

Community Air Quality Monitoring: Special Studies

Wilmington

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California Environmental Protection Agency

 **Air Resources Board**

Executive Summary

This report presents the final results from a special air quality monitoring study in the community of Wilmington in Los Angeles. The California Air Resources Board (ARB) conducted the study during 2001 and 2002 as part of a larger statewide evaluation of the adequacy of the State's air quality monitoring network as required by the Children's Environment Health Protection Act (Escutia, Senate Bill 25, 1999).

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Wilmington was chosen to study the air quality impact of large industrial facilities, the Port of Los Angeles, and other transportation-related facilities on nearby schools. For the study, a primary monitoring site was chosen next to Wilmington Park Elementary School (Wilmington School). Data from the Wilmington School site was compared to data from long-term air monitoring sites in downtown Los Angeles and North Long Beach. These long-term sites are part of California's ambient air quality monitoring network.

Additional monitoring was conducted at the Hawaiian Avenue Elementary School (Hawaiian School), to obtain information about the air quality impact of particulate matter (PM₁₀) emissions from a freeway, a refinery, and the Port of Los Angeles that are all located within a half mile of the school.

In general, the study did not find large differences between most pollutants at Wilmington School and the nearby long-term monitoring site of North Long Beach. Both sites are located near the coast and are subject to similar daily wind patterns that usually disperse locally produced air pollution. Exceedances of the State 24-hour PM₁₀ standard were recorded at both locations, but air pollution levels above any federal ambient air quality standard were not measured at either site during this study.

Particulate matter levels (PM₁₀) were, however, higher at the Wilmington School site than North Long Beach and were similar to PM₁₀ levels measured in downtown Los Angeles during the same time period. Both Wilmington School and downtown Los Angeles exceeded the State 24-hour PM₁₀ standard (50 ug/m³) on 15 occasions during the 15-month study while this standard was exceeded only 6 times at North Long Beach. Because of the relatively close proximity and similar meteorology at the two sites, the higher PM₁₀ levels measured in Wilmington are likely due to PM₁₀ emissions from sources in Wilmington.

The particulate matter levels at Hawaiian School was higher than those measured at either of the Wilmington School, or the Downtown Los Angeles sites. The State 24-hour PM₁₀ standard was exceeded on 26% of the days measured at Wilmington School while it was exceeded 42% of the days measured at the Hawaiian School over a seven-month period. This difference suggests that nearby sources of particulate matter emissions are having an impact on air pollution levels at Hawaiian School.

The potential cancer risk associated with air pollution at the Wilmington School site was lower than the downtown Los Angeles site, but similar to the North Long Beach site. The estimated cancer risk at downtown Los Angeles, not including diesel particulate, was 23% higher than Wilmington School or North Long Beach. The main toxic pollutants associated with cancer risk at all three sites are primarily from motor vehicles. Differences in motor vehicle-related pollutants account for most of the difference observed between downtown Los Angeles and Wilmington or Long Beach. Other pollutants measured at Wilmington were similar to those measured at the other two monitoring sites.

The air monitoring conducted in Wilmington was part of a larger study to evaluate the statewide air quality monitoring network. This evaluation is contained in a report titled *The Assessment of California's Statewide Air Monitoring Network* (Adequacy Report). The Adequacy Report was written before all of the 2001 and 2002 data from the downtown Los Angeles and North Long Beach sites used in this report were available. As a result, the analyses and findings relating to Wilmington in the Adequacy Report may differ somewhat from those contained in this report.

Introduction

Investigating the relationship of air pollution to children's health is an ongoing priority at the California Air Resources Board (ARB). The agency has sponsored many studies on the health effects of children and their exposure to air contaminants. These and other studies indicate that children:

- are more vulnerable to environmental contaminants than adults;
- have higher exposure compared to adults relative to their body size;
- breathe more air on a comparable scale; and
- tend to be more active and breathe more rapidly than adults —therefore taking in larger doses of air contaminants.

In the long term, exposure to air pollutants can adversely affect the development of children's lungs, heart, and immune systems.

The Children's Environmental Health Protection Act

In recognition of children's vulnerability to air pollution, the California Legislature enacted the Children's Environmental Health Protection Act (Escutia, Senate Bill 25, 1999). This legislation directed the ARB to take additional steps to ensure that the State's air pollution programs are protective of children's health. These steps include:

- a review of air quality standards to ensure children are protected;
- an evaluation of the adequacy of the current outdoor ambient air monitoring network to gather data necessary to determine children's exposure, including special monitoring studies in six communities in air pollution nonattainment areas around the State; and
- the review and development, where needed, of air toxic control measures to protect children's health.

The Children's Environmental Health Protection Act (Act) also requires the Office of Environmental Health Hazard Assessment (OEHHA) to identify those pollutants that are most harmful to children.

Wilmington Air Quality Monitoring Study

This report presents the final results from a special air quality monitoring study in the community of Wilmington in Los Angeles. The ARB conducted the air

monitoring during 15 months in 2001 and 2002 as one of six special community air quality monitoring studies required by the Act.

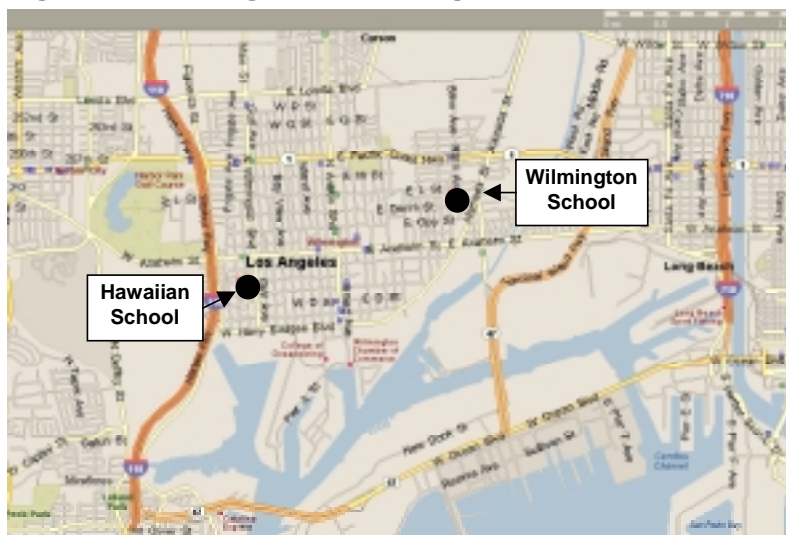
The air monitoring conducted in Wilmington was part of a larger study to evaluate the statewide air quality monitoring network. This evaluation is contained in a report titled *The Assessment of California's Statewide Air Monitoring Network* (Adequacy Report) (<http://www.arb.ca.gov/ch/programs/sb25/adequacy.htm>). The Adequacy Report was written before all of the 2001 and 2002 data from the downtown Los Angeles and North Long Beach sites used in this report were available. As a result, the analyses and findings relating to Wilmington in the Adequacy Report may differ somewhat from those contained in this report.

Description of the Air Monitoring Study

Site Selection

The ARB selected Wilmington as a study site to investigate air pollution levels at schools because of the proximity of local schools to large industrial and port facilities as well as ships, trucks, and trains. Wilmington is home to several oil refineries with a combined refining capacity of over 250,000 barrels per day. It is also situated near the ports of Los Angeles and Long Beach, which are sources of diesel and fugitive emissions from bulk transport activities. There are an estimated 12 schools and childcare facilities in the Wilmington area.

Figure 1: Wilmington Monitoring Sites



The ARB conducted monitoring at two schools in the community, Wilmington Park Elementary School (Wilmington School) and Hawaiian Avenue Elementary School (Hawaiian School). The locations of the two schools are shown in Figure 1. The number of children attending Wilmington Park Elementary, plus those attending nearby Wilmington Park Children’s Center, is approximately 1400. The ARB worked closely with the South Coast Air Quality Management District (SCAQMD), the Los Angeles Unified School District, and others to design a study to evaluate air pollution levels at schools in Wilmington.

Pollutants Sampled

Outdoor air levels of approximately 50 air pollutants were monitored near Wilmington School during a 15-month period from May 2001 through July 2002. The monitoring site was on property next to the Wilmington School owned by the Mahar House (1115 Mahar Avenue), a Los Angeles-based charitable organization. The pollutants sampled included both toxic air pollutants and others

Table 1: Some Key Pollutants Monitored in Wilmington

Wilmington	
Toxic Air Pollutants	Criteria Pollutants
1,3-butadiene	Particulate matter
Benzene	Ozone
Acetaldehyde	Carbon monoxide
Formaldehyde	Oxides of nitrogen
Perchloroethylene	
Carbon tetrachloride	
Methylene chloride	
Para-dichlorobenzene	
Hexavalent chromium	
Polycyclic aromatic hydrocarbons	
Arsenic	
Lead	
Manganese	
Nickel	
Hawaiian School	
	Particulate Matter

known as “criteria pollutants” that contribute to smog and particulate matter.

Monitoring for particulate matter, carbon monoxide, and nitrogen oxides was also conducted at a second site, located at Hawaiian Elementary School (540 Hawaiian Avenue). The primary focus of ARB’s monitoring at this site was to obtain more information about the concentration of particulate matter (PM₁₀) from the

freeway and refinery located to the west of the site and from the port activities located to the south. The SCAQMD conducted monitoring for the other two pollutants. The results are available from the SCAQMD but are not included in this report.

Table 1 lists the key pollutants measured and reviewed for this report. The levels of the other pollutants measured were very low. Particulate matter from diesel-powered engines, an important contributor to cancer risk, was not directly measured as part of this study. Monitoring methods for diesel particulates are still under development.

Toxic air pollutants are known or suspected to cause cancer or other serious illnesses. Air pollutants that contribute to smog and particulate matter are “criteria pollutants” for which health-based criteria or air quality standards have been established. The standards establish the levels above which a criteria pollutant may cause adverse health effects in humans.

California’s Ambient Air Quality Monitoring Network

The California ambient air quality monitoring network (air monitoring network) is a key tool in measuring air quality in California and for determining children’s exposure to air pollution. The network consists of over 250 permanent, long-term air quality monitoring sites, which are used to:

- track progress towards clean air;
- help determine exposures to sensitive populations, such as children and the elderly;
- help evaluate which pollutants in the outdoor air present the greatest hazards and thus help the ARB establish priorities for control;
- guide the announcement of “Spare the Air” days and other potentially hazardous conditions; and
- investigate the relationships between air pollution and children’s health.

Wilmington Monitoring Data Compared to Air Monitoring Network Sites

Staff compared measurements from Wilmington to measurements from two of the closest air monitoring sites: North Long Beach and Los Angeles-North Main (see Figure 2). North Long Beach is seven miles northeast of Wilmington and Los Angeles-North Main is twenty-four miles to the north. Results of this monitoring are summarized in the following sections.

Figure 2: Wilmington and Long-term LA Monitoring Sites

Air Monitoring Results for Criteria Pollutants

Criteria pollutants can cause lung damage, heart problems, and in some cases, premature deaths. Based on the health and environmental impacts of these pollutants, State and federal air quality agencies have identified safety thresholds and established air quality standards for these pollutants to protect public health.

Four criteria pollutants—particulate matter that is 10 microns in diameter and smaller (PM_{10}), ozone, carbon monoxide (CO), and oxides of nitrogen (NO_x), —were measured at Wilmington. These pollutants are also routinely measured at the North Long Beach and Downtown Los Angeles long-term monitoring sites.

Particulate Matter (PM_{10})

The Los Angeles region currently does not meet the State or federal air quality standards for particulate matter (PM_{10}). The very small size of PM_{10} allows the pollutant to reach deep in the lungs where it may be deposited and cause adverse health effects. Major sources of PM_{10} in California include motor vehicles, area-wide sources such as dust from construction and landfills, wood-burning stoves and fireplaces, wildfires and brush/waste burning, and industrial facilities. PM_{10} can also be formed in the atmosphere through chemical reactions between other air pollutants. As population increased in Los Angeles, so did activities that

Criteria pollutant
An air pollutant with established safety thresholds and standards.

increased PM₁₀ emissions. However, there has been a downward trend in measured levels of PM₁₀ since 1990. Also, emissions of *diesel* particulate matter, which poses the most significant health risk, dropped 40 percent from 1990 to 2000 due to stricter emission standards and the introduction of cleaner fuel.

Table 2 summarizes results from the particulate matter monitoring over the 15-month period of this study (May 2001 to July 2002). The same period was also used for the criteria pollutants. It is typical to study air quality for a year or more to account for seasonal variations. Unlike the other criteria pollutants, which are measured continuously, PM₁₀ is usually measured over a 24-hour period once every six days.

Table 2. Particulate Matter (PM₁₀) from May 2001 through July 2002.

Location	Average*	Maximum*	Number of Days Above State Standard**
Wilmington School	40	81	15 of 67 days
Downtown Los Angeles	43	97	15 of 66 days
North Long Beach	36	61	6 of 68 days

* Values are 24-hour average concentrations reported in units of micrograms per cubic meter (ug/m³). Average is the average of all valid 24-hour samples collected at that location.

Maximum is the highest 24-hour sample measured at that location.

** Particulate matter standards—Federal 24 hour average: 150 micrograms/m³ (µg/m³); State: 24 hour average: 50 µg/m³

As shown in Table 2, levels of particulate matter were higher than the established State standard about one in every 5 days when measurements were taken at the Wilmington School and Downtown Los Angeles sites and about one in every 11 of the days when PM₁₀ was measured at North Long Beach. The average and maximum levels are comparable during this 15-month period for Wilmington and Downtown Los Angeles, with lower levels at North Long Beach. Measurements presented in this table may not have always been collected on exactly the same days at the three sites, but all measurements were taken during the same time period.

Statistical analysis indicates that there is a real difference between the average PM₁₀ concentrations at Wilmington School and that at North Long Beach. However, there is no meaningful difference in the average PM₁₀ concentrations between the Wilmington and the Downtown Los Angeles sites. Particulate matter levels and frequency of state standard exceedances were higher at the Wilmington and Downtown Los Angeles than North Long Beach, for the same time period.

Because of the geographic and meteorological similarities between the Wilmington School and North Long Beach sites, the higher PM₁₀ levels measured in Wilmington are likely due to PM₁₀ emissions from sources in Wilmington.

Additional PM₁₀ data were collected at Hawaiian School from November 2001 to May 2002 on the same sampling schedule as Wilmington School. Table 3 summarizes results for particulate matter over this seven-month period. Also included in this table are results for the same time period at Wilmington, Downtown Los Angeles, and North Long Beach.

Table 3. Particulate Matter (PM₁₀) from November 2001 through May 2001

Location	Average*	Maximum*	Number of Days Above State Standard**
Wilmington School	39	78	9 of 34 days
Hawaiian School	46	80	12 of 28 days
Downtown Los Angeles	37	65	6 of 26 days
North Long Beach	33	58	3 of 30 days

* Values are 24-hour average concentrations reported in units of micrograms per cubic meter (ug/m³).

Average is the average of all valid 24-hour samples collected at that location.

Maximum is the highest 24-hour sample measured at that location.

** Particulate matter standards—Federal 24 hour average: 150 micrograms/m³ (µg/m³);
State: 24 hour average: 50 µg/m³

The 24-hr state PM₁₀ standard (50 ug/m³) was exceeded at both Wilmington-area monitoring sites, but more frequently at Hawaiian School. The particulate matter levels at Hawaiian were higher than at the Wilmington School or the Downtown Los Angeles sites and much higher than North Long Beach. The State 24-hour PM₁₀ standard was exceeded on 26% of the days measured at Wilmington School while it was exceeded 42% of the time at the Hawaiian School over this seven-month period. This difference suggests that nearby sources of particulate matter emissions are having a measurable impact on air pollution levels on Hawaiian School. While we are seeing differences between the two schools, the maximum value measured at Hawaiian School is still only a little over one half of the federal 24-hour PM₁₀ standard. It is worth noting that PM₁₀ levels in distant sites in the Los Angeles region can be about twice as high as those seen during this study.

Ozone

Ozone is a product of a chemical reaction between nitrogen oxides and volatile organic compounds in the presence of sunlight and is a major indicator of smog.

Near the earth's surface, ozone can cause breathing difficulties and even lung damage. Ground-level ozone can also damage vegetation, buildings, rubber, and plastics. Currently, large portions of the Los Angeles region, as well as many other areas of California, do not meet the federal or State air quality standards for ozone.

As summarized in Table 4, levels of ozone at Wilmington School were lower than those measured at the Downtown Los Angeles site. Over a period of fifteen months, no days above the State ozone standard were measured at Wilmington School or North Long Beach; however, eight days above the standard were measured at Downtown Los Angeles over this same time period. There were no violations of the federal one-hour ozone standard at any of the three sites.

Table 4. Ozone from May 2001 through July 2002

Location	Average*	Maximum*	Number of Days Above State Standard**
Wilmington School	43	92	0
Downtown Los Angeles	50	122	8
North Long Beach	42	84	0

* Values are one-hour average concentrations reported in units of parts per billion (ppb).

Average is the average of all daily one-hour maximum concentrations measured at that location.

Maximum is the highest one-hour concentration measured at that location.

** Ozone standards—Federal 1 hour: 120 ppb, State 1 hour: 90 ppb

California has adopted aggressive emission controls on motor vehicles and other sources. As a consequence, the ozone levels have decreased dramatically over the last two decades in the Los Angeles region. We expect this progress to continue.

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless gas at room temperature. It is readily absorbed through the lungs into the blood, causing insufficient oxygen to reach the heart, brain, and other tissues. The resultant harm can be critical for people with heart disease, chronic lung diseases, and anemia as well as for unborn children.

Carbon monoxide is formed as a result of incomplete combustion of fuels and waste materials such as gasoline, diesel fuel, wood, and agricultural debris.

Mobile sources generate most of the CO emissions in California. The contribution of industrial sources to overall CO emissions is small. Currently, CO

levels in most areas of California are below the State standard, so carbon monoxide is a diminishing problem in California.

As shown in Table 5, the annual average CO levels at Wilmington School are somewhat lower than the two air monitoring network sites. The maximum 8-hour average values recorded at all three sites only reached about one half of the State or federal CO air quality standard. Much of the progress in reducing levels of carbon monoxide is attributable to motor vehicle controls and the introduction of cleaner fuels. We expect continued progress towards reductions in carbon monoxide levels throughout the State.

Table 5. Carbon Monoxide from May 2001 through July 2002

Location	Average*	Maximum*	Number of Days Above State Standard**
Wilmington School	1.1	5.3	0
Downtown Los Angeles	1.6	4.5	0
North Long Beach	1.4	4.7	0

* Values are 8-hour average concentrations reported in units of parts per million (ppm).

Average is the average all daily maximum 8-hour average concentrations measured at that location.

Maximum is the highest 8-hour average concentration measured at that location.

** Carbon monoxide standards: Federal and State 8 hour: 9 ppm

Oxides of Nitrogen

The two major types of oxides of nitrogen are nitric oxide (NO) and nitrogen dioxide (NO₂). Air quality standards have been established for NO₂, but not for NO. Since, the Los Angeles region and other areas of the State are currently attaining the State standard for NO₂, this report will discuss NO_x. The NO₂ standard was not exceeded at Hollenbeck during the study.

Oxides of nitrogen (NO_x) contribute to the formation of ozone and particulate matter, both of which are major air pollutants that reach unhealthy levels in many areas of California. NO_x is emitted during the high-temperature combustion of fuels. On-road motor vehicles and other mobile sources currently contribute most of the NO_x emissions in California. As shown in Table 6, Wilmington annual levels of NO_x are very similar to the levels measured at the North Long Beach site.

Table 6. Oxides of Nitrogen* from May 2001 through July 2002

Location	Average**	Maximum**
Wilmington School	128	636
Downtown Los Angeles	175	570
North Long Beach	131	578

* No federal or State standard has been established for NO_x; the State standard for NO₂ (250 ppb for a one-hour average) was not exceeded during the study.

** Values are one-hour average concentrations reported in units of parts per billion (ppb).

Average is the average of all daily maximum one-hour average concentrations measured at that location.

Maximum is the highest one-hour average concentration measured at that location.

Emissions of NO_x from on-road motor vehicles declined by more than 30 percent from 1990 to 2000 and are projected to decrease by an additional 40 percent between 2000 to 2010 due to stringent emission standards on motor vehicles and the introduction of cleaner burning gasoline. Emissions from industrial sources have also decreased, largely because of a switch from fuel oil to natural gas and the implementation of combustion controls. However, the ARB continues to work toward reducing levels of NO_x due to its role in the formation of ozone and particulate matter.

Air Monitoring Results for Key Toxic Air Pollutants

Health Effects of Toxic Air Pollutants

Toxic air pollutants can cause adverse health effects individually and collectively. Some of the health effects include cancer, asthma, respiratory problems, and other serious illnesses. Cancer risk estimates related to toxic air pollution contained in this report represent the chance of excess cancer cases in one million people, assuming exposure over a 70-year lifetime.

The health risks estimates in this report are based on the best available scientific information. Sources of potential uncertainty in these estimates include the unavailability of risk estimates for certain pollutants and limitations in scientific understanding of pollutants' health effects. Furthermore, our analysis of health risks from toxic air pollutants focused on one possible adverse health effect, cancer, whereas these pollutants may also cause a variety of respiratory, reproductive, and other adverse health effects. We focus on cancer risk because

Top 9 Air Toxics Monitored in Wilmington

Benzene
1,3-Butadiene
Formaldehyde
Acetaldehyde
Perchloroethylene
Carbon Tetrachloride
Hexavalent chromium
Methylene chloride
Paradichlorobenzene

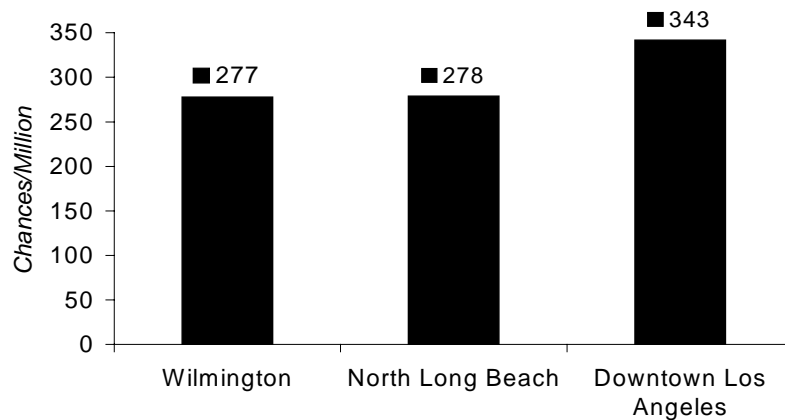
we identified only one pollutant that was over the threshold for noncancer health risks.

Monitoring results indicate that the potential cancer risk at Wilmington School is mostly attributable to nine of the toxic air pollutants measured during the study: benzene, 1,3-butadiene, formaldehyde, acetaldehyde, perchlorethylene, carbon tetrachloride, hexavalent chromium, methylene chloride, and paradichlorobenzene. The cancer risks calculated for this report are based on the concentrations of these nine toxic air pollutants. Including other toxic air pollutants measured at these sites does not significantly change the overall risk at each site nor does it change the overall relationship of cancer risk between sites.

These cancer risk estimates did not include diesel particulate matter (diesel PM). Diesel PM is believed to be the largest contributor to health risks from urban toxic air pollutants. The estimated average potential cancer risk from diesel PM in the Los Angeles area is 720 chances per million. Diesel PM was not measured directly as part of this study because a proven method for measuring it is not currently available. The ARB is in the process of developing methods to measure diesel PM. California already has an aggressive program to reduce diesel PM emissions throughout the State.

Cancer risk estimates for pollutants for Wilmington

To put the results from Wilmington into perspective, ARB staff estimated the potential cancer risk for the nine pollutants at Wilmington School and the two air monitoring network sites based on days where samples were collected at all three locations (Figure 3). The potential cancer risk due to these nine pollutants at Wilmington School is lower than that estimated for the same nine pollutants at the Downtown Los Angeles and Long Beach sites. However, there was no real difference in cancer risk between Wilmington School and North Long Beach.

Figure 3. Potential Cancer Risk* for Nine Key Toxic Air Pollutants

* Figure 3 does not include estimated risk from diesel PM. The potential risk estimates assume a lifetime exposure through breathing pathway only. Estimates for Wilmington, Downtown LA, and North Long Beach are based on May 2001 – July 2002 data, for matched days only (see Table7).

Matched Days

A comparison of monitoring measurements taken on the same days. The toxic air pollutants in this study were usually measured for 24 hours every six days.

Why does the potential cancer risk differ among the Wilmington, Downtown Los Angeles, and North Long Beach sites? To answer this question, staff looked at the nine pollutants individually. Table 7 shows the contribution of toxic pollutant to the overall cancer risk shown in Figure 3. The following discussion of toxic pollutants is based on all of the data collected on matched days between May 2001 and July 2002.

Table 7. Annual Levels of Key Toxic Air Pollutants (5/01-7/02)

Pollutant	Risk Factor*	Wilmington		No Long Beach		Downtown LA	
		Average** conc.	cancer risk***	Average** conc.	cancer risk***	Average** conc.	cancer risk***
Benzene	93	0.74	68	0.75	69	0.96	89
1,3-Butadiene	376	0.34	127	0.32	128	0.38	143
Formaldehyde	7	2.30	17	3.34	17	4.99	37
Acetaldehyde	5	1.38	7	1.87	9	1.18	6
Perchloroethylene	40	0.09	4	0.12	4	0.17	7
Carbon Tetrachloride	264	0.09	24	0.09	24	0.09	24
Hexavalent Chromium	150	0.12	18	0.12	18	0.16	24
Methylene Chloride	3	0.64	2	0.6	2	0.65	2
Para-Dichlorobenzene	66	0.18	12	0.16	11	0.15	10

* Toxicity values for cancer causing air pollutants expressed in terms of risk per unit concentration of the air pollutant given in chances of cancer per million people.

** Values are 24-hour average concentrations reported in units of parts per billion (ppb).

*** Cancer risk estimates are calculated as (risk factor * average concentration) = cancer risk. Cancer risk estimates represent the chance of excess cancer cases in one million people, assuming these people breathe the average levels of the pollutant over a 70-year lifetime.

Key Toxic Air Pollutants

Benzene and 1,3-Butadiene

Taken together benzene and 1,3-butadiene make up around 70% of the cancer health risk from the nine pollutants. These pollutants are discussed together because motor vehicles are the primary source of benzene and 1,3-butadiene. In addition to increased potential cancer risk, breathing benzene and 1,3-butadiene can cause non-cancer health effects. Benzene can cause central nervous system depression. 1,3-butadiene can cause neurological effects such as blurred vision, fatigue, headache, and vertigo at very high levels. Levels of these two pollutants measured in Wilmington were well below the threshold for these noncancer health effects. Emissions from these two pollutants have been reduced in California through aggressive regulations requiring motor vehicle emission controls, gasoline vapor recovery systems, and cleaner fuels. From 1990 to 2000, outdoor statewide levels declined 72 percent for benzene and 53 percent for 1,3-butadiene. The ARB has regulations in place to further reduce emissions from benzene and 1,3-butadiene.

Formaldehyde and Acetaldehyde

Formaldehyde and acetaldehyde are also emitted by motor vehicles but they also may be formed from chemical reactions between other air pollutants in the atmosphere. In addition to increased potential cancer risk, breathing formaldehyde and acetaldehyde can cause non-cancer health effects, which include irritating the eyes, skin, and respiratory tract. Formaldehyde can be an irritant for individuals at levels over 2 parts per billion (ppb). The average formaldehyde concentration measured at Wilmington School was 2.3 ppb, which indicates that some individuals might experience mild eye irritation during peak exposures. Formaldehyde is the only toxic air pollutant measured in this study where any currently identified noncancer health effects might occur. Emissions of acetaldehyde and formaldehyde have been reduced in California through aggressive regulations requiring motor vehicle emission controls, gasoline vapor recovery systems, and cleaner fuels. Data for acetaldehyde and formaldehyde are more variable, but levels have decreased significantly since 1990. The ARB has regulations in place to further reduce emissions from acetaldehyde and formaldehyde.

Level of detection

Lowest concentration of a pollutant that a monitor can measure.

Nanogram

One billionth of a gram

Perchloroethylene

The level of perchloroethylene, a persistent organic pollutant, was higher at the Downtown Los Angeles than at Wilmington or North Long Beach. In addition to potential cancer risks, perchloroethylene can irritate the eyes and respiratory tract. It can also depress the central nervous system. Industrial processes and dry cleaners are the major sources of emissions of perchloroethylene.

ARB's control measures on dry cleaning facilities have helped to reduce levels of perchloroethylene statewide, but more needs to be done. Statewide outdoor perchloroethylene levels in 2000 were approximately 58 percent lower than 1990 levels. Controls on degreasers used for automotive maintenance and repair that are already in place should further reduce levels of this pollutant.

Carbon Tetrachloride

Average levels of carbon tetrachloride at Wilmington were comparable to those in the Los Angeles region and statewide. Because carbon tetrachloride emissions are very low in California, levels throughout the State are relatively constant. In fact, carbon tetrachloride levels are fairly constant around the globe, the lingering effect of past use. Carbon tetrachloride takes about 50 years to break down in the atmosphere.

Hexavalent Chromium

The amount of hexavalent chromium in most samples collected at the three sites was too low to be measured by laboratory instruments. California adopted a control measure in 1988 to reduce emissions of hexavalent chromium from chrome plating; as a result, statewide levels have been reduced. Because hexavalent chromium is highly toxic, even minute amounts still pose a health risk.

Para-dichlorobenzene and Methylene Chloride

For most samples, levels of para-dichlorobenzene and methylene chloride at Wilmington School were below the level of detection. The average levels of the detectable samples of methylene chloride at Wilmington were comparable to levels at Downtown Los Angeles and Burbank. Para-dichlorobenzene is used as a room deodorant, in moth balls, and as a dye intermediate. It is also a registered insecticide.

Many manufacturers of consumer products are voluntarily phasing out their use of methylene chloride. In the case of aerosol paints, use will be restricted by an

ARB regulation. In 2000, the ARB adopted a control measure to eliminate the use of methylene chloride in degreasers for automotive maintenance and repair.

Air Monitoring Results for Other Toxic Pollutants

In addition to the criteria and toxic air pollutants discussed above, other air pollutants related to industrial sources near Wilmington School were measured as part of this study. These pollutants were either measured at very low levels or were too low to be measured by laboratory equipment.

Several metals, including manganese, nickel, and lead, were higher at Wilmington School than at the Downtown Los Angeles and Long Beach sites. However, the measured levels of these metals were too low to pose a significant health risk. For instance, while the average level of manganese at Wilmington was 28 nanograms per meter³ (ng/m³), this is only 14% of the threshold above which there are some health concerns which is 200 ng/m³. Sources of these metals include industrial and commercial operations as well as motor vehicles.

The average levels of arsenic at Wilmington were comparable to other sites and to average statewide levels. Average levels of arsenic at Wilmington School were 1.6 ng/m³, which is only about 5% of the threshold above which there are some health concerns of 30 ng/m³. The primary industrial sources of arsenic in California are electrical services and metal mining. Arsenic is also used in insecticides, weed killers, fungicide, and as a wood preservative.

Monitoring Results for Elemental Carbon - A Possible Surrogate for Diesel Particulate Matter

Elemental carbon is a material found in particulate matter (PM₁₀). In the past, it has been used as an indicator of, or surrogate for, diesel particulate matter (diesel PM) levels because of the relatively high content of elemental carbon in diesel. Because diesel PM emissions are of major concern in Wilmington, elemental carbon was monitored in this study. Elemental carbon consists of tiny, black, solid particles of soot, most of which are smaller than 2.5 microns. This small size allows the particles to reach deep into the lungs where they may be deposited and result in adverse health effects.

Recently, however, diesel technologies have improved and the diesel fleet has become cleaner. Other combustion processes such as fireplaces, cooking, forest fires, gasoline engines, agricultural burning, and power plants also emit elemental

carbon. As emissions from the diesel fleet have decreased, these other sources now account for a larger percentage of total elemental carbon in the air. With these changes, elemental carbon alone is generally no longer a good marker for diesel PM.

Elemental carbon is not routinely monitored and there are no standards or thresholds established for which levels of elemental carbon are deemed unsafe. ARB used the U.S. EPA-approved method to measure elemental carbon in this study. However, earlier studies in the Los Angeles area used a different method of analysis, so there are no historical regional or statewide values available for comparison.

Elemental carbon monitoring was performed at Wilmington School for the entire study period. During this time, only 7 out of approximately 57 samples contained elemental carbon above the level that elemental carbon could be measured using the EPA method for elemental carbon analysis (Limit of Detection is 1 ugC/m^3). The maximum elemental carbon measured during this time period was 4 ugC/m^3 .

The SCAQMD also collected elemental carbon samples at Hawaiian School. Their data had fewer samples below the level of detection and the elemental carbon levels were higher than the levels measured by ARB at Wilmington School. ARB and SCAQMD used different methods of analysis for determining the concentration of elemental carbon. ARB uses a method approved by the EPA that provides a value approximately one-half to one-third less than if analyzed using the method employed by the SCAQMD. This difference in analysis methods probably explains most of the difference in the elemental carbon data collected at the two schools. You may contact the SCAQMD for more information about their elemental carbon monitoring results for Hawaiian School.

Meteorological Impact on Air Quality

Daily Patterns

Weather can have a significant effect on air pollution levels. Because of their location near the coast, Wilmington School and the nearby air monitoring network site at North Long Beach both enjoy weather that tends to prevent the build up of air pollution in their respective communities.

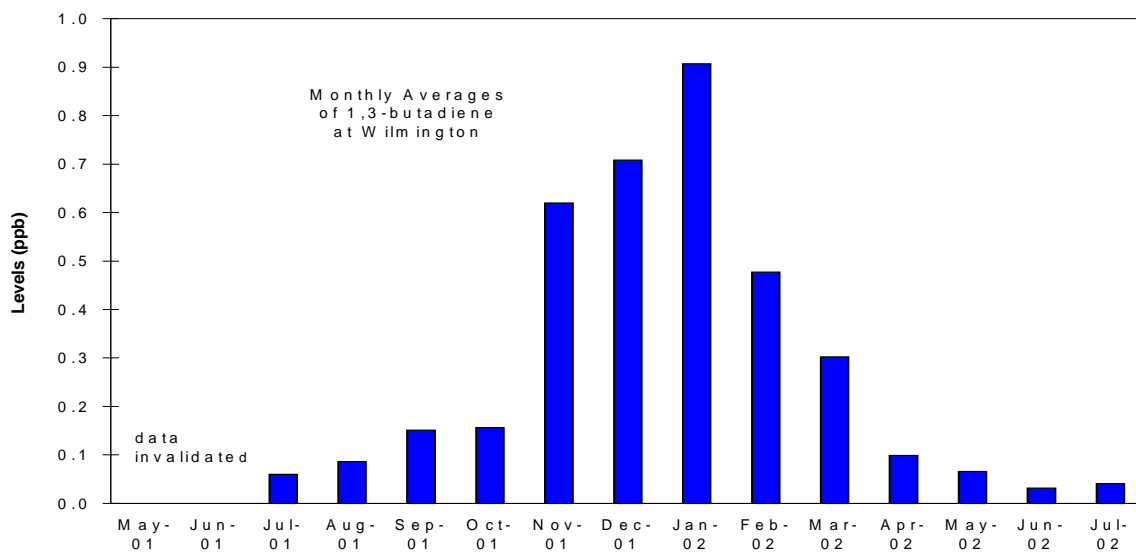
The difference in land and water temperature produces an onshore breeze almost daily for any place located near the ocean. In this area, an onshore breeze will begin in midmorning and it will force any air over the coast into the interior

valleys or vertically lift the air away from the surface. This natural ventilation carries cleaner surface air into the area for as long as the onshore breeze blows. This type of a breeze continues through the day until it dies down late in the afternoon. This daily wind pattern is found in the Wilmington area between 75 to 99 percent of the time and tends to prevent the build-up of high levels of air pollution. This favorable meteorology seems to explain why the air pollution levels measured in this study were lower than one might anticipate from the large number of air pollution sources in the Wilmington area.

Seasonal Variations

Many pollutants showed seasonal variations. For example, 1,3-butadiene and benzene are usually higher in the winter than in the summer. This seasonal pattern is common because the air tends to be more stagnant with less mixing in the winter months, allowing pollutants to accumulate. The seasonal pattern of 1,3-butadiene in Wilmington is shown below (Figure 4).

Figure 4. 1,3-Butadiene at Wilmington



Conclusions

The school monitoring sites in Wilmington were chosen to fulfill the Children's Environmental Health Protection Act's requirement to look at the impact of a variety of large sources of air pollution on locations where children live, learn, and play. Based on fifteen months of outdoor air measurements collected at Wilmington School, North Long Beach, and downtown Los Angeles, along with seven months of monitoring at Hawaiian School, ARB staff identified several patterns in the air quality data.

The most significant finding was that air quality in North Long Beach and Wilmington is similar for all pollutants except PM₁₀. This suggests that similar regional rather than local conditions are the primary factors influencing the levels of most air pollutants at these two sites. The higher levels of PM₁₀ observed at both Wilmington School and Hawaiian School suggests that local source contribute a significant portion of the local PM₁₀ burden, especially with respect to the maximum PM₁₀ levels observed. However, the PM₁₀ values measured are similar to many parts of the greater Los Angeles area and only about one half the 24-hour average concentrations sometimes observed in the eastern parts of the South Coast Air Basin.

Cancer Risk

The potential cancer risk value at Wilmington School is based on the nine top risk toxic pollutants measured in this study. The cumulative cancer risk from these nine pollutants was essentially identical to North Long Beach and lower than downtown Los Angeles. The potential cancer risk would be much higher if the effects of diesel particulate were included. However, at this time there is no routine method for directly measuring diesel particulate in the air. The presence of a large number of diesel sources coupled with the higher observed PM₁₀ levels observed in Wilmington, suggests that the diesel particulate levels at Wilmington School are likely to be higher than at North Long Beach.

Reducing Air Pollution in Wilmington

There are numerous programs that specifically target mobile source emissions such as those found in Wilmington. The ARB is responsible for developing statewide programs and strategies to reduce the emission of smog-forming pollutants and toxics by mobile sources. The ARB has programs such as the Diesel Risk Reduction Program and the California Motor Vehicle Program that help reduce air pollution from motor vehicles.

The Diesel Risk Reduction Program reduces diesel emissions from both new and existing diesel engines and vehicles. One of the key elements of the plan is to retrofit existing diesel engines in California to reduce diesel particulate emissions to near zero, in the shortest time possible. The program focuses on several control options such as the catalyst-based diesel particulate filters or traps and other viable alternative technologies and fuels. You can find out more information about the diesel risk reduction plan at:

<http://www.arb.ca.gov/diesel/documents/rrpapp.htm>

The ARB also has a website that lists information on all mobile source related programs. You can find more information about these programs at:

<http://www.arb.ca.gov/msprog/msprog.htm>

The ARB will continue to evaluate the health effects of pollutants in the air while implementing programs with local authorities that aim at reducing levels of air pollution in communities such as Wilmington.

For more information, contact:

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The California Air Resources Board is a part of the California Environmental Protection Agency.

The Mission of the California Air Resources Board

“To promote and protect public health, welfare, and ecological resources through the effective and efficient reduction of air pollutants while recognizing and considering the effects on the economy of the State.

