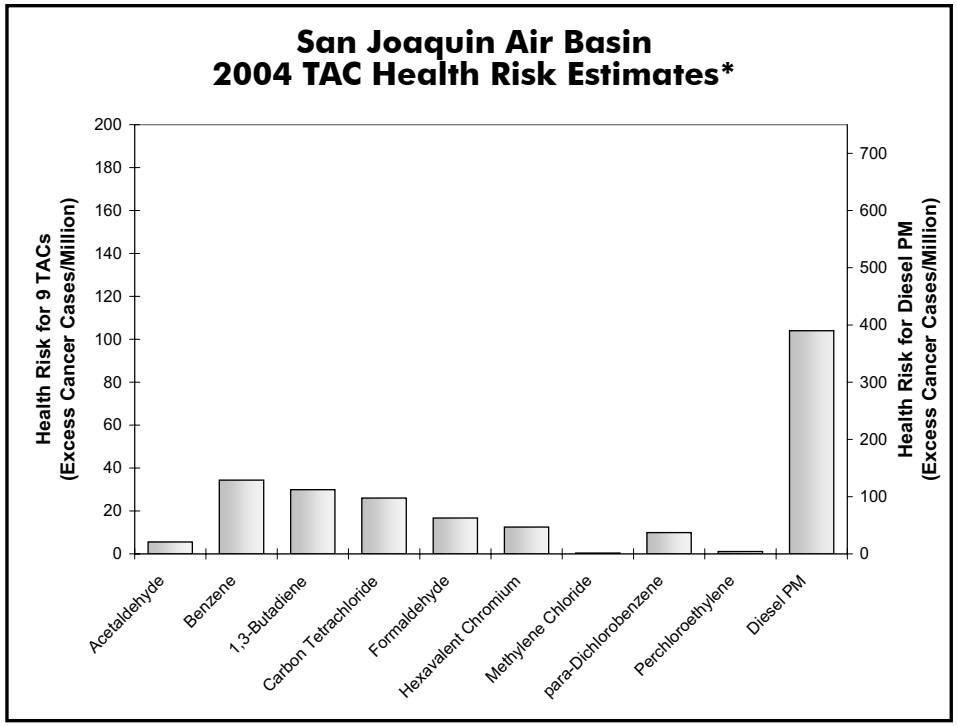
Table 5-53

San Joaquin Valley Air Basin

Air Quality and Health Risk

From 1990 through 2004, the ARB monitored ambient TAC concentrations at six sites in the San Joaquin Valley Air Basin. Data for all years are available only for the Stockton site. Data are available for 1991 through 2004 at the Fresno-First Street site, for 1990 through 1993 at the Bakersfield-Chester Avenue site, and for 1995 through 2003 at the Bakersfield-5558 California Avenue site. Data are also available at the Modesto-14th Street site from 1990 through 1999. In addition, limited TAC data are available at the Modesto-I Street site during 1991 to 1997.

Annual average concentrations and associated health risks of the top ten TACs individually, as well as their cumulative health risk for the San Joaquin Valley Air Basin, are given in Table 5-54. Data for individual sites are provided in Appendix C. Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 are uncertain because the method used to analyze these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years, however, these data are included here for completeness.



** Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2004.*

Figure 5-14

Figure 5-14 shows 2004 health risks posed by the top ten TACs individually for the San Joaquin Valley Air Basin. As indicated on the graph, the health risk data reflect the year of 2004 except for diesel PM and carbon tetrachloride. The health risk for diesel PM reflects the year 2000, the most recent year for which estimated data are available. Carbon tetrachloride data for 2004 are not available due to problems with laboratory equipment and associated data reliability, therefore, 2003 data are used instead. It is important to note that health risks shown here are based on an annual average concentration for all sites in the air basin. The health risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Diesel PM poses the greatest health risk among the ten TACs. The estimates for diesel PM was based on receptor modeling techniques. The diesel PM health risk in the San Joaquin Valley Air Basin for 2000 was estimated at 390 excess cancer cases per million people exposed over a 70-year lifetime. While this value is lower than the estimated statewide health risk, it is similar to values estimated for other urbanized areas of the State such as the San Diego Air Basin and the Sacramento Valley Air Basin. The estimated diesel PM con-

centration and associated health risk decreased 50 percent between 1990 and 2000.

The trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the influences of weather and sampling schedule, the air basin average concentration for 1990-1992 time period was compared to that for 2002-2004. Among these nine TACs, 1,3-butadiene and benzene pose the greatest risks, and since 1990, they have been reduced by 68 percent and 77 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions; they have been reduced by 78 percent and 73 percent, respectively. However, *para*-dichlorobenzene increased by 29 percent. The increase can be attributed to a mechanism that ARB's Monitoring and Laboratory Division used for estimating very low concentrations and those that are below the limit of detection. Overall, the average concentrations and associated health risks of most TACs for the San Joaquin Valley Air Basin have been reduced since 1990, and they are lower than the statewide averages.

In addition to the routine monitoring, a special study was conducted at a site located in the Fresno area of the San Joaquin Valley Air Basin between June 2002 and August 2003. Monitoring included both TACs and criteria air pollutants. This Fresno community is located in a residential neighborhood near sources of motor vehicle pollution. There are a large number of children living in the community. Although not included in the almanac, data from Fresno and other community monitoring studies are being used in support of the ARB's Community Health Program. More information on the Community Health Program is available at *www.arb.ca.gov/ch/programs/sb25/sb25.htm*.

San Joaquin Valley Air Basin
Annual Average Concentrations and Health Risks

San Joaquin Valley Air Basin Toxic Air Contaminants-Annual Average Concentrations and Health Risks																
TAC*	**Conc./Risk**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Acetaldehyde	Annual Avg	1.94	1.84	1.38	1.73	1.29	0.54	1.28	1.19	1.3	1.56	1.09	1.15	1.24	1.34	1.14
	Health Risk	9	9	7	8	6	3	6	6	6	8	5	6	6	7	6
Benzene	Annual Avg	2.45	2.11	1.36	1.32	1.33	1.16	0.73	0.71	0.76	0.69	0.63	0.538	0.552	0.463	0.372
	Health Risk	227	196	126	122	123	107	68	66	71	64	58	50	51	43	34
1,3-Butadiene	Annual Avg	0.41	0.36	0.24	0.34	0.32	0.26	0.22	0.20	0.23	0.18	0.16	0.15	0.15	0.10	0.08
	Health Risk	154	135	89	127	121	99	83	73	88	67	59	56	55	36	30
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.11		0.10	0.08		0.11		0.10	0.09	0.09	0.10	
	Health Risk	34	34		29		26	20		30		25	23	24	26	
Chromium, Hexavalent	Annual Avg			0.23	0.21	0.19	0.28	0.13	0.11	0.1	0.1	0.12		0.086	0.078	0.083
	Health Risk			34	31	29	42	20	16	15	15	18		13	12	13
para-Dichlorobenzene	Annual Avg		0.11	0.11	0.13	0.11	0.11	0.1	0.13			0.11	0.13	0.15	0.15	0.15
	Health Risk		7	7	9	7	8	7	9			7	9	10	10	10
Formaldehyde	Annual Avg	2.45	1.81	1.46	1.67	1.8	2.1	2.96	2.77	2.86	3.44	2.61	3.08	3.13	3.02	2.27
	Health Risk	18	13	11	12	13	15	22	20	21	25	19	23	23	22	17
Methylene Chloride	Annual Avg	0.76	0.59	0.55	0.76	0.59	0.61	0.54	0.53	0.52	0.5	0.53	0.27	0.16	0.14	0.11
	Health Risk	3	2	2	3	2	2	2	2	2	2	2	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.13	0.13	0.10	0.47	0.07	0.07	0.07	0.06	0.04		0.08	0.05	0.04	0.03	0.03
	Health Risk	5	5	4	19	3	3	3	2	2		3	2	2	1	1
Diesel PM**	*Annual Avg*	*(2.6)*					*(1.7)*					*(1.3)*				
	Health Risk	*(780)*					*(510)*					*(390)*				
Average Basin Risk* **	Without Diesel PM	450	401	280	360	304	305	231	194	235	181	196	169	184	157	111
	With Diesel PM	***(1230)***					***(815)***					***(586)***				

* Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

** Diesel PM concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years.

*** Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics.*

Table 5-54

San Diego Air Basin

2005 Emission Inventory by Compound

Acetaldehyde

Approximately 89 percent of the emissions of acetaldehyde are from mobile sources.

Benzene

The primary sources of benzene emissions in the San Diego Air Basin are mobile sources (approximately 95 percent).

San Diego - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	7	1%	0%
Area-wide Sources	45	9%	1%
On-Road Mobile	146	29%	2%
Gasoline Vehicles	72	15%	1%
Diesel Vehicles	73	15%	1%
Other Mobile	300	60%	4%
Gasoline Fuel	70	14%	1%
Diesel Fuel	151	30%	2%
Other Fuel	78	16%	1%
Natural Sources	0	0%	0%
Total	497	100%	6%
Total Statewide	**7675**		

Table 5-55

San Diego - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	41	5%	0%
Area-wide Sources	4	0%	0%
On-Road Mobile	480	57%	4%
Gasoline Vehicles	460	54%	4%
Diesel Vehicles	20	2%	0%
Other Mobile	325	38%	3%
Gasoline Fuel	253	30%	2%
Diesel Fuel	41	5%	0%
Other Fuel	31	4%	0%
Natural Sources	0	0%	0%
Total	849	100%	7%
Total Statewide	**12293**		

Table 5-56

1,3-Butadiene

Approximately 98 percent of the emissions of 1,3-butadiene are from mobile sources.

San Diego - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	1	1%	0%
Area-wide Sources	2	1%	0%
On-Road Mobile	99	52%	4%
Gasoline Vehicles	97	51%	3%
Diesel Vehicles	2	1%	0%
Other Mobile	88	46%	3%
Gasoline Fuel	60	31%	2%
Diesel Fuel	4	2%	0%
Other Fuel	25	13%	1%
Natural Sources	0	0%	0%
Total	190	100%	7%
Total Statewide	**2778**		

Table 5-57

Carbon Tetrachloride

Stationary sources such as chemical and allied product manufacturers account for all of the emissions of carbon tetrachloride.

San Diego - Carbon Tetrachloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.12	100%	8%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.12	100%	8%
Total Statewide	**1.48**		

Table 5-58

Chromium, Hexavalent

Approximately 77 percent of the hexavalent chromium emissions are from other mobile sources. Stationary sources account for approximately 17 percent.

San Diego - Chromium, Hexavalent			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.04	17%	3%
Area-wide Sources	< .01	1%	0%
On-Road Mobile	0.01	6%	1%
Gasoline Vehicles	0.01	6%	1%
Diesel Vehicles	< .01	0%	0%
Other Mobile	0.18	77%	12%
Gasoline Fuel	0.01	5%	1%
Diesel Fuel	< .01	0%	0%
Other Fuel	0.17	71%	11%
Natural Sources	0	0%	0%
Total	0.24	100%	16%
Total Statewide	**1.52**		

Table 5-59

para-Dichlorobenzene

All of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

San Diego - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0	0%	0%
Area-wide Sources	203	100%	9%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	203	100%	9%
Total Statewide	**2391**		

Table 5-60

Formaldehyde

Approximately 83 percent of the formaldehyde emissions are from mobile sources.

San Diego - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	35	3%	0%
Area-wide Sources	56	4%	0%
On-Road Mobile	397	32%	2%
Gasoline Vehicles	250	20%	1%
Diesel Vehicles	147	12%	1%
Other Mobile	753	61%	4%
Gasoline Fuel	214	17%	1%
Diesel Fuel	303	24%	2%
Other Fuel	235	19%	1%
Natural Sources	0	0%	0%
Total	1240	100%	6%
Total Statewide	**19078**		

Table 5-61

Methylene Chloride

Area-wide sources such as paint removers/strippers, automotive brake cleaners, and other consumer products account for approximately 82 percent of the emissions of methylene chloride.

San Diego - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	65	18%	1%
Area-wide Sources	306	82%	5%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	370	100%	6%
Total Statewide	**6557**		

Table 5-62

Perchloroethylene

Approximately 73 percent of the emissions of perchloroethylene are from stationary sources such as dry cleaning plants, manufacturers of aircraft parts and fabricated metal parts, and other stationary sources.

San Diego - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	477	73%	9%
Area-wide Sources	180	27%	3%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	657	100%	12%
Total Statewide	**5361**		

Table 5-63

Diesel Particulate Matter

Approximately 98 percent of the emissions of diesel particulate matter are from mobile sources.

San Diego - Diesel PM			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	34	2%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	437	24%	1%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	437	24%	1%
Other Mobile	1327	74%	4%
Gasoline Fuel	0	0%	0%
Diesel Fuel	1327	74%	4%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	1798	100%	6%
Total Statewide	**31002**		

Table 5-64

San Diego Air Basin

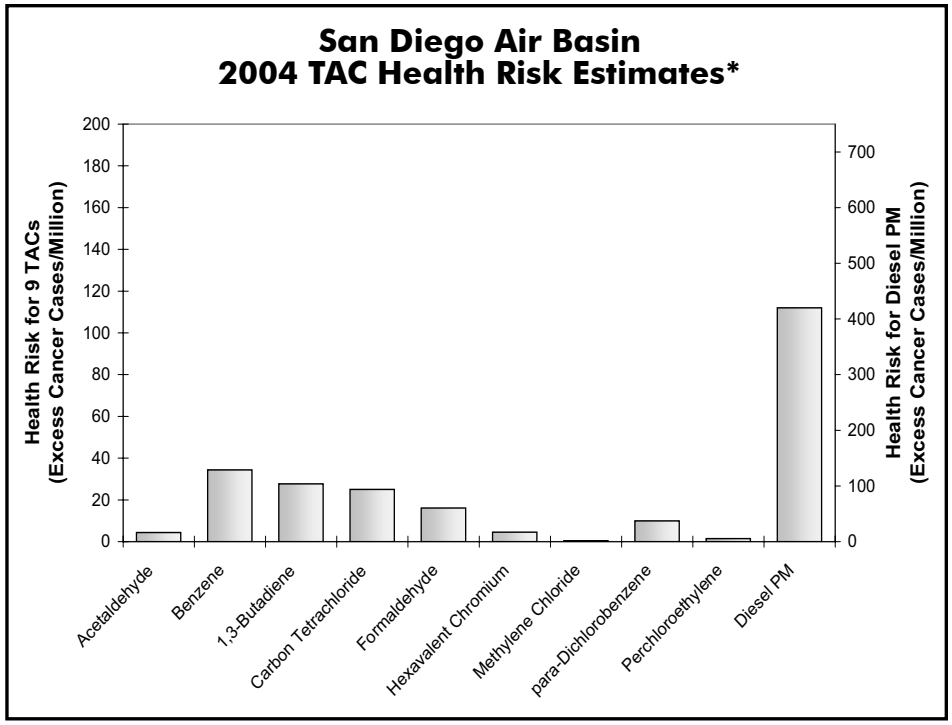
Air Quality and Health Risk

During 1990 through 2004, the ARB monitored ambient TAC concentrations at two sites in the San Diego Air Basin. The sites are located in Chula Vista and El Cajon. Annual average concentrations and associated health risks of the top ten TACs individually, as well as their cumulative health risk for the San Diego Air Basin are provided in Table 5-65. Data for individual sites in the air basin are provided in Appendix C.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method to analyze these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, data for years prior to 1996 are not directly comparable to data collected during the later years, however, these data are included here for completeness.

Figure 5-15 shows 2004 health risks posed by the top ten TACs individually for the San Diego Air Basin. As indicated on the graph, the health risk data reflect the year 2004 except for diesel PM and carbon tetrachloride. The health risk for diesel PM reflects the year 2000, the most recent year for which estimated data are available. Carbon tetrachloride data for 2004 are not available due to problems with laboratory equipment and associated data reliability, so 2003 data are used instead. It is important to note that health risks shown here are based on an annual average concentration for all sites in the air basin. The health risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Diesel PM poses the greatest health risk among the ten TACs. The estimates for diesel PM was based on receptor modeling techniques. In the San Diego Air Basin, the estimated health risk for diesel PM in 2000 was 420 excess cancer cases per million people exposed over 70 years. While the health risk from diesel PM is lower than the estimated statewide value, it is comparable to the annual averages estimated for other urbanized areas such as the Sacramento Valley and San Joaquin Valley Air Basins. Diesel PM health risk has been reduced by 52 percent in the San Diego Air Basin between 1990 and 2000.



** Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2004.*

Figure 5-15

Trends and health risks for the nine other TACs were based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin

average concentration for 1990-1992 time period were compared to those for 2002-2004. Among these nine TACs, 1,3-butadiene and benzene pose the greatest health risks. Since 1990, their risks have been reduced by 67 percent and 75 percent, respectively. Methylene chloride and perchloroethylene also show significant reductions of 84 percent and 82 percent, respectively. However, *para*-dichlorobenzene and formaldehyde have increased by 31 percent and five percent, respectively. The increase in *para*-dichlorobenzene can be attributed to a mechanism that ARB's Monitoring and Laboratory Division used for estimating very low concentrations and those that are below the limit of detection. In general, health risks from most TACs in the San Diego Air Basin have been reduced since 1990. Reductions in ambient TAC concentrations and health risk should continue, as new rules and regulations are implemented to control TACs. It is important to note that there may be other compounds that pose a significant health risk but are not monitored.

In addition to routine monitoring, a special study was conducted at a site located in the Logan Heights/Barrio Logan area of San Diego during the period of October 1999 through February 2001. Monitoring included both TACs and criteria air pollutants. The Barrio Logan community is located in a large urban area near major freeways, industrial sources, and neighborhood sources such as gas stations, dry cleaners, and automotive repair facilities. Although not included in this almanac, data from Barrio Logan and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at *www.arb.ca.gov/ch/programs/sb25/sb25.htm*.

San Diego Air Basin
Annual Average Concentrations and Health Risks

San Diego Air Basin Toxic Air Contaminants-Annual Average Concentrations and Health Risks																
TAC*	**Conc./Risk**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Acetaldehyde	Annual Avg	1.33	1.5	1.22	1.41	1.48	0.64	1.03	1	0.86	1.04	0.84	0.95	0.97	0.89	0.89
	Health Risk	6	7	6	7	7	3	5	5	4	5	4	5	5	4	4
Benzene	Annual Avg	2.25	1.7	1.48	1.16	1.39	0.98	0.76	0.76	0.76	0.86	0.65	0.505	0.491	0.483	0.371
	Health Risk	208	158	137	107	129	90	71	70	70	79	60	47	45	45	34
1,3-Butadiene	Annual Avg	0.33	0.26	0.26	0.31	0.31	0.24	0.21	0.20	0.20	0.22	0.16	0.14	0.12	0.09	0.07
	Health Risk	125	97	97	117	115	91	78	75	74	83	60	51	45	33	28
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.10		0.10	0.08				0.09	0.09	0.09	0.09	
	Health Risk	35	34		27		26	20				25	23	24	25	
Chromium, Hexavalent	Annual Avg			0.24	0.19	0.16	0.18	0.11	0.11	0.1	0.1	0.1		0.045	0.05	0.03
	Health Risk			36	28	23	27	16	16	15	15	15		7	8	5
para-Dichlorobenzene	Annual Avg		0.1	0.11	0.13	0.15	0.12	0.11	0.13				0.15	0.15	0.15	0.15
	Health Risk		7	8	8	10	8	7	8				10	10	10	10
Formaldehyde	Annual Avg	1.64	1.53	1.26	1.76	2.25	2.13	2.62	2.62	2.27	2.67	2.23	2.59	2.99	2.68	2.19
	Health Risk	12	11	9	13	17	16	19	19	17	20	16	19	22	20	16
Methylene Chloride	Annual Avg	0.59	0.83	1.34	1.13	0.73	0.63	0.59	0.57		0.53	0.76	0.17	0.16	0.16	0.13
	Health Risk	2	3	5	4	3	2	2	2		2	3	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.28	0.27	0.26	0.20	0.21	0.25	0.15	0.13			0.09	0.06	0.06	0.05	0.04
	Health Risk	11	11	11	8	8	10	6	5			4	2	2	2	1
Diesel PM**	*Annual Avg*	*(2.9)*					*(1.9)*					*(1.4)*				
	Health Risk	*(870)*					*(570)*					*(420)*				
Average Basin Risk* **	Without Diesel PM	399	328	309	319	312	273	224	200	180	204	187	157	160	147	98
	With Diesel PM	***(1269)***					***(843)***					***(607)***				

* Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

** Diesel PM concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years.

*** Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics.*

Table 5-65

Sacramento Valley Air Basin

2005 Emission Inventory by Compound

Acetaldehyde

Approximately 61 percent of the emissions of acetaldehyde are from mobile sources. Another 35 percent are from area-wide sources, including the burning of wood in residential fireplaces and wood stoves.

Benzene

The primary sources of benzene emissions in the Sacramento Valley Air Basin are mobile sources (approximately 84 percent).

Sacramento Valley - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	27	3%	0%
Area-wide Sources	301	35%	4%
On-Road Mobile	148	17%	2%
Gasoline Vehicles	70	8%	1%
Diesel Vehicles	78	9%	1%
Other Mobile	377	44%	5%
Gasoline Fuel	96	11%	1%
Diesel Fuel	221	26%	3%
Other Fuel	60	7%	1%
Natural Sources	0	0%	0%
Total	854	100%	11%
Total Statewide	**7675**		

Table 5-66

Sacramento Valley - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	163	15%	1%
Area-wide Sources	8	1%	0%
On-Road Mobile	469	44%	4%
Gasoline Vehicles	447	42%	4%
Diesel Vehicles	21	2%	0%
Other Mobile	428	40%	3%
Gasoline Fuel	343	32%	3%
Diesel Fuel	60	6%	0%
Other Fuel	25	2%	0%
Natural Sources	0	0%	0%
Total	1068	100%	9%
Total Statewide	**12293**		

Table 5-67

1,3-Butadiene

Approximately 82 percent of the emissions of 1,3-butadiene are from mobile sources.

Sacramento Valley - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	< 1	0%	0%
Area-wide Sources	42	17%	2%
On-Road Mobile	95	38%	3%
Gasoline Vehicles	93	38%	3%
Diesel Vehicles	2	1%	0%
Other Mobile	109	44%	4%
Gasoline Fuel	82	33%	3%
Diesel Fuel	6	2%	0%
Other Fuel	22	9%	1%
Natural Sources	0	0%	0%
Total	247	100%	9%
Total Statewide	**2778**		

Table 5-68

Carbon Tetrachloride

Stationary sources such as chemical and allied product manufacturers account for all of the emissions of carbon tetrachloride.

Sacramento Valley - Carbon Tetrachloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.05	100%	3%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.05	100%	3%
Total Statewide	**1.48**		

Table 5-69

Chromium, Hexavalent

Approximately 52 percent of the Hexavalent Chromium emissions are from other mobile sources.

Sacramento Valley - Chromium, Hexavalent			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.02	29%	1%
Area-wide Sources	< .01	6%	0%
On-Road Mobile	< .01	12%	1%
Gasoline Vehicles	< .01	12%	1%
Diesel Vehicles	< .01	0%	0%
Other Mobile	0.03	52%	2%
Gasoline Fuel	0.02	25%	1%
Diesel Fuel	< .01	1%	0%
Other Fuel	0.02	25%	1%
Natural Sources	0	0%	0%
Total	0.07	100%	4%
Total Statewide	**1.52**		

Table 5-70

para-Dichlorobenzene

Most of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

Sacramento Valley - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	< 1	0%	0%
Area-wide Sources	171	100%	7%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	171	100%	7%
Total Statewide	**2391**		

Table 5-71

Formaldehyde

Approximately 71 percent of the formaldehyde emissions are from mobile sources, and 18 percent are from area-wide sources.

Sacramento Valley - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	188	10%	1%
Area-wide Sources	340	18%	2%
On-Road Mobile	387	21%	2%
Gasoline Vehicles	230	13%	1%
Diesel Vehicles	157	9%	1%
Other Mobile	924	50%	5%
Gasoline Fuel	290	16%	2%
Diesel Fuel	443	24%	2%
Other Fuel	191	10%	1%
Natural Sources	0	0%	0%
Total	1840	100%	10%
Total Statewide	**19078**		

Table 5-72

Methylene Chloride

Approximately 71 percent of the emissions of methylene chloride are from area-wide sources such as paint removers/strippers, automotive brake cleaners, and other consumer products.

Sacramento Valley - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	105	29%	2%
Area-wide Sources	256	71%	4%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	362	100%	6%
Total Statewide	**6557**		

Table 5-73

Perchloroethylene

Approximately 66 percent of the emissions of perchloroethylene are from stationary sources such as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

Sacramento Valley - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	299	66%	6%
Area-wide Sources	151	34%	3%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	450	100%	8%
Total Statewide	**5361**		

Table 5-74

Diesel Particulate Matter

Approximately 89 percent emissions of diesel particulate matter are from mobile sources.

Sacramento Valley - Diesel PM			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	273	11%	1%
Area-wide Sources	0	0%	0%
On-Road Mobile	489	21%	2%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	489	21%	2%
Other Mobile	1617	68%	5%
Gasoline Fuel	0	0%	0%
Diesel Fuel	1617	68%	5%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	2379	100%	8%
Total Statewide	**31002**		

Table 5-75

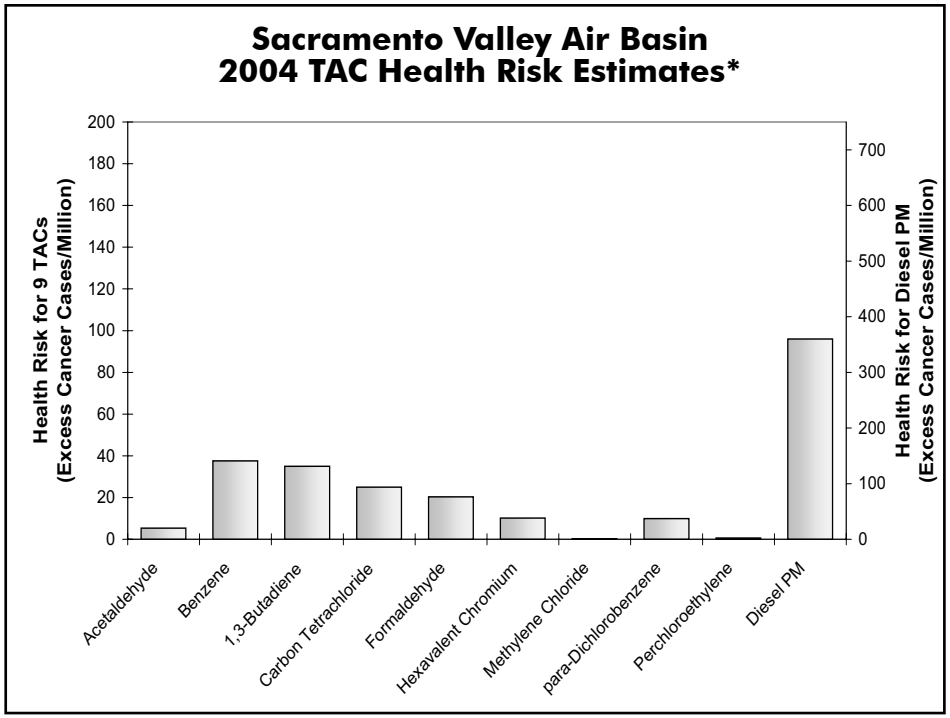
Sacramento Valley Air Basin

Air Quality and Health Risk

Unlike the other air basins described in this almanac, TAC monitoring in the Sacramento Valley Air Basin has not been continuous at any site. TAC concentrations were monitored at the Chico-Salem Street site during 1990 through the middle of 1992. The site was then moved to Chico-Manzanita Avenue. While there was monitoring in the Chico area for 1992, an annual average is not included here because neither site has a full year of data. Similarly, TAC concentrations were monitored at the Citrus Heights site during 1990 through part of 1993, when the site was relocated to Roseville. Again, annual average concentration and associated health risk are not available for the year during which the site was moved because neither site has a full year of data.

Table 5-76 gives annual average concentrations and health risks for the top ten TACs individually, as well as their cumulative health risk for the Sacramento Valley Air Basin. Data for individual sites are provided in Appendix C. Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 are uncertain because the method to analyze these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years, however, these data are included here for completeness.

Figure 5-16 is based on all data collected in the Sacramento Valley Air Basin and shows the estimated annual average health risks for the top ten TACs in this area. As shown in the graph, the health risk estimates for eight of the TACs measured by the ambient network reflect 2004. Carbon tetrachloride data for 2004 are not available due to problems with laboratory equipment and associated data reliability, therefore, 2003 data are used instead. The health risk for diesel PM reflects the year 2000, the most recent year for which estimated data are available. It is important to note that health risks shown here are based on only two areas in the air basin, and other locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.



** Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2004.*

Figure 5-16

Diesel PM poses the greatest health risk among the ten TACs. The estimates for diesel PM was based on receptor modeling techniques. The ARB estimated the health risk for diesel PM in 2000 to be 360 excess cancer cases per million people in the Sacramento Valley Air Basin. This is about half the estimated statewide health risk, and it is

similar to that for the San Joaquin Valley. It was reduced by 52 percent between 1990 and 2000.

Trends and health risks for the other nine TACs were based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for 1990-1992 time period were compared to those for 2002-2004. Both 1,3-butadiene and benzene pose substantial health risk, and they have been reduced by 69 percent and 76 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 87 percent and 72 percent, respectively. In contrast, *para*-dichlorobenzene and formaldehyde show increases of nine percent and 23 percent, respectively. The increase in *para*-dichlorobenzene can be attributed to a mechanism that ARB's Monitoring and Laboratory Division used for estimating very low concentrations and those that are below the limit of detection.

Sacramento Valley Air Basin
Annual Average Concentrations and Health Risks

Sacramento Valley Air Basin Toxic Air Contaminants-Annual Average Concentrations and Health Risks																
TAC*	**Conc./Risk**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Acetaldehyde	Annual Avg	1.29			1.37	1.04	0.39	1.03	1.05	0.92	1.23	0.83	0.74	1.14	1.04	1.09
	Health Risk	6			7	5	2	5	5	4	6	4	4	6	5	5
Benzene	Annual Avg	2.02	1.88	1.35	1	1.02	0.8	0.56	0.55	0.5	0.56	0.45	0.422	0.443	0.406	0.406
	Health Risk	187	174	125	92	95	74	51	51	47	52	42	39	41	38	38
1,3-Butadiene	Annual Avg	0.38	0.33	0.28	0.29	0.22	0.19	0.18	0.16	0.15	0.13	0.12	0.13	0.12	0.09	0.09
	Health Risk	142	125	106	108	83	70	66	60	58	48	45	47	44	35	35
Carbon Tetrachloride	Annual Avg	0.12	0.12		0.11		0.10	0.08				0.09	0.09	0.09	0.09	
	Health Risk	33	32		29		26	21				25	23	24	25	
Chromium, Hexavalent	Annual Avg			0.17	0.14	0.13	0.18	0.11	0.1	0.1	0.1	0.1	0.1	0.053	0.05	0.068
	Health Risk			26	21	19	26	16	15	15	15	15	15	8	8	10
para-Dichlorobenzene	Annual Avg			0.11	0.1	0.2	0.14	0.11	0.14			0.1	0.13	0.15	0.15	0.15
	Health Risk			7	7	14	9	7	10			7	9	10	10	10
Formaldehyde	Annual Avg	1.57			1.77	1.75	1.91	2.76	2.92	2.52	3.61	2.51	2.41	3.79	3.53	2.76
	Health Risk	12			13	13	14	20	22	19	27	18	18	28	26	20
Methylene Chloride	Annual Avg	0.65	0.56	0.55	0.98	0.66	0.53	0.54	0.52		0.6	0.57	0.29	0.08	0.08	0.07
	Health Risk	2	2	2	3	2	2	2	2		2	2	1	<1	<1	<1
Perchloroethylene	Annual Avg	0.07	0.07	0.06	0.05	0.17	0.05	0.06	0.05			0.06	0.03	0.03	0.02	0.02
	Health Risk	3	3	3	2	7	2	2	2			2	1	1	<1	<1
Diesel PM**	*Annual Avg*	*(2.5)*					*(1.6)*					*(1.2)*				
	Health Risk	*(750)*					*(480)*					*(360)*				
Average Basin Risk* **	Without Diesel PM	385	336	269	282	238	225	190	167	143	150	160	157	162	147	118
	With Diesel PM	***(1135)***					***(705)***					***(520)***				

* Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

** Diesel PM concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years.

*** Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics.*

Table 5-76

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