EXHIBIT DD

Executive Summary

The Multiple Air Toxics Exposure Study (MATES-II) is a landmark urban toxics monitoring and evaluation study conducted for the South Coast Air Basin (Basin). The study was initiated as part of the Environmental Justice Initiatives adopted by the South Coast Air Quality Management District (District) Governing Board in October 1997. The study represents one of the most comprehensive air toxics programs ever conducted in an urban environment, and certainly much more comprehensive than a similar study (MATES-I) conducted by the District over a decade ago.

The MATES-II project consists of several elements. It consists of a comprehensive monitoring program, an updated emissions inventory of toxic air contaminants, and a modeling effort to fully characterize Basin risk.

There were two separate monitoring components to MATES-II: (1) a network of 10 fixed sites which monitored for toxic air contaminants once every six days for an entire year (from April 1998 through March 1999); and (2) a microscale study which utilized three mobile platforms to sample at 14 additional communities. The microscale study specifically targeted residential areas which could be influenced by nearby sources of toxic emissions. In order to cover all these locations in a one-year period, the sampling platforms were situated in a community for a one-month period. For the entire program, both fixed and microscale sites, over 4,500 samples were collected and analyzed. Due to the large number of samples, laboratories at both the District and the California Air Resources Board (ARB) shared responsibilities for the chemical analyses.

In addition to the monitoring portion, MATES-II also included an update of the latest toxics emissions inventories for the Basin, and computer modeling to determine a more complete picture of toxics risks. Since it is not feasible to conduct sampling at each and every location in the Basin, it is important to utilize the models to provide predictions for locations where monitoring has not been possible. (It should be noted that the costs for this program are over $750,000, not counting the in-kind services provided by the ARB.)

To provide important scientific guidance to the District during the study, the Air Toxics Study Technical Review Group (ATSTRG) was formed. This panel of 13 experts from academia, environmental groups, industry, and public agencies, representing expertise in air toxics, was assembled to review the project from inception, and to offer guidance on ways to improve the study. The program design reflected, to a large extent, the input provided by this panel.

In the monitoring program, over 30 air pollutants were measured. (Table ES-1). These included both gas and particulates. Toxic air contaminants are determined by the U.S. EPA, and by the California EPA, including the Office of Environmental Health Hazard Assessment and the ARB. For purposes of this study, the California toxic risk factors are used.

Table ES-1

Pollutants Measured in MATES-II

CAS No.	Chemical Name	CAS No.	Chemical Name
71432	Benzene	50000	Formaldehyde
7440439	1,3 Butadiene	75070	Acetaldehyde
106467	Dichlorobenzene (ortho- & para)		Acetone
75014	Vinyl Chloride	7440382	Arsenic
10414	Ethyl Benzene		Chromium
	Toluene	7439921	Lead
	Xylene (m-, p-, o-)	7440020	Nickel
	Styrene		Cobalt
56235	Carbon Tetrachloride		Copper
67663	Chloroform		Manganese
75343	Dichloroethane [1,1]	7723140	Phosphorous
	Dichloroethylene [1,1]		Selenium
75092	Methylene Chloride		Silica
127184	Perchloroethylene		Silver
79016	Trichloroethylene		Zinc
74783	Chloromethane		PAHs
			Elemental Carbon
			Organic Carbon

Toxic measurements in the Basin are not new. Although MATES-II represents the most comprehensive study of its kind, the ARB has collected samples at five sites in the Basin since 1990. As a background to the current study, an evaluation of the trends of key toxic pollutants was conducted. Data from all sites have shown a pronounced decrease in toxic levels in the Basin from 1990 through 1997. In fact, the risk associated with cancer rates (often referred to as "carcinogenic risk") associated with air toxics has decreased by about 50 percent during this period.

When "carcinogenic risk" is discussed, it typically refers to the increased probability ~~of a person contracting cancer over the course of a lifetime if exposed to the source of cancer-causing compounds for~~ that an individual exposed to an average air concentration of a chemical will develop cancer when exposed over 70 years. Cancer risks are often expressed on a per-million basis for comparative purposes. ~~In other words~~ As an example, a cancer risk of 100 in a million at a location means that the individuals staying at that location for 70 years have a 100 in a million chance of contracting cancer.

A "cancer burden" typically refers to the number of excess cancer cases expected in the exposed population. If 10,000 people live at that location, then the cancer burden for this population will be _one (the population multiplied by the cancer risk). This means that one of the 10,000 people staying at the location for 70 years is~~are~~ ~~expected~~ estimated to contract cancer.

To make carcinogenic risk determinations, at least one full year of data is strongly recommended to represent exposure potential. This is why the fixed site network (or "regional study") was conducted over a one-year period. The microscale study, on the other hand, is intended more to determine ~~potential localized "hot spots."~~ whether localized sources of emissions cause a significant increase in concentration of certain toxic air contaminants. ~~causing a measurable localized increase in risk due to toxic air contaminant emissions.~~ Data collected at these sites cannot readily be expressed in terms of risk because only one month of data is available at 12 of the 14 microscale sites. (At two sites, sampling was conducted for one month during each calendar quarter.) Localized conditions can be assessed, however, by comparing the toxic levels at each microscale site to its nearest station in the fixed-site network. Where differences occur the microscale influences of nearby sources can be estimated. To further complement this assessment, microscale-level modeling has been included in this study, as well as an enhanced toxics inventory in the immediate vicinity of each microscale site. These efforts, combined, provide a mechanism for both regional-scale and local-scale air toxic characterizations across the Basin.

Consistent with the fact that most of the region's population and toxic-emitting sources are within Los Angeles County, most of the monitoring sites were placed in Los Angeles County. Of the 10 fixed sites, seven were in Los Angeles County, and one each in the other three counties of the Basin. Because fixed sites are situated based on EPA guidelines for "neighborhood scale" monitoring, each of the ten locations may be representative of adjacent communities as well. Microscale sites, on the other hand, were specifically located to characterize ~~for~~ localized conditions. For the 14 microscale sites, eight were in Los Angeles County and two in each of the other three counties. (See Figure ES-1.) Unlike reactive pollutants, such as ozone and fine particulates which increase in concentration as the wind carries its precursor emissions inland, many toxic pollutants are non-reactive. This means that highest levels are expected to be close to the sources.

The key results of the MATES-II study are as follows;

Fixed-Site (Regional) Program

A. Monitoring

1) The ~~average~~ carcinogenic risk in the Basin is about 1,400 per million people[*]. Mobile sources (e.g., cars, trucks, trains, ships, aircraft, etc.) represent the greatest contributor. About 70% of all risk is attributed to diesel particulate emissions; about 20% to other toxics associated with mobile sources (including benzene, butadiene, and formaldehyde); about 10% of all risk is attributed to stationary sources (which include industries and other certain businesses such as dry cleaners and chrome plating operations.) (See Figure ES-2.)

2) The carcinogenic risk of 1,400 per million is based on a range from about 1,120 in a million to about 1,740 in a million among the ten sites. (See Figure ES-3, top.)

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[*] Based on the average of the pollutant concentrations measured at the fixed monitoring sites.

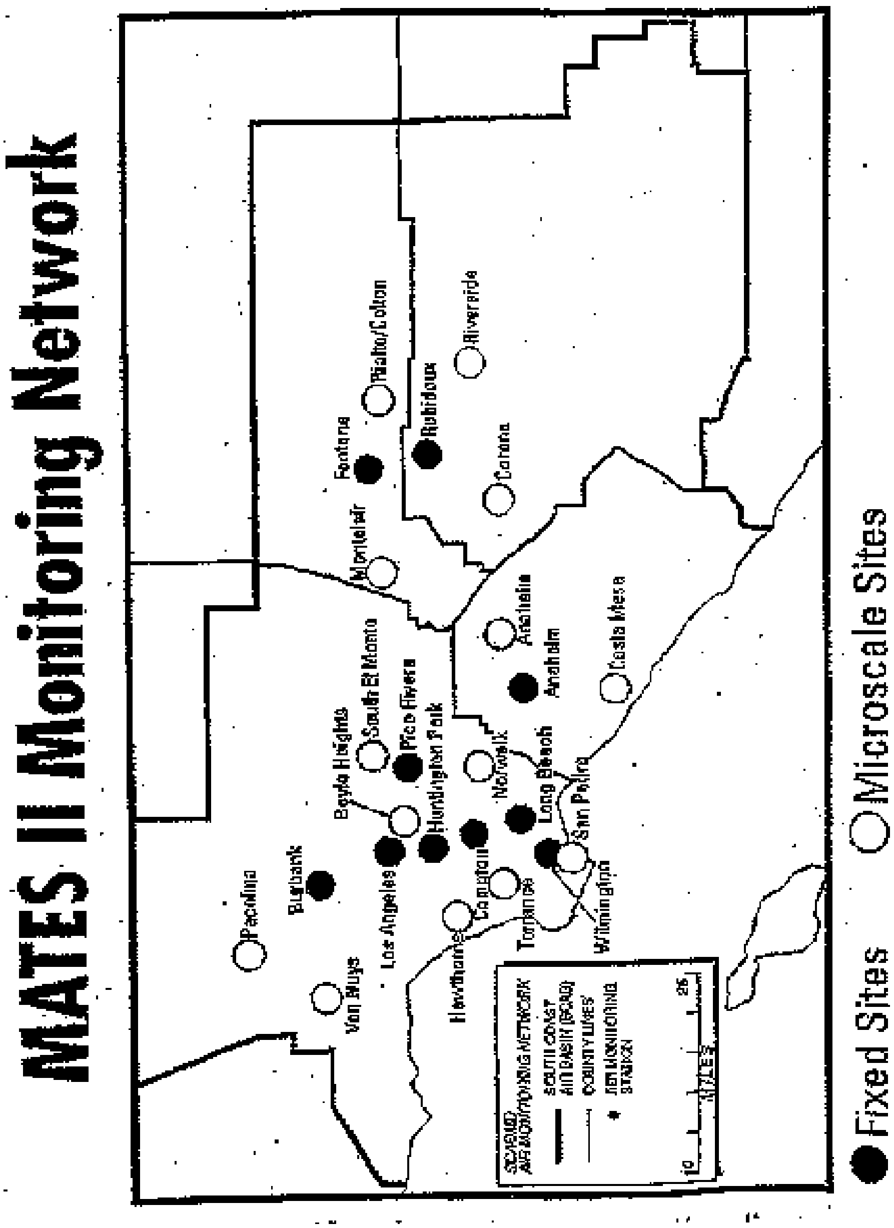


Figure ES-1. Map of MATES - II Monitoring Locations

3) The sites with the greatest risk levels were in the south-central and east-central portions of Los Angeles County. At these locations, the dominance of mobile sources is even greater than at other sites. The sites with the lower risk levels were mostly in the other three counties. (See Figure ES-3, top and middle.)

4) The differences in carcinogenic risk from one site to another are much more driven by the influence from mobile sources than from stationary sources. (See Figure ES-3, top and middle.)

5) The carcinogenic risk from one site to another, as ascribed to stationary sources, is rather uniform across the Basin. In this respect, there is not much difference among the four county sites. (See Figure ES-3, bottom.)

6) There are strong seasonal variations to the levels of toxic air contaminants, primarily with those pollutants associated with mobile sources. Elemental carbon (a surrogate for diesel particulates), benzene, and butadiene -- all have seasonal peaks in the late fall and winter months. Lowest levels are observed during the spring and summer months. (See Figure ES-4, top.)

7) The seasonal variations with respect to toxic air contaminants from stationary sources are generally small. Levels are quite consistent across all months of the year. (See Figure ES-4, bottom.)

8) Levels of risk are, for the most part, consistent with the long-term downward trends evident in the ARB data since 1990. Noticeable improvements have occurred for three major elements of toxic risk: hexavalent chromium, benzene, and butadiene. (Note: trends for diesel particulates are not available from the ARB data, however, elemental carbon trends recently reported by Christoforou, et al., (2000) indicate a decrease of about 32% from the early 1980's to the early 1990's.)

B. Modeling

1) Model results show similar ~~average~~ levels of carcinogenic risk across the Basin as does the monitoring data. Models also show the strong domination of mobile sources contributing to risk.

2) The model results, which are more complete in describing risk levels across the Basin than is possible with the monitored data, show that the higher~~est~~ risk levels occur in the south-central Los Angeles area, in the harbor area, and near freeways. (See Figure ES-5.)

3) Results suggest that the ~~average basin~~ basinwide cancer risk level may be 16~~7~~ percent lower than the ~~average~~ corresponding risk levels estimated from the monitoring sites.

4) Results show that the higher pollutant concentrations generally occur near their emission sources.

5) Models generally underestimate measured values. It is estimated that model performance would improve with the latest versions of the mobile source emission models provided by the California Air Resources Board.

Microscale Program

1) With few exceptions, the monitoring at each of the 14 microscale sites did not register ~~abnormally~~ significantly higher levels of any toxic air contaminants. However, it cannot be concluded that "hot spots" do not exist at other locations.

2) ~~An abnormally~~ Significantly higher levels of styrene (not~~not considered to be~~ currently assigned a carcinogenic risk factor, but ~~one~~ a pollutant which was measured as part of the laboratory analysis) was observed at the Anaheim microscale site. This finding is corroborated by an examination of local emissions inventories which found three facilities that emit styrene to be close to the monitoring site. This illustrates that local "hot spots" do occur.

3) ~~Abnormally~~ Significantly higher levels of formaldehyde were measured at the San Pedro microscale site. The nature of the measurements, showing decreasing levels of formaldehyde over time, and insensitivity of such levels to changes in wind directions, suggest an instrument contamination problem as the cause for this observation.

4) Even at microscale sites, the risk impacts are dominated more by mobile sources than by stationary sources. For only two sites (Torrance and Costa Mesa) are stationary sources more dominant than mobile sources. At these sites, they do not necessarily have higher stationary source emissions, rather there is a noticeable decrease in the levels of toxic air contaminants from mobile sources.

5) Levels of toxic air contaminants associated with stationary source emissions are reasonably uniform among the microscale sites, consistent with the findings from the fixed site locations.

6) Facility-based modeling conducted as part of the permitting process shows that highest levels of toxic air contaminants can occur very close to the fence-line of facilities. Due to logistical constraints in placing mobile monitoring platforms, ~~L~~locations other than where the microscale platforms were located could therefore have higher levels than at the microscale monitoring sites.

Caveats and Risk Uncertainty

1) There is currently no technique to directly measure diesel particulates, the major contributor to basinwide carcinogenic risk. Based on research results as reported by ARB, diesel particulates can be estimated by measuring elemental carbon, a black, sooty particulate. In essence, elemental carbon becomes a surrogate for diesel particulates. Although this estimating technique is likely to have uncertainties, the emissions inventory and modeling, which account for directly emitted diesel particulates, confirm that diesel particulates are the major contributor to carcinogenic risk.

2) The determination of risk values for each compound carries a level of uncertainty, which, for some pollutants, is large. Typically, the risk values are derived from animal or epidemiological studies of exposed workers or other populations. Uncertainty occurs from the application of individual results to the general population. When risk factors for specific compounds are determined, levels are usually established conservatively. There is considerable debate on appropriate risk values, and often the levels established by the USEPA and CalEPA differ. For the purpose of this study, California values are used.

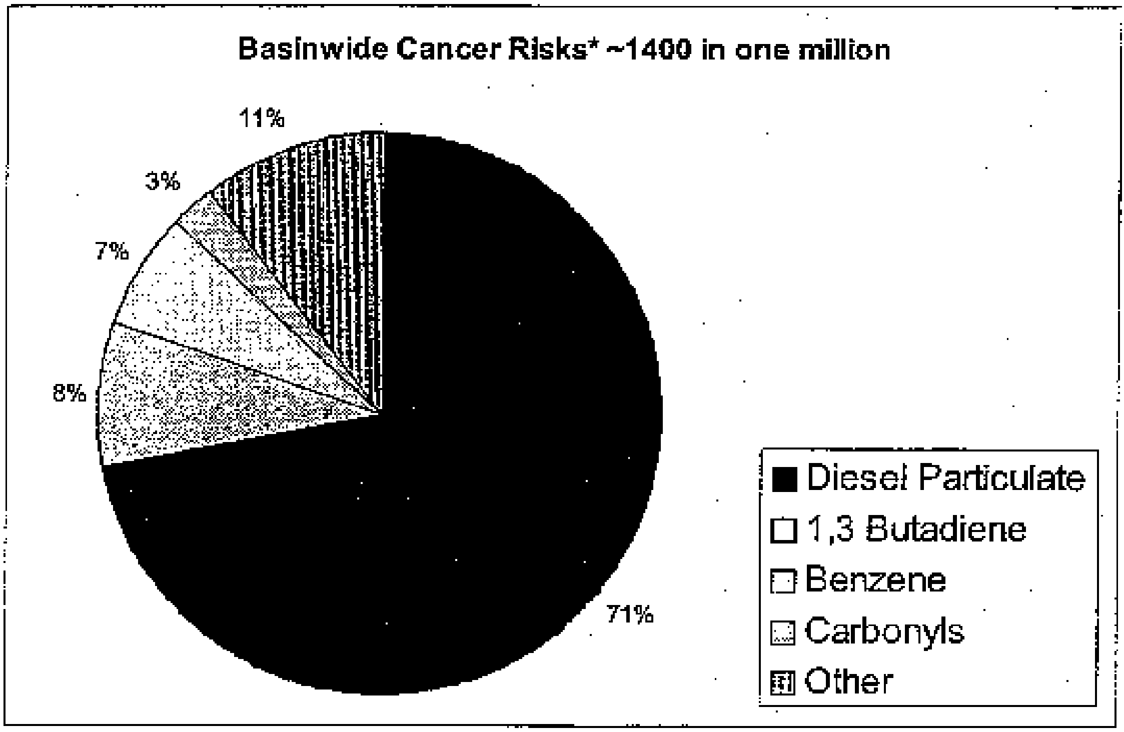
3) There is further debate as to the appropriate levels of risk ascribed to diesel particulates. CalEPA, in recommending a cancer risk level of 300 in a million per microgram per cubic meter (ug/m^3) of diesel particulates, considered evidence which suggested diesel risks as low as 150 in a million to as high as ~~1,500~~ 2,400 in a million per ug/m^3. The USEPA has not yet declared diesel particulates as a toxic air contaminant. Thus, the selection of a risk factor for diesel particulates can have a substantial effect in assessing overall risks; however, ~~it~~even using the lowest bound of the CalEPA-recommended risk factor (150 in a million) does not change diesel's domination in the overall risks. For purposes of this study, and to be consistent with the approaches used for other toxic pollutants, the CalEPA recommended value of 300 in a million per ug/m^3 is used.

4) There is an estimated uncertainty level of ± 25 percent associated with laboratory measurements of many toxic compounds. Part of this uncertainty is attributed to the fact that many of the toxic compounds measured are at extremely low concentration levels, at parts per billion (ppb) levels, and often near the detection limits of the instrumentation. A number of compounds cannot be detected at all. When non-detections occur, it is assumed that the actual levels are not zero, but are half of the instrument detection limit. In other words, if the detection limit is 1 ppb, and a compound is not detected at that level, it is assumed that the actual concentration is one-half of 1 ppb. This convention has been in use by the Air Resources Board since the reporting of monitored toxics in the state commenced in 1990. This convention allows the vast majority of the data users to statistically manage the data. Other methods of handling non-detects are often difficult to implement or offer no practical advantage. The method is a conservative one that protects the public when analytical shortcomings cannot address real emissions that are known to exist. Although this convention is not in regulation forma ~~codified policy~~, it is considered at this time to be the best available tool for

addressing concentrations of pollutants where current laboratory technologies cannot yet detect such low levels, and at the same time treating public safety concerns. As a sensitivity test, it was assumed that non-detect values were zero for those pollutants which had a predominance of non-detections. Under such an assumption, the overall risk values would have been lowered by 4.6%.

Figure ES-2

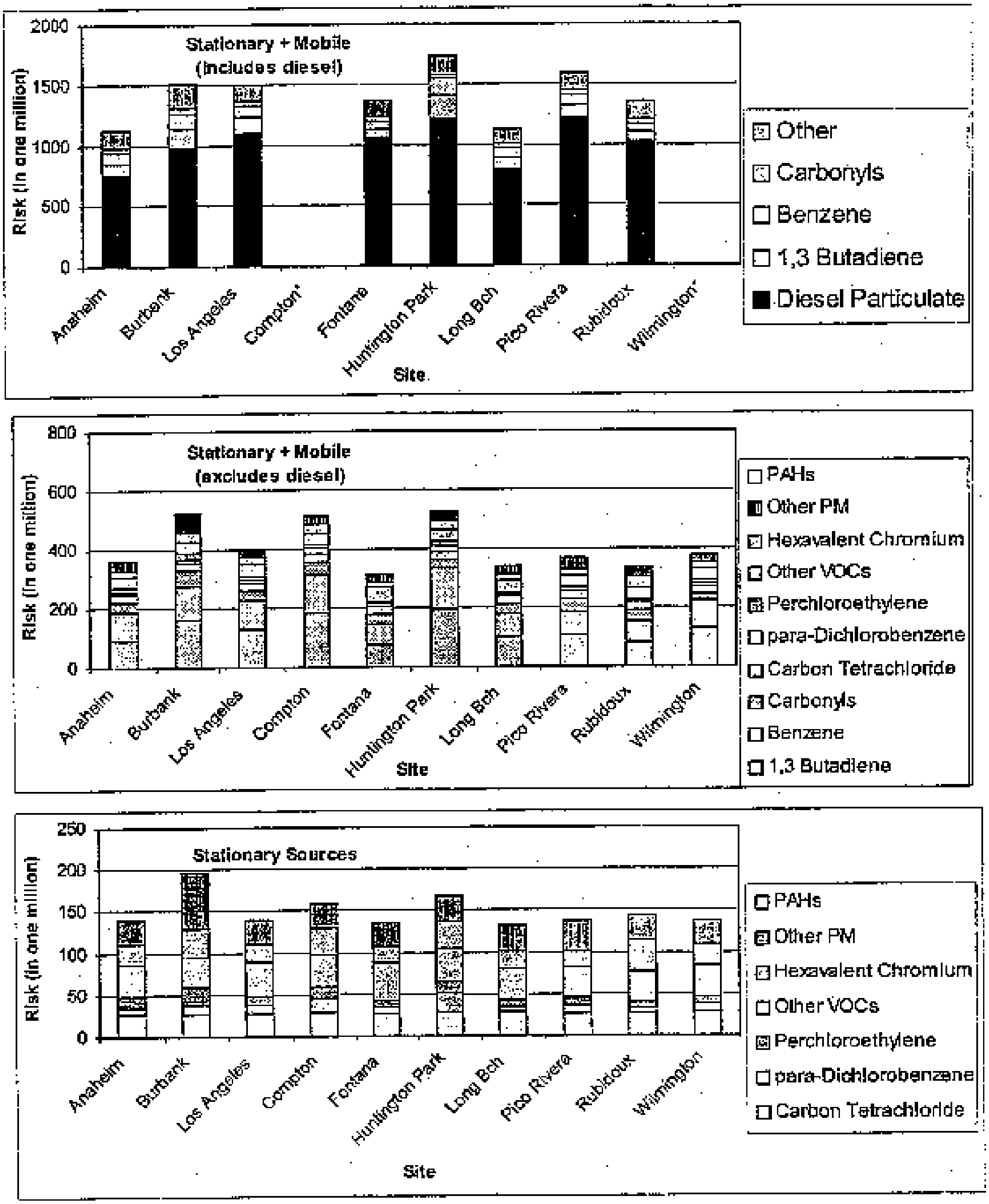
Major Pollutants Contributing to Cancer Risk In the South Coast Air Basin



*Based on the average of the pollutant concentrations measured at the fixed monitoring sites.

Figure ES-3
Cancer Risks at the MATES-II Fixed Sites

Risks are shown for all sources including diesel particulates (top), all sources excluding diesel particulates (middle), and stationary sources (bottom).



* No Elemental Carbon Measured

Figure ES-4

Monthly Variation in Cancer Risks for all Sources Including Diesel Particulates (top) and for Stationary Sources (bottom)

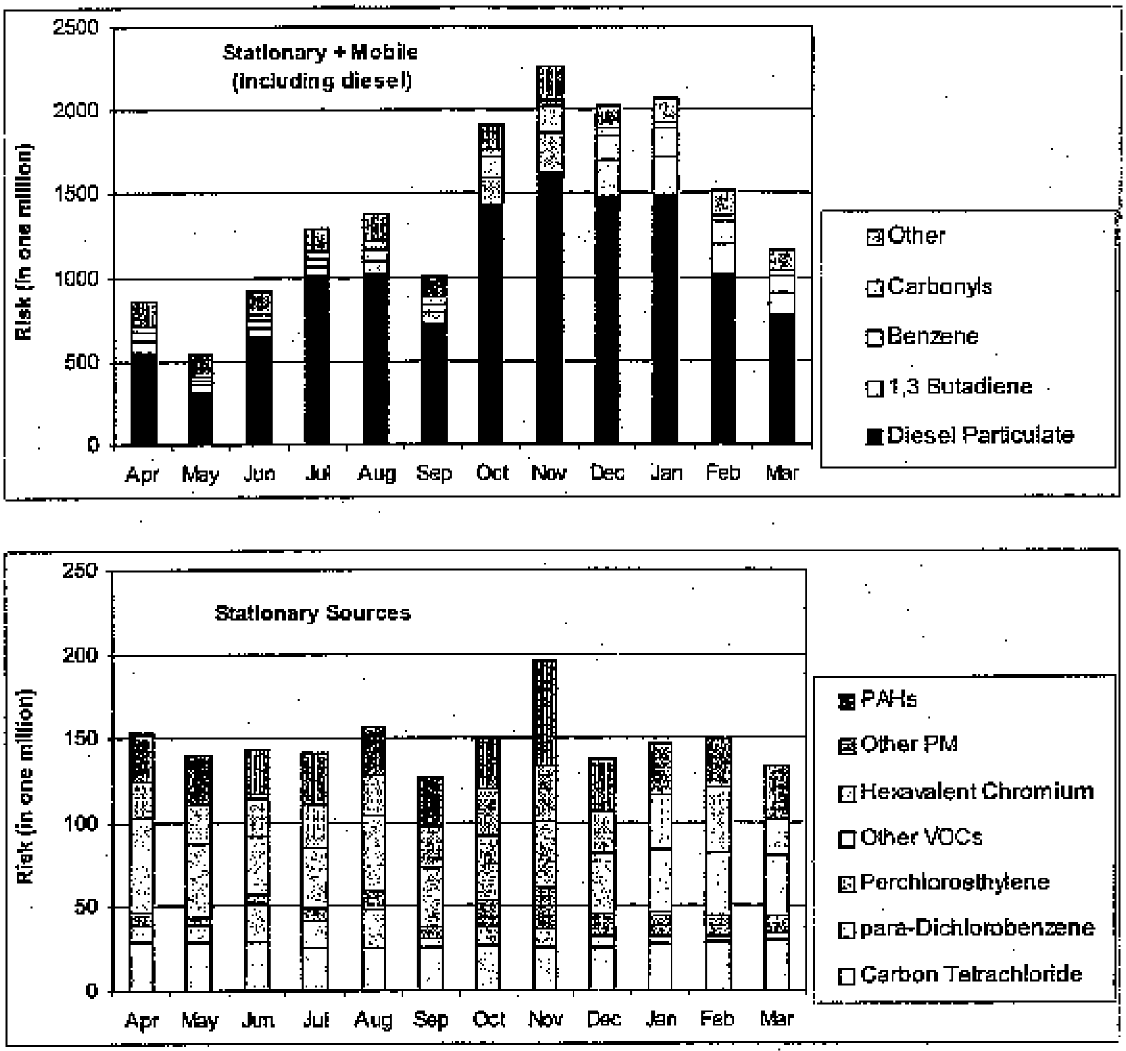
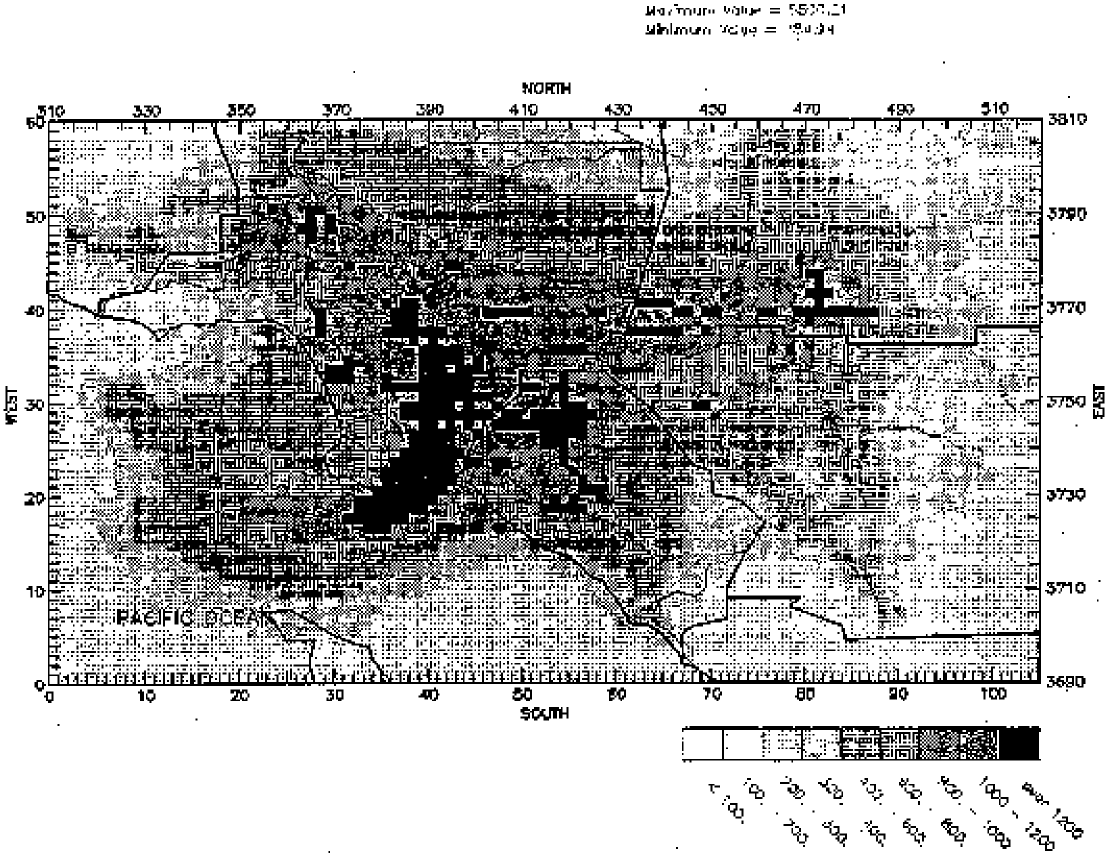


Figure ES-5

Model Estimated Risk for the Basin

(Numbers in a million, all sources.)



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FORWARD

The Final MATES-II report addresses comments received since the release of the draft document. Changes to text are given with underline and strikeout for ease of noting the changes made. Also, the following tables and figures have been revised:

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Finally, Chapter 9 has been added to the report to provide a summary of the comments received and the AQMD staff's responses to those comments.

Chapter 1

Introduction

At its October 10, 1997 meeting, the SCAQMD Governing Board directed staff to conduct a major air toxic evaluation program, referred to as MATES II (Multiple Air Toxics Exposure Study) to quantify the current magnitude of population exposure risk from existing sources of selected air toxic contaminants. This program was more comprehensive than a similar study conducted over a decade ago in MATES I, in that more sites were sampled, more toxic compounds were analyzed, and other elements such as microscale modeling were also incorporated into the study. The AQMD conducted this study in three parts addressing; (1) Air Toxic Monitoring;÷ (2) Air Toxic Emissions Inventory Enhancements; and (3) Air Toxic Modeling and Risk Assessment.

Air Toxic Monitoring

The Air Toxic Monitoring portion of the program includes two key elements: 10 fixed sites characterizing neighborhood - scale considerations over a one-year period and a complementary microscale study using three mobile platforms to sample for one month at each of 14 additional locations. The microscale sites were selected to reflect potential localized influences of toxic emitting sources near residential neighborhoods. Sampling began in April 1998 and concluded in the middle of June 1999. Over 4,500 air samples were collected for analysis. Both AQMD and the California Air Resources Board (ARB) laboratories cooperatively shared the analytical burden. Chapter 3 discusses in further detail the monitoring element of the study. Also shown in the chapter are carcinogenic risks at the various sampling locations tallied from the measured toxic concentrations.
The carcinogenicity of different compounds, used to determine carcinogenic risk, is determined by both the U. S. Environmental Protective Agency (USEPA) and by the office of the California Environmental Protection Agency (CalEPA) through a very comprehensive and lengthy process. The District uses the unit risk factors (URF) developed by the CalEPA in calculating risk for various programs. This component of the methodology is especially important in the case of diesel particulate, which has been recently identified as a toxic air contaminant (TAC) by CalEPA. Appendix I-A contains the URF for various compounds. A brief discussion on the uncertainties associated with risk calculations is included in Chapter 3.

Air Toxic Emissions Inventory Enhancement

The emissions inventory update included the analysis of all sources of toxic emissions from a regional point of view (point, area, and mobile sources); plus the considerations of microinventories around each of the 14 -microscale sites. Significant efforts were made to spatially allocate emissions for gasoline service stations, perchloroethylene dry cleaning operations, and chrome-plating operations. Lastly, the diesel particulate emission inventory for the South Coast Air Basin (Basin) was improved by identifying additional sources, other than on-road diesel engines. The emission inventory methods and results are presented in Chapter 4.

Air Toxic Modeling

Two- and three-dimensional fields of the necessary meteorological variables were developed using the meteorological model called CALMET for the fixed site sampling period, April 1998 to March 1999. Air quality dispersion modeling was performed using the Urban Airshed Model (UAM), the model used for ozone air quality analysis. Model performance was evaluated for the individual compounds at the ten fixed monitoring sites. From the model-simulated concentration fields, carcinogenic risks were totaled from the individual compound risks using the CalEPA unit risk factors and shown spatially for the Basin. In addition, to quantify local impacts of –major industrial activities upwind of residential areas, microscale modeling was conducted at 10 microscale sites. The methods and results of the air quality modeling and risk assessment are discussed and shown in Chapter 5.

To provide guidance through the development of MATES II, the AQMD established an Air Toxics Study Technical Review Group (ATSTRG) that included experts in air monitoring, toxic emissions inventories, –modeling, and risk assessment. The objective of the ATSTRG was to provide technical guidance to the AQMD. Table 1-1, and ~~A~~aAppendix I-B contains the names of the members of the ATSTRG.

This report provides technical information on various elements of sampling techniques; emissions inventory methodologies for regional and local purposes; and risk analysis based on toxic air quality data collected from fixed sites and microscale sites; as well as regional and microscale air toxic modeling. Numerous appendices contain the detailed technical information that may be of interest to specific audiences.

Table 1-1
Air Toxics Study Technical Review Group
Member List

Member Name:	Affiliation:
Dr. Robert Blaisdell	Cal EPA Office of Environmental Health Hazard Assessment
Dr. Steve Colome	IES/CES
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Chapter 2

Historical Trends in Toxic Air Contaminants and Associated Cancer Risks in the South Coast Air Basin and Vicinity

This chapter is a brief summary of the historic trends in toxic air contaminants and associated cancer risks in the South Coast Air Quality Basin. More detailed discussions are provided in Appendix II.

2.1 Summarized Highlights

- As a result of numerous State and District regulations, concentrations of 1,3 butadiene, benzene, carbon tetrachloride, methylene chloride, perchloroethylene, trichloroethylene, hexavalent chromium, lead, and nickel have been reduced significantly in the Basin.
- These reductions in toxics exposure have resulted in 44 to 63 percent reductions in carcinogenic risk to residents of the Basin since 1990.

2.2 Discussion

From 1986 to 1987, the District conducted a Multiple Air Toxics Exposure Study (MATES) to determine the Basin-wide risks associated with major airborne carcinogens. Integration of measured ambient concentrations, population distribution, and health risk data for individual chemical species constituted a method of estimating regional inhalation exposure, risk, and number of potential excess cancer cases. Of the 20 air toxics studied, benzene emissions and hexavalent chromium appeared to have had the greatest potential impact on the Basin's population at that time. The ARB has maintained a network of six monitoring stations in Southern California since the late 1980s to measure selected gaseous organic and toxic metal compounds. Examining this rich historical data set provides perspective for the current monitoring and modeling efforts of MATES-II.

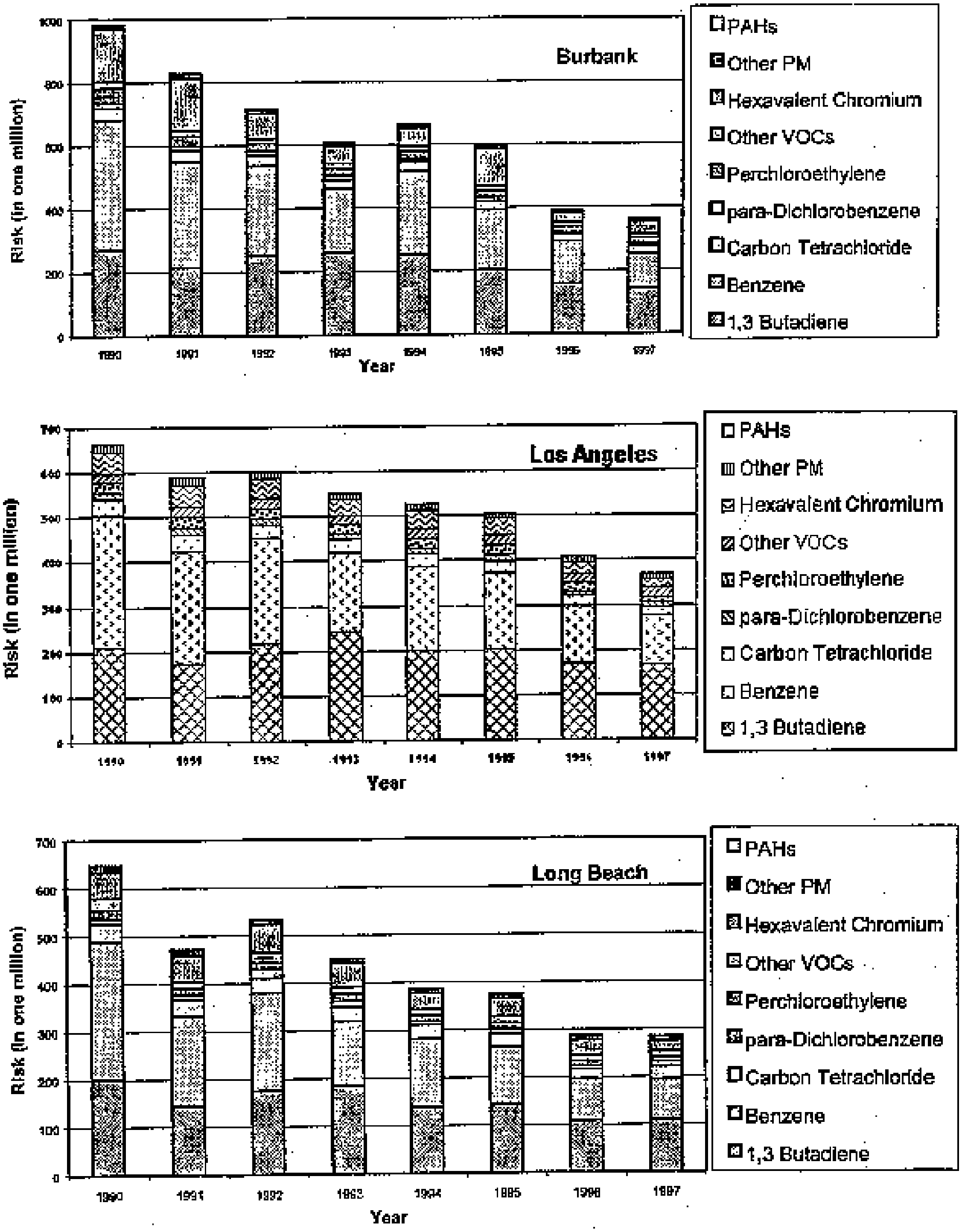
The trends in cancer risks for the six stations are shown in Figure 2-1. The methods used to prepare this figure are discussed in Appendix II. Cancer risks are itemized by the six most important TACs and three lumped categories category called "Others." Diesel particulates which are now considered carcinogenic but not measured in the past, are not included in this analysis. Cancer risks have decreased significantly at all stations since 1990. Specifically, risks have decreased by 63, 44, 56, 48, 56, and 48 percent at Burbank, Los Angeles, Long Beach, Rubidoux, Simi Valley, and Upland, respectively. The improvement is primarily from reductions in benzene and 1,3-butadiene concentrations (70 to 80 percent) and secondarily from decreases in hexavalent chromium concentrations (8 to 20 percent).

Figure 2-2 compares the cancer risks from MATES-I and MATES-II. The MATES-I measurement program took place from May 1986 to April 1987, whereas the MATES-II measurement program was conducted from April 1998 to March 1999. Three stations are common to both studies and they are Los Angeles (LA), Long Beach (LB), and Rubidoux (RU). Only pollutants common to both sampling programs are shown in Figure 2-2. In addition, cadmium and ethylene dibromide are eliminated in the comparison since their detection limits are significantly different between the studies. The data from MATES-I are taken from Tables 4-1 and 4-2 of the MATES-1 report (SCAQMD 1988). Cancer risks since MATES-I have decreased by 76, 73, and 55 percent at Los Angeles (LA), Long Beach (LB), and Rubidoux (RU), respectively.

Figure 2-3 shows the network means for various TACs for each year along with the 90 percent confidence intervals. Statistically significant reductions in mean concentrations have occurred over the period 1990 to 1997 for 1,3 butadiene, benzene, ~~carbon tetrachloride,~~ methylene chloride, perchloroethylene, trichloroethylene, hexavalent chromium, lead, and nickel. Numerous State and District regulations, such as the Low Emissions Vehicle (LEV) Program, the Toxic Hot Spot (AB2588) Program, reformulated fuels, and- Regulation XIV have contributed to these significant improvements.

Figure 2-1

Trends in Cancer Risk in the South Coast Air Basin and Vicinity



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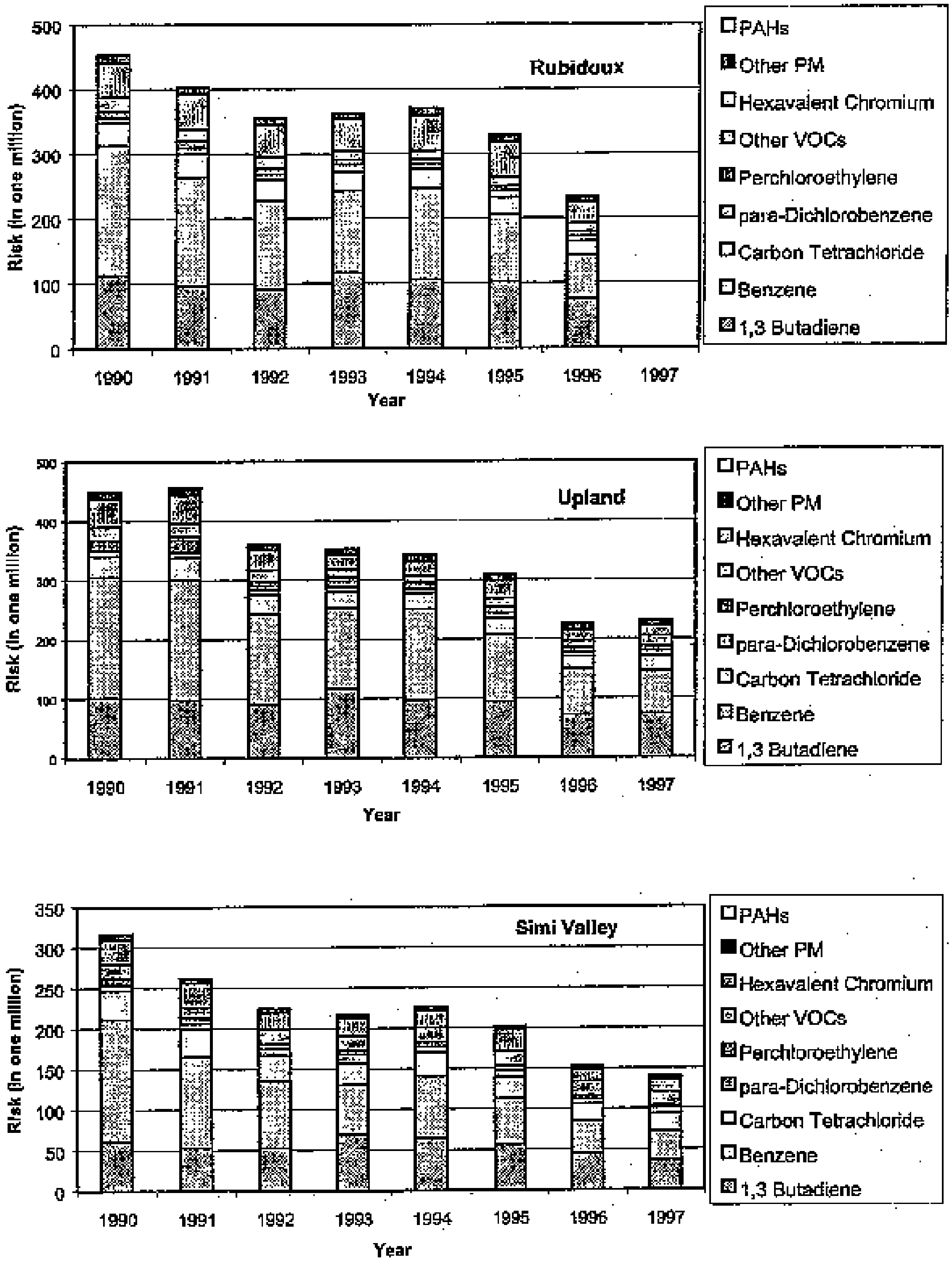


Figure 2-2

Comparison of Cancer Risks from MATES-I and MATES-II Measurements

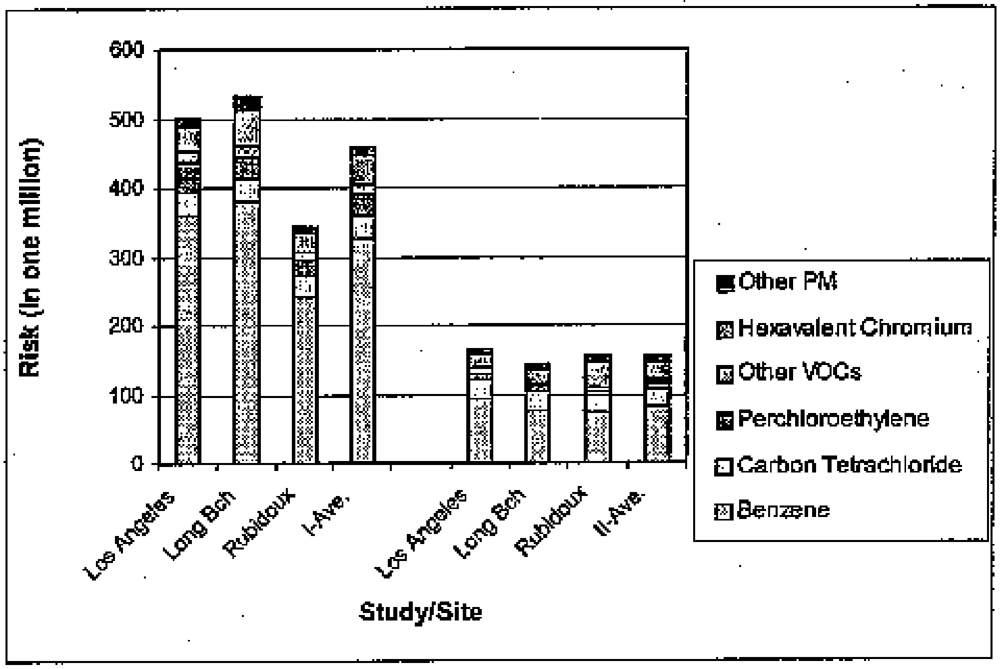
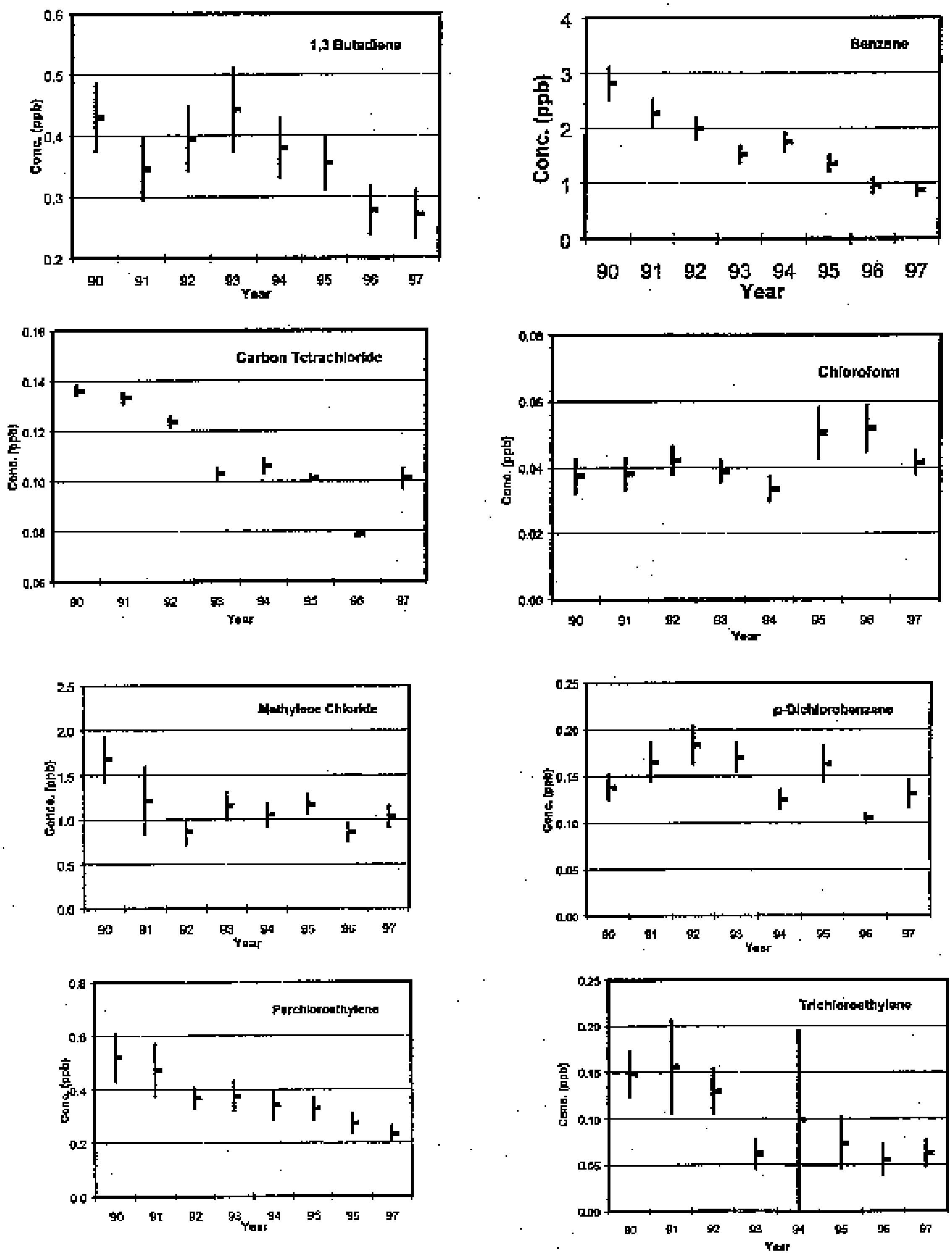


Figure 2-3

Trends in Selected Toxic Air Contaminants

Tick mark represents the mean; bars represent the 90 percent confidence interval about the mean.



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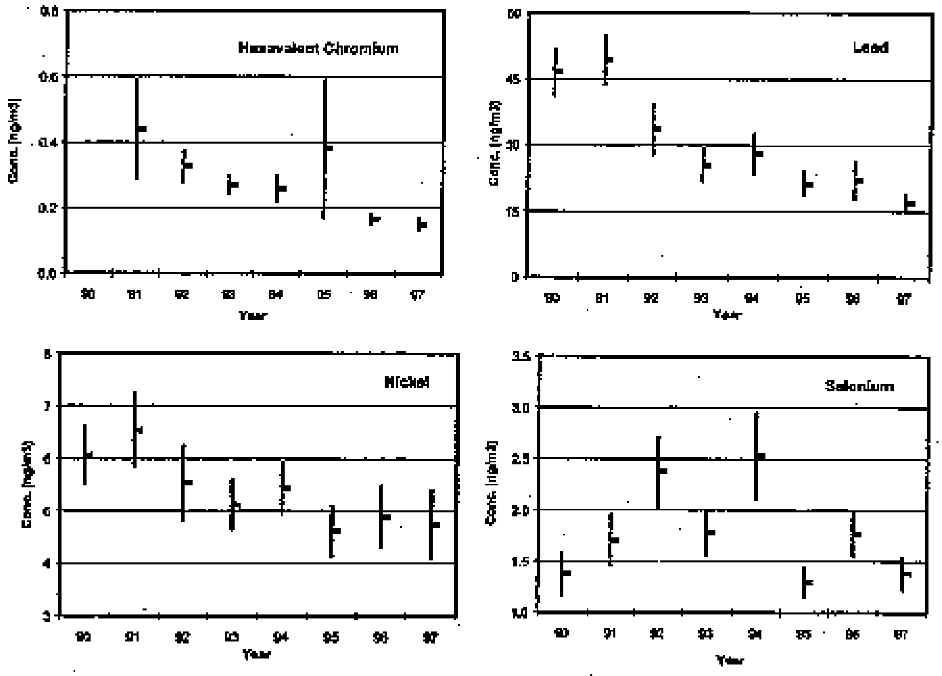


Chapter 3
MATES II Monitoring Program

The monitoring portion of MATES-II was designed to measure numerous air toxic compounds at different locations in the Basin in order to establish a baseline of existing air toxic ambient concentrations, as well as risk level data, and to assist in the assessment of modeling performance accuracy. Ten sites were selected and air samples were collected for up to one year.

3.1 Site Location and Monitoring

With the input from ATSTRG and the Environmental Justice Task Force, ten MATES-II sites were selected. Five were selected to provide continuity with the ARB long-term trend sites (Los Angeles, Burbank, Long Beach, Rubidoux and Upland/Fontana). The Pico Rivera site was selected because monitoring equipment was available from the EPA-sponsored PAMS program. Anaheim was chosen for geographic equity, such that at least one site existed in each of the four counties. Wilmington, Compton, and Huntington Park were new sites selected to examine environmental justice concerns. Because the fixed site locations are based on EPA guidelines for "neighborhood scale" monitoring, each of these sites may also be representative of adjacent communities. Table 3-1 and Figure 3-1 shows the location of the monitoring sites.

Table 3-1
MATES II Sites

Abbr.	Site	Period of Record	Address
Fixed MATES II Sites			
AN	Anaheim	4/29/98 – 3/25/99	1010 S. Harbor Blvd., Anaheim
BU	Burbank	4/05/98 – 3/31/99	228 W. Palm Ave., Burbank
CP	Compton	7/22/98 – 3/31/99	720 N. Bullis Rd., Compton
FO	Fontana	4/05/98 – 3/31/99	14360 Arrow Highway, Fontana
HP	Huntington Park	6/10/98 – 3/31/99	6301 S. Santa Fe Ave., Huntington Park
LB	Long Beach	4/05/98 – 3/31/99	3648 N. Long Beach Blvd., Long Beach
LA	Los Angeles	4/05/98 – 3/31/99	1630 N. Main St., Los Angeles
PR	Pico Rivera	4/23/98 – 3/31/99	3713 B-San Gabriel River Parkway, Pico Rivera
RU	Rubidoux	5/29/98 – 3/31/99	5888 Mission Blvd., Rubidoux
WI	Wilmington	7/31/98 – 3/31/99	900 E. Lomita Blvd., Wilmington

At each site, sampling equipment included particulate samplers; canisters; and carbonyl samplers, as well as equipment to measure key meteorological parameters. At the five long-term trend sites, monitors also measured ozone, oxides of nitrogen, and carbon monoxide. The ARB and AQMD shared the responsibility of performing laboratory analyses for VOCs and particulates. All polycyclic aromatic hydrocarbon (PAH) samples were analyzed by ARB; all carbon analyses (elemental and organic) were conducted by AQMD. Appendix III-A contains a detailed description of the analytical methods used.

Sampled compounds are listed in Tables 3-2 and 3-3. The first table shows those compounds that were measured on a routine basis, while Table 3-3 depicts those compounds that were sampled on a more limited basis, if their presence were suspected from nearby sources. (A careful screening process was established to determine the listings in Tables 3-2 and 3-3. Unit risk factors, prior data, and analytical capabilities were considered from an original candidate list which included all state and federally designated toxic air contaminants. A subgroup of the ATSTRG was formed to consider these factors, from which the final lists were derived.)

The sampling schedule followed the USEPA National Air Monitoring schedule for particulate matter which is once every six days for a twenty-four hour period from midnight to midnight.

3.2 Findings

Results of the data focus on the following key topics:

- intersite comparison of ambient toxic concentrations and cancer risks among the ten fixed sites,
- seasonal variability of ambient toxic concentrations, and
- comparison of species and source apportionment of cancer risk among the sites.

Table 3-2
Routinely Measured Compounds

CAS No.	Chemical Name	CAS No.	Chemical Name
71432	Benzene	50000	Formaldehyde
7440439	1,3 Butadiene	75070	Acetaldehyde
106467	Dichlorobenzene (ortho- & para)		Acetone
75014	Vinyl Chloride	7440382	Arsenic
10414	Ethyl Benzene		Chromium
	Toluene	7439921	Lead
	Xylene (m-, p-, o-)	7440020	Nickel
	Styrene		Cobalt
56235	Carbon Tetrachloride		Copper
67663	Chloroform		Manganese
75343	Dichloroethane [1,1]	7723140	Phosphorous
	Dichloroethylene [1,1]		Selenium
75092	Methylene Chloride		Silica
127184	Perchloroethylene		Silver
79016	Trichloroethylene		Zinc
74783	Chloromethane		PAHs
			Elemental & Organic Carbon

Table 3-3
Compounds Considered for Measurement Based on Local Factors

Compound	Compound
Acrylonitrile	Dioxins & Furans
Di(2-ethylhexyl)phthalate	Asbestos
Glycol Ethers	Fine Mineral Fibers
Toluene-2,4-diisocyanate	BaP
Toluene-2,6-diisocyanate	

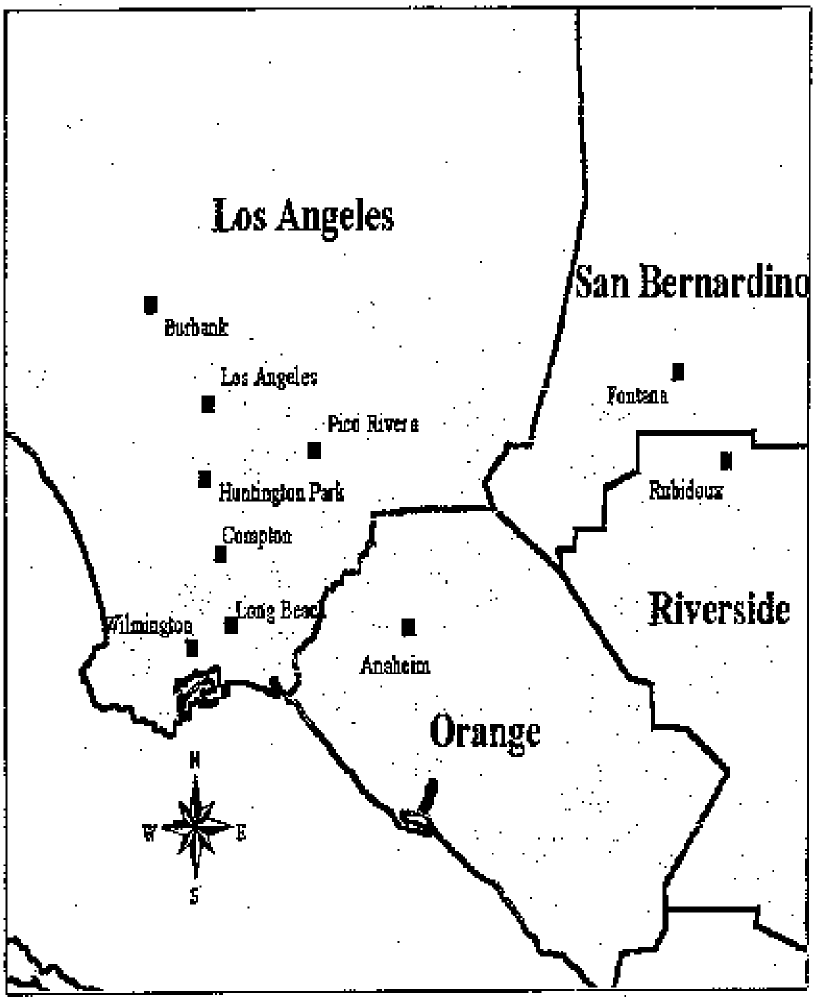


Figure 3-1
Location of MATES II Sites

3.2.1 Intersite Comparison Concentrations

Figure 3-2 compares mean concentrations for each site along with its 10th and 90th percentile confidence intervals for the important carcinogenic compounds measured.

The charts for 1,3-butadiene and benzene show that the spatial patterns for the two pollutants are highly correlated. That is, peaks for both pollutants occur at Compton and Huntington Park and minimum values occur at Anaheim, Fontana, Long Beach, Pico Rivera, and Rubidoux. These differences are statistically significant and understandable since 1,3 butadiene and benzene are both products of on-road vehicles.

The spatial pattern of carbon tetrachloride is flat, as concentrations over the ten sites vary by only ten percent. In addition, observed 1995 annual concentrations of carbon tetrachloride at Santa Barbara and Chula Vista, sites well outside the South Coast Air Basin, are 0.10 ppb (ARB, 1999). This is in the range of values observed at the ten sites shown here. This ~~implies~~ shows that ~~there any is no~~ local source influences of carbon tetrachloride have ~~and that the observed concentrations are~~ essentially been reduced to near background conditions.

Huntington Park and Compton have higher p-dichlorobenzene concentrations relative to the other eight sites. Ambient styrene concentrations at Anaheim are, on average, more than twice the levels measured at the other nine sites. This implies local sources of p-dichlorobenzene at Compton and Huntington Park, and of styrene at Anaheim. The large variability in the data at Huntington Park and Anaheim indicate that the source (or sources) are proximate to the monitor such that on some sampling days the wind directs the emissions to the monitor and on other days the emissions are directed away from the monitor. Further analyses identified three major sources of styrene upwind of the monitoring site at Anaheim.

Peak perchloroethylene concentrations occur at Burbank and minimum concentrations occur at Fontana, Long Beach, Pico Rivera, and Rubidoux. Trichloroethylene concentrations at the Los Angeles site are two to six times greater than the concentrations measured at the other nine sites. Trichloroethylene concentrations at Anaheim are also elevated relative to Burbank, Compton, Fontana, Huntington Park, Long Beach, Pico Rivera, and Rubidoux. These differences are statistically significant at the 90 percent confidence level.

Formaldehyde and acetaldehyde are both primarily directly emitted and secondarily formed via chemical reactions in the atmosphere, with the principal source of formaldehyde, acetaldehyde, and their precursors being on-road mobile sources. The spatial pattern for formaldehyde and acetaldehyde is similar, which is reasonable given that both pollutants have common sources. Concentrations over the network vary by a factor of two. The downwind sites of Pico Rivera and Rubidoux have relatively high concentrations, which is also reasonable given that formaldehyde and acetaldehyde are secondarily formed.

The pollutants of acetone, methyl ethyl ketone, hexavalent chromium, nickel and selenium each vary over the network by a factor of two to three. Burbank has higher methyl ethyl ketone concentrations than the sites of Los Angeles, Fontana, Huntington Park, Long Beach, and Wilmington; hexavalent chromium is highest at Rubidoux, Compton, Huntington Park, and Burbank; nickel is highest at Huntington Park and Pico Rivera; and selenium is highest at Huntington Park.

Elemental carbon is included in Figure 3-2 since it is treated as a surrogate to diesel particulate matter. Lead and elemental carbon exhibit somewhat similar spatial patterns. Huntington Park and Pico Rivera have the highest concentrations for both pollutants, while Anaheim and Long Beach have the lowest concentrations

3.2.2 Intersite Comparison

Cancer Risk - Uncertainty in Risk Assessment

There are inherent uncertainties in risk assessment with regard to the identification of compounds as causing cancer or other health effects in humans, the cancer potencies and Reference Exposure Levels (RELs) of compounds, and the exposure that individuals receive. It is common practice to use conservative (health protective) assumptions with respect to uncertain parameters. The uncertainties and conservative assumptions must be considered when evaluating the results of risk assessments. The following summarizes major areas of uncertainty and the assumptions used to address them.

Since the potential health effects of contaminants are commonly identified based on animal studies, there is uncertainty in the application of these findings to humans. In addition, for many compounds it is uncertain whether the health effects observed at higher exposure levels in the laboratory or in occupational settings will occur at lower environmental exposure levels. In order to ensure that potential health impacts are not underestimated, it is commonly assumed that effects seen in animals or at high exposure levels could potentially occur in humans following low-level environmental exposure (albeit at a lower rate), unless there is specific evidence to the contrary.

The estimation of cancer potencies and RELs is another major area of uncertainty. Estimates of potencies and RELs are derived from experimental animal studies or from epidemiological studies of exposed workers or other populations. Uncertainty arises from the application of potency or REL values derived from this data to the general human population.

With regard to cancer potencies, if the potency estimate is derived from animal studies, it is common practice by regulatory agencies to use an upper bound estimate of the potency of a compound in order to ensure that risks to humans from a given exposure are not understated. Similarly, the RELs developed by regulatory agencies commonly incorporate safety factors to ensure that they are health protective.

Uncertainty also exists in exposure estimates that are used to estimate risks. The risk assessment procedures used by the District assume that there is no difference between indoor and outdoor pollutant concentrations although such differences may exist. The procedures also assess exposures as though individuals residing in the vicinity of a source remain in this location for a lifetime of 70 years. A different set of exposure assumptions may lead to lower exposure estimates and consequently lower risk estimates.

There is further debate as to the appropriate levels of risk ascribed to diesel particulates. CalEPA, in recommending a cancer risk level of 300 in a million per microgram per cubic meter (ug/m^3) of diesel particulates, considered evidence which suggested diesel risks as low as 150 in a million to as high as ~~1,500~~2,400 in a million per ug/m^3. The USEPA has not yet declared diesel particulates as a toxic air contaminant. Thus, the selection of a risk factor for diesel particulates can have a substantial effect in assessing overall risks; however, ~~it~~even using the lowest bound of the CalEPA-recommended risk factor (150 in a million) does not change diesel's domination in the overall risks. For purposes of this study, and to be consistent with the approaches used for other toxic pollutants, the CalEPA recommended value of 300 in a million per ug/m^3 is used.

Despite its inherent uncertainties, risk assessment remains the most useful tool available for estimating the potential health risks due to low-level environmental exposures measuring progress, and comparing between various locations. Several agencies are undertaking efforts to further refine the risk assessment process.

3.2.3 Intersite Comparison

Cancer Risk

The total carcinogenic risks for the ten fixed sites are shown in Figure 3-3 (top chart). Two other charts are shown in the figure: one shows the risks from pollutants associated with mobile sources (middle chart, excluding diesel) and the other shows the risks from pollutants associated with stationary sources (bottom chart). Cancer risks are itemized by six key TACs (benzene, 1,3-butadiene, hexavalent chromium, carbon tetrachloride, perchloroethylene, and para-dichlorobenzene) and four lumped categories. The lumped category labeled "Carbonyls" consists of formaldehyde and acetaldehyde; the category labeled "Other VOCs" consists of chloroform, ethylene dibromide, ethylene dichloride, methylene chloride, and trichloroethylene; the category called "Other PM" consists of arsenic, beryllium, cadmium, nickel, lead, and selenium; and lastly the category named "PAHs" consists of benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and ideno(1,2,3-cd)pyrene.

As shown in the top part of Figure 3-3, cancer risks over the network vary by nearly a factor of 1.7, ranging from a low of about 310 in one million at Fontana, to a high of about 530 in one million. The higher levels are about the same at Burbank, Huntington Park and Compton. Note that 1,3 butadiene, benzene, and the carbonyls contribute 57 to 69 percent of the risk and as stated earlier the principle source of these toxics is the on-road motor vehicles. Also the risks from mobile sources vary by a factor of 2.0, whereas those from stationary sources vary by a factor of only 1.5. As seen in the bottom of Figure 3-3-, the risks from stationary sources are fairly uniform throughout the MATES II network. In other words, most of the spatial variability observed in the monitoring network is from 1,3 butadiene, benzene, formaldehyde, and acetaldehyde, -pollutants associated with mobile sources.

Figure 3-4 shows total carcinogenic risk including the diesel particulate contribution. The assumed unit risk factor for diesel particulate is 3.0×10^{-4} $(\mu g/m^3)^{-1}$. Research by Gray (1986), which was ~~and~~ used by ARB (1998) in their identification of diesel exhaust as a toxic air contaminant, is used here to estimate diesel particulate concentrations from the elemental carbon concentrations. Gray (1986) showed that approximately 67 percent of the fine elemental carbon mass in the Los Angeles atmosphere comes from diesel engine emissions, and that of all diesel exhaust particles emitted, elemental carbon averaged about 64 percent of this total. Therefore, diesel particulate concentrations are estimated by multiplying the elemental carbon concentrations by 1.04 (67%/64% = 1.04). It should be noted that elemental carbon concentrations were not measured at Compton and Wilmington (due to physical limitations) so Figure 3-4 only shows the total cancer risks at eight of the ten fixed sites. In the figure, "Other" refers to the total contribution from the carbon tetrachloride, para-dichlorobenzene, perchloroethylene, other VOCs, hexavalent chromium, other PM, and PAHs.

The addition of diesel particulate toxicity dramatically increases carcinogenic risk. Risks range from a low of about 1120 in one million at Anaheim and Long Beach, to a high of about 1740 in one million. Those sites with the highest measured risk levels, Huntington Park, Pico Rivera, Los Angeles, and Burbank, are indicative of the urban core area surrounding Downtown Los Angeles. Diesel particulate, 1,3 butadiene, and benzene (all mobile source related) contribute 87 to 91 percent of the risk.

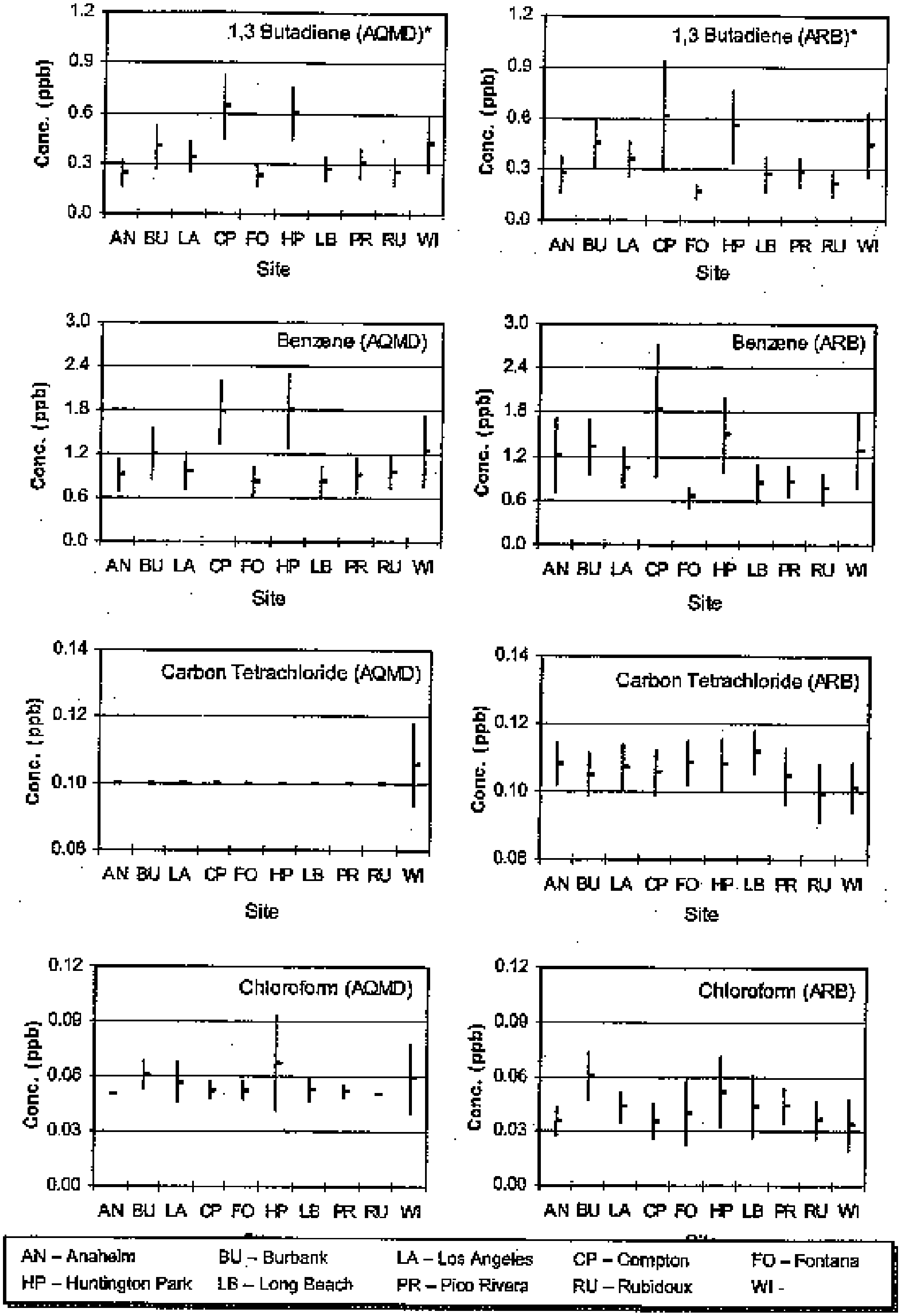


Figure 3-2. Comparison of Concentrations Among MATES-II Sites.
Tick mark represents the mean and the bar represents the 90 percent confidence interval about the mean.
* (AQMD) and (ARB) refer to laboratories conducting analysis.

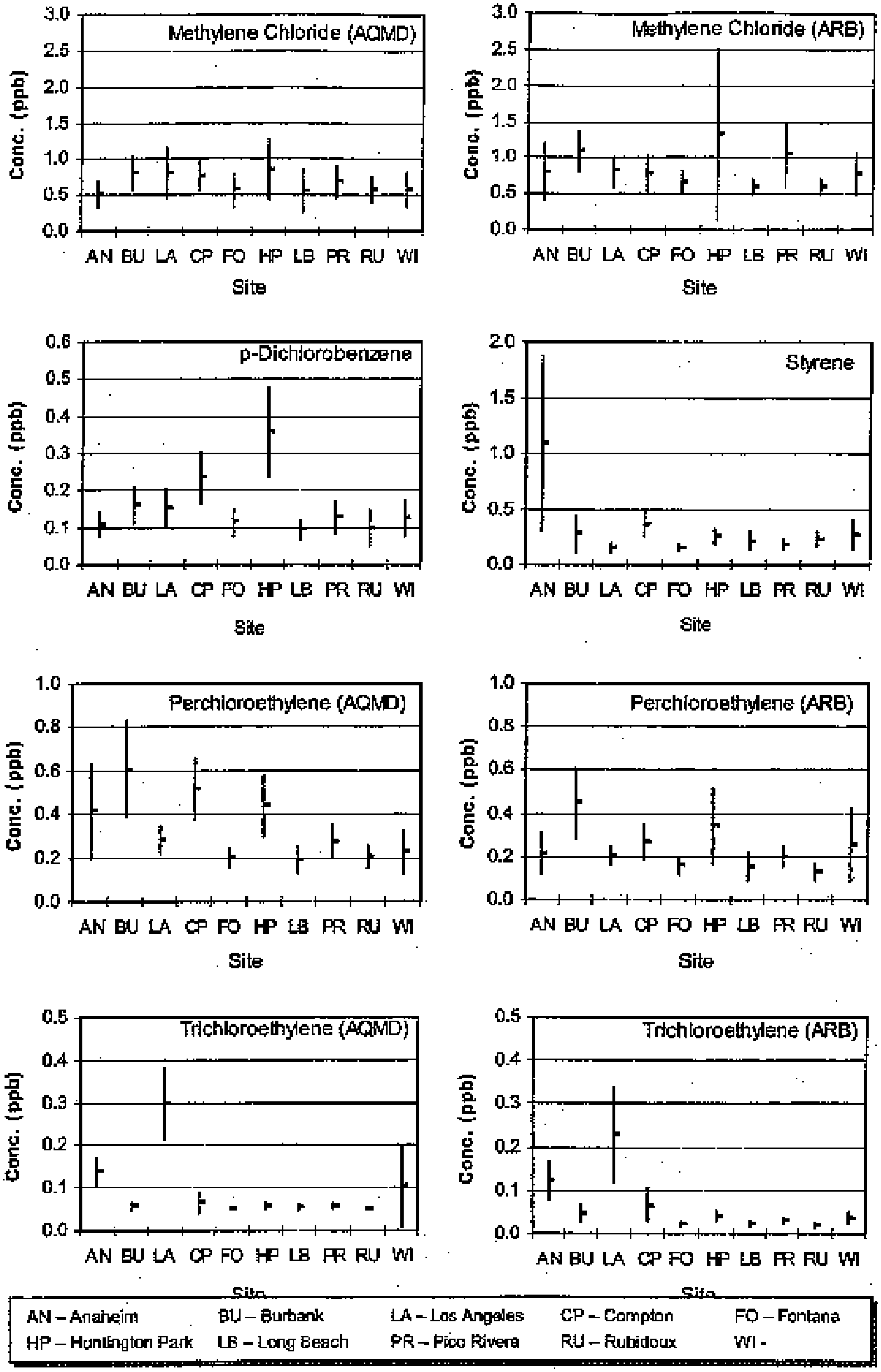
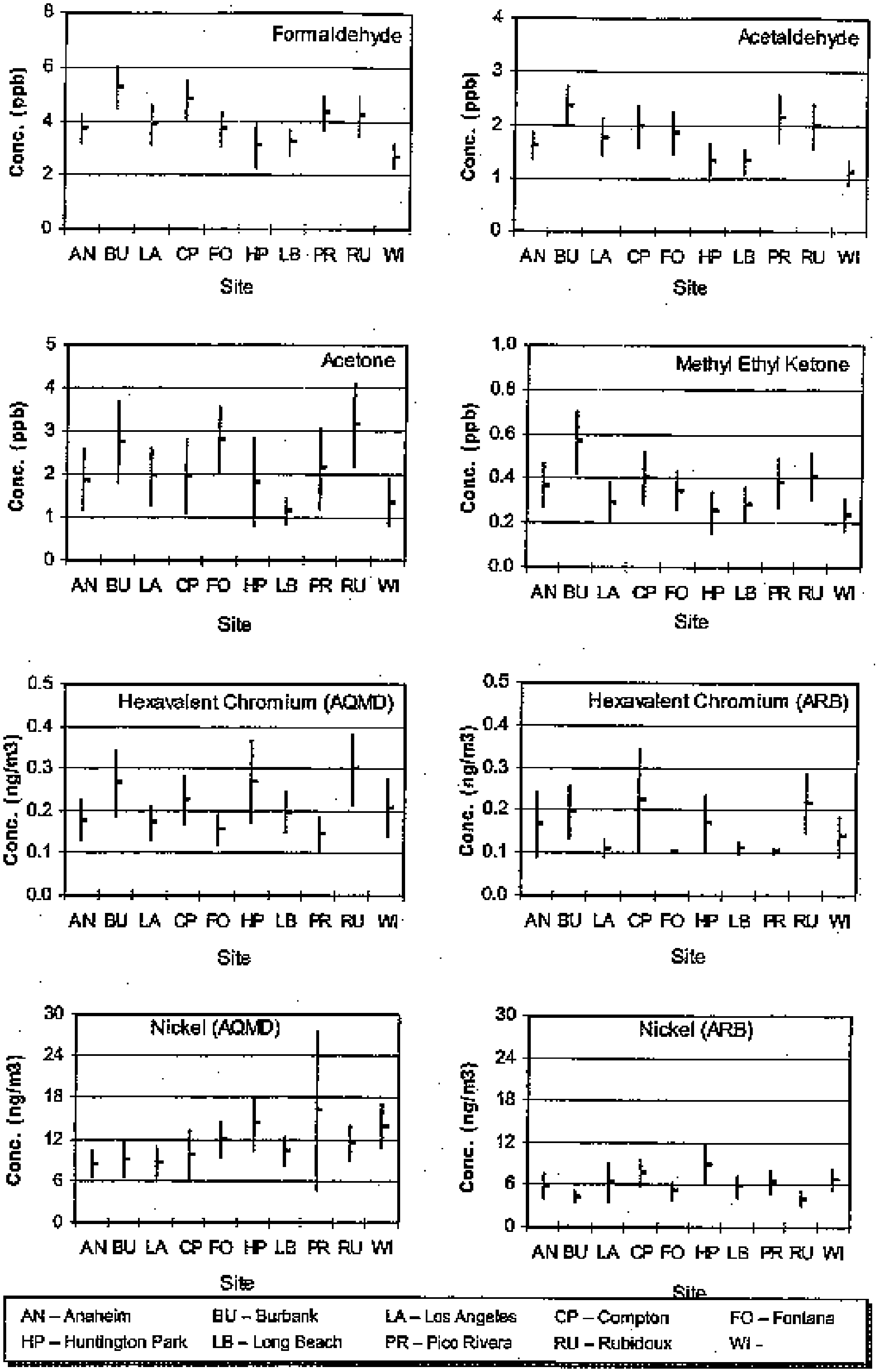


Figure 3-2. Continued



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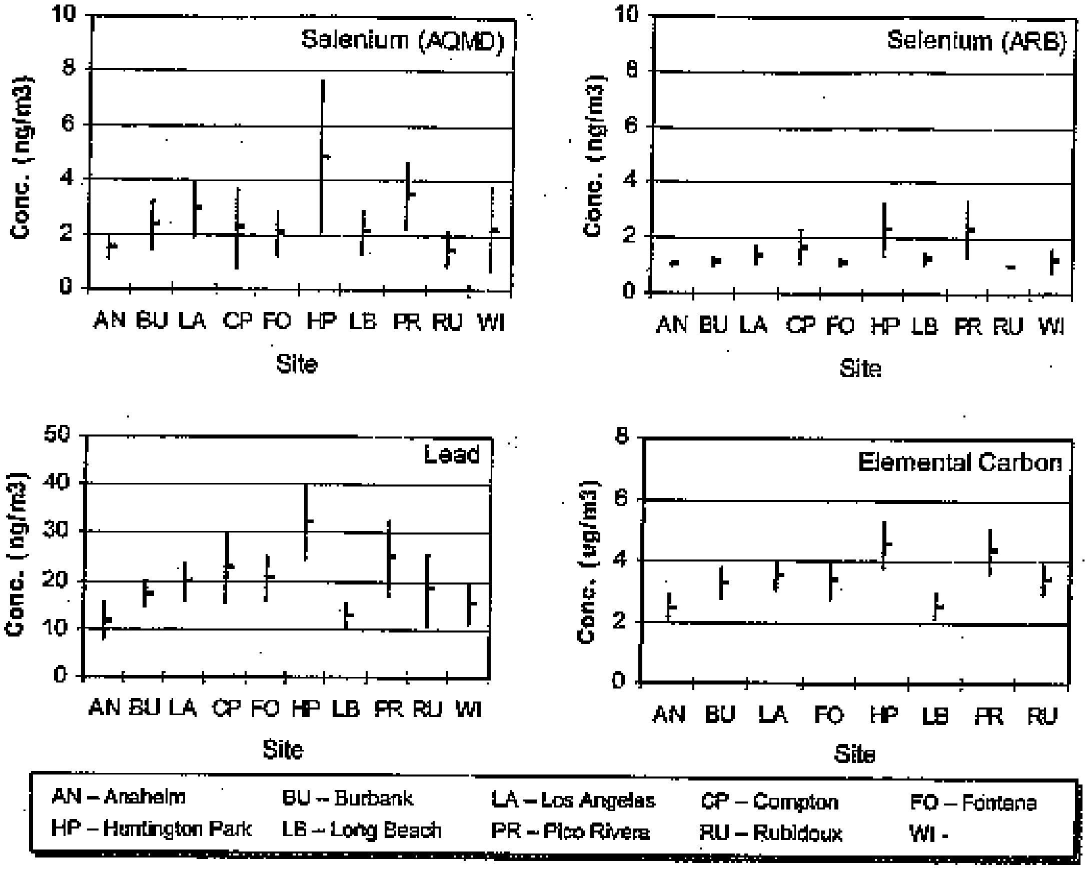

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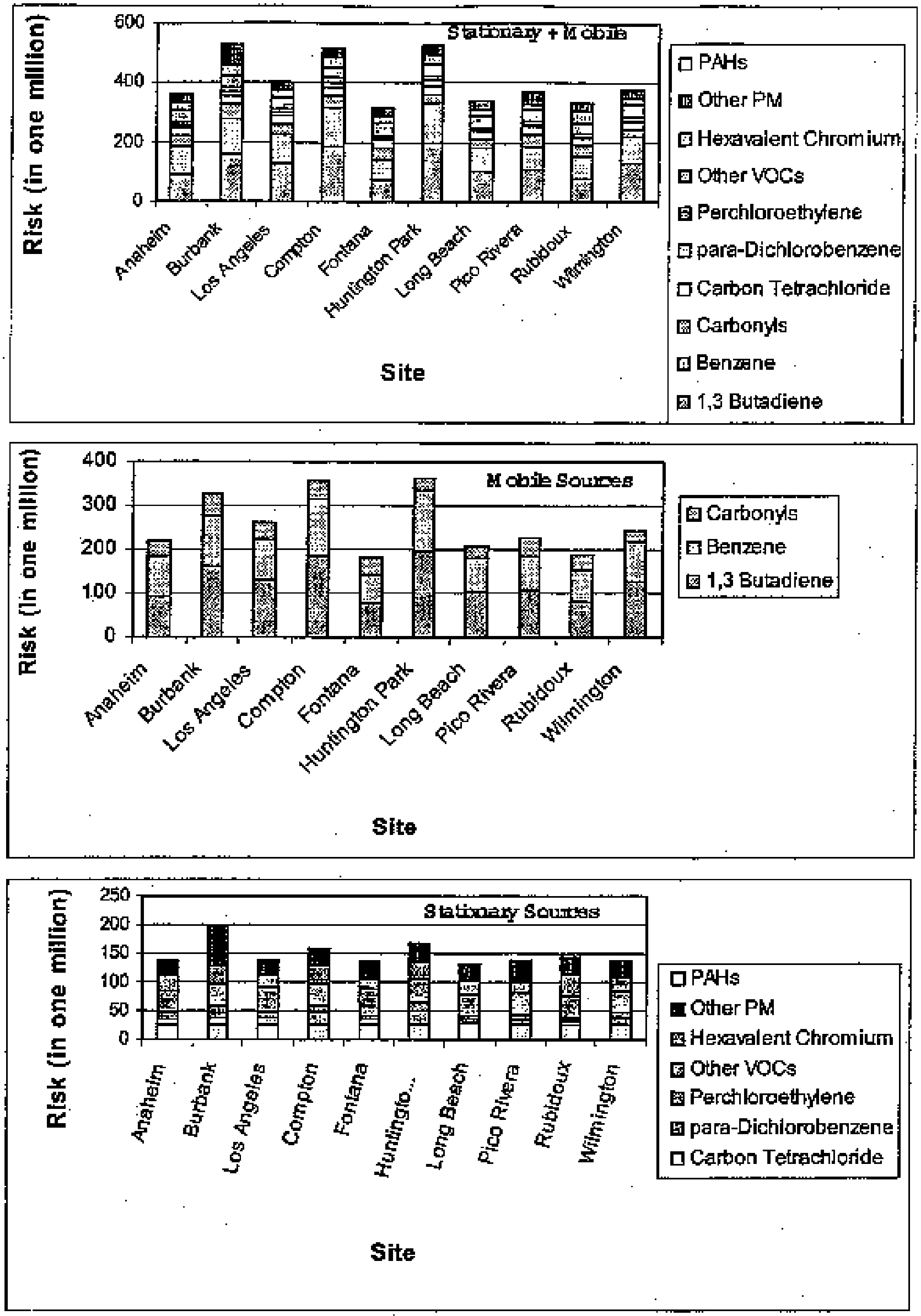


Figure 3-3. Cancer Risks at the MATES-II Fixed Sites.
Risks are shown for all sources (top), mobile sources (middle), and stationary sources (bottom), all excluding diesel toxicity.

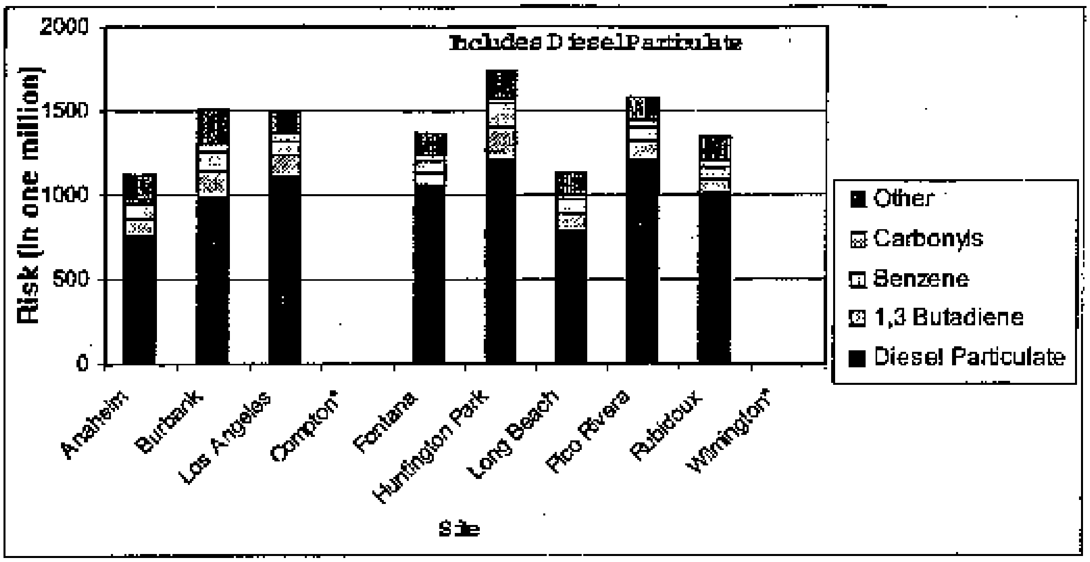


Figure 3-4. Cancer risks including diesel particulate toxicity at the MATES II fixed sites.
*No elemental carbon measured at these sites

3.2.4 Seasonal Variability

Monthly network mean concentrations and their 10th and 90th percent two-tailed confidence intervals are shown in Figure 3-5 for 18 of the measured pollutants.

Not all the pollutants exhibit a seasonal pattern but those that do follow two discernible patterns. Benzene, 1,3 butadiene, methylene chloride, perchloroethylene, methyl ethyl ketone, lead, and elemental carbon exhibit wintertime maximum and summertime minimum concentrations. This pattern is due to local seasonal meteorological conditions. Typically in late fall and winter, light winds result in reduced ventilation and late night and early morning surface inversions trap emissions from ground-level sources, such as on-road vehicles, and inhibit the vertical dispersion of pollutants, whereas, increased ventilation is typical of the summertime months. Stronger land breeze/sea breeze circulation and increased insulation results in increased wind speeds and increased vertical atmospheric dispersion and subsequently reduced ambient concentrations.

Formaldehyde, acetaldehyde, p-dichlorobenzene, and nickel exhibit a different seasonal pattern, which is a summer/fall maximum and a winter/spring minimum. Depending on the pollutant there are two potential causes for this pattern. Much of the measured formaldehyde and acetaldehyde are secondarily formed through photochemical reactions and thus the pattern follows cycle of increasing solar radiation. The peak is delayed since summertime is also the time of increased ventilation and vertical mixing which tends to reduce concentrations. However, late summer/early fall is a time of high insulation but somewhat reduced ventilation and vertical dispersion.

It is speculated that wind blown or mechanically disturbed crustal material is an important source of nickel. However, the original source of the nickel is man-made activities, which then are deposited on the surface of the soil. Wind blown dust is greatest during the dry season (i.e., summer and early fall) and least during the rainy season (winter and early spring), thus possibly explaining the seasonal pattern of the nickel concentrations.

Seasonal variations of the total cancer risks from the individual species are shown in Figures 3-6 and 3-7. The monthly values should be viewed as toxicity weighted concentrations and not as cancer risks since risks should be assessed based on long-term ambient exposure. A strong wintertime peak is shown in both figures. This is because much of the toxicity comes from pollutants that exhibit strong wintertime maximums, such as 1,3 butadiene, benzene, and diesel particulate.

In addition to monthly total carcinogenic risks, Figures 3-6 and 3-7 also show the monthly risks from pollutants associated with mobile sources and monthly risks associated with stationary sources. Note that the mobile source pollutants account for nearly all the monthly variability in the risk. Mobile source risk varies by a factor of about four, whereas stationary source risk varies by only a factor of 1.5. Therefore, most of the seasonal variability, observed in the monitoring network, is from the mobile source pollutants of 1,3 butadiene, benzene, formaldehyde, and acetaldehyde.

These seasonal results are intriguing, since meteorology would be expected to cause similar effects, whether stationary or mobile. There are several possible explanations for this observation:

1) While the three key mobile source toxic air contaminants exhibit similar seasonal trends, not all stationary source pollutants follow this pattern. The effect of different seasonalities for stationary sources is somewhat "cancellable" in an aggregate setting.

2) Operations of stationary sources may be more limited (e.g., daytime only; weekday only, etc.) such that differing results over a 24-hour period may occur even under comparable meteorology

3) Virtually all mobile sources are emitted within 5 meters of the surface, whereas some stationary sources have much greater emission release heights.

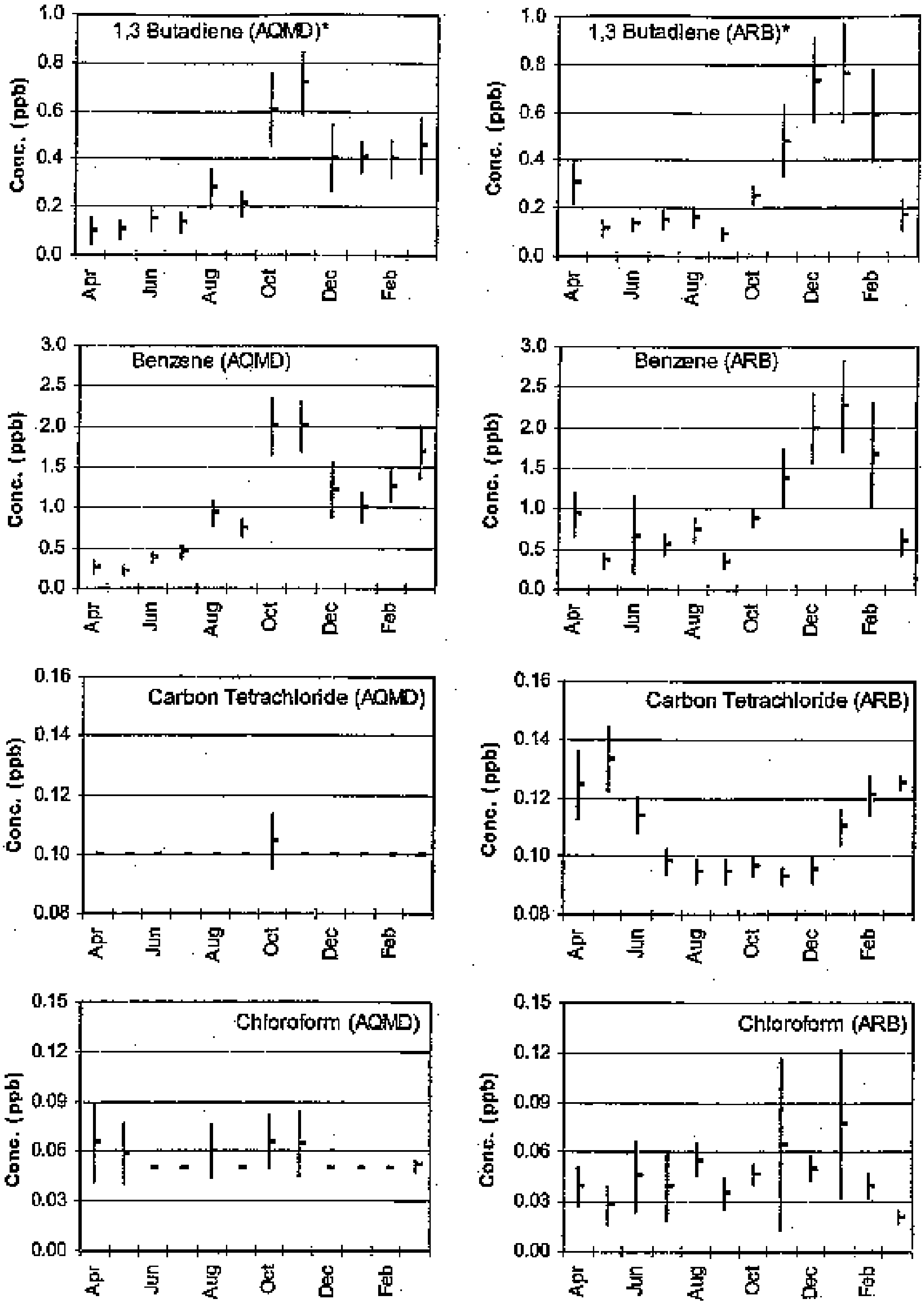
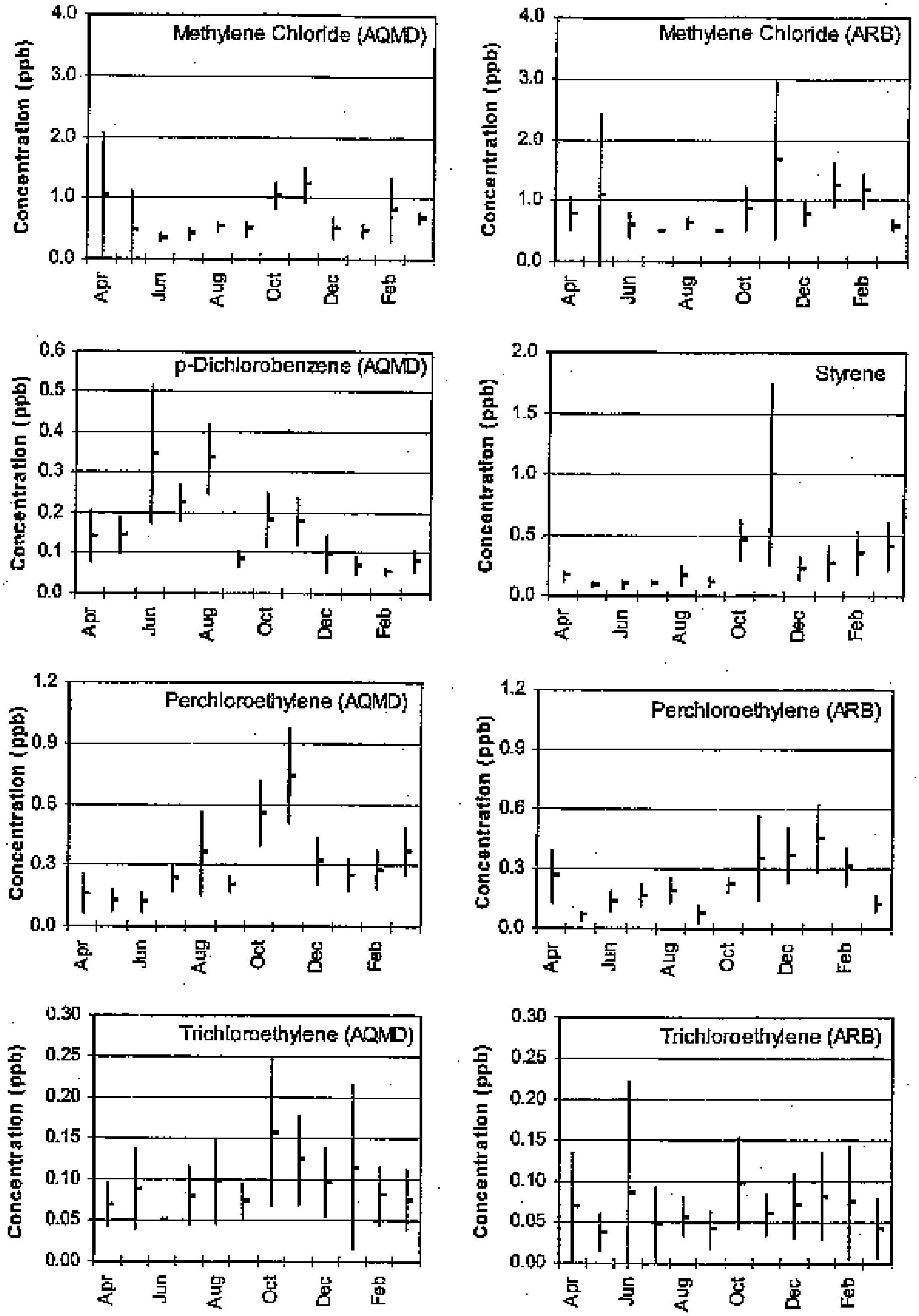


Figure 3-5. Seasonal Variation of Toxic Compounds.
Tick mark represents mean and the bars represent the 90 percent confidence interval about the mean.
* (AQMD) and (ARB) refer to the laboratories performing the analyses.



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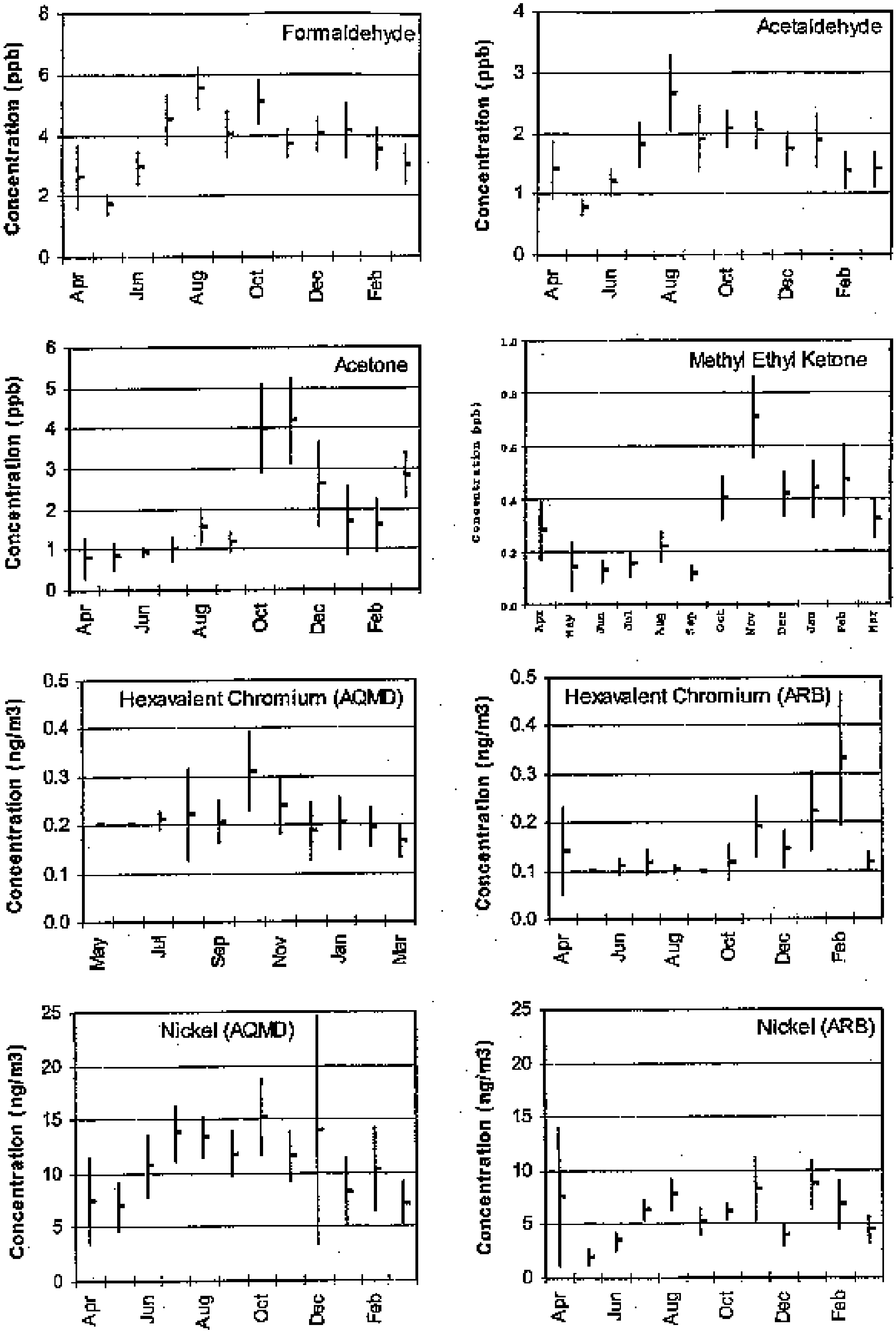

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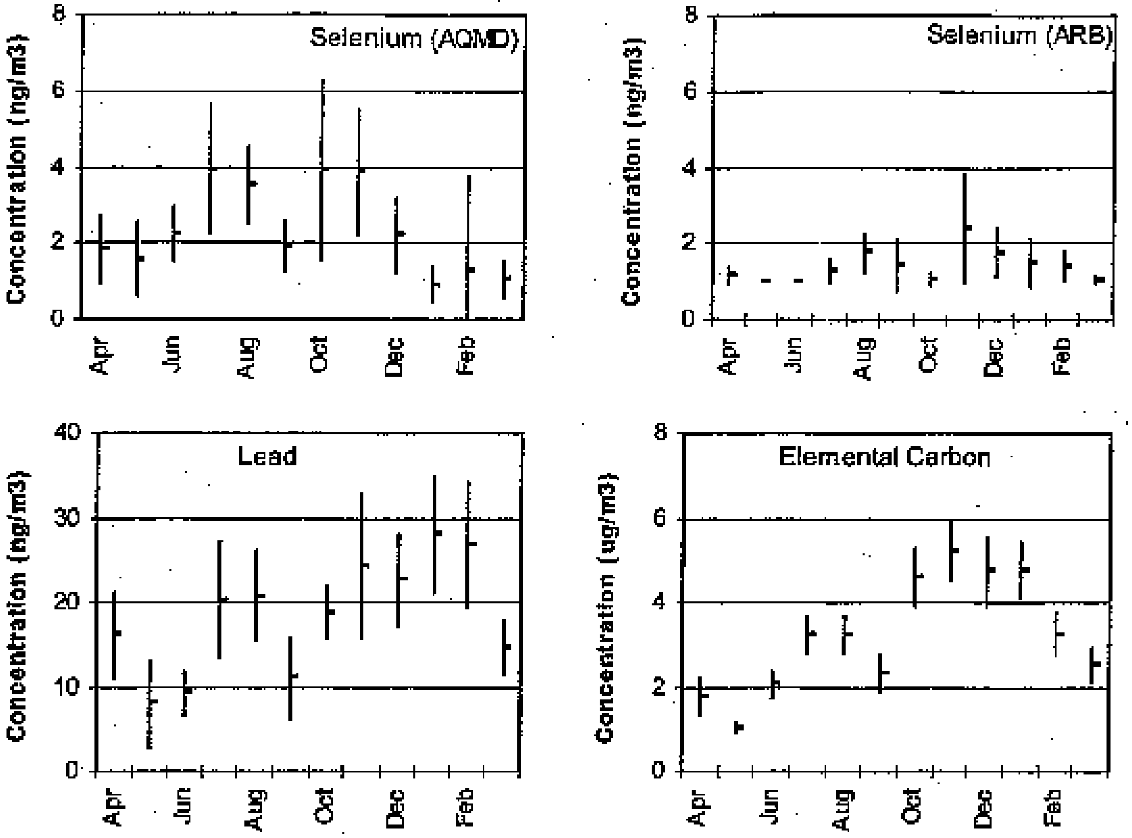


Figure 3-5. Concluded.

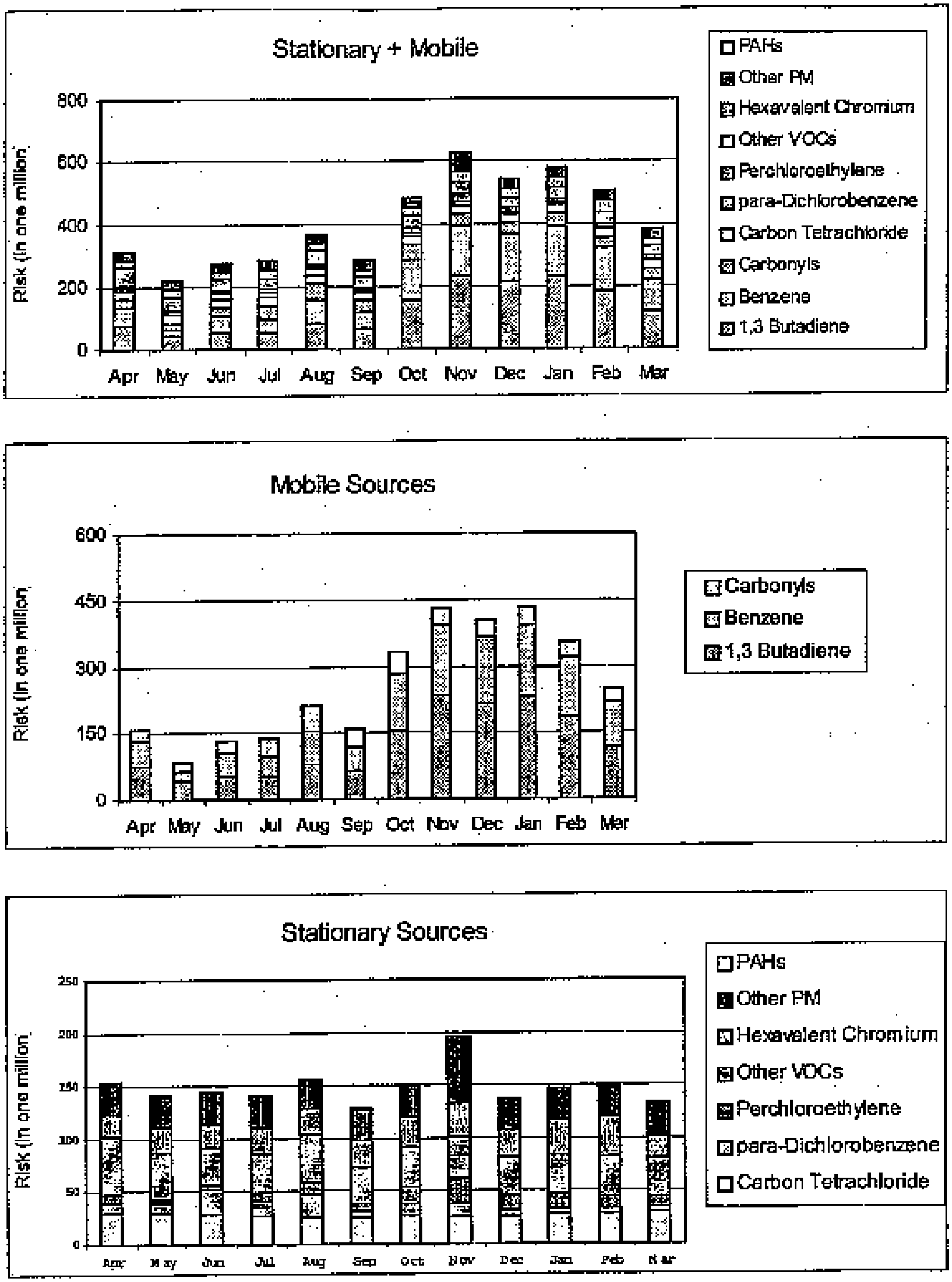


Figure 3-6. Monthly variation in cancer risks* excluding diesel particulate toxicity.

* Estimates to illustrate seasonal variation, not representative of lifetime exposure.

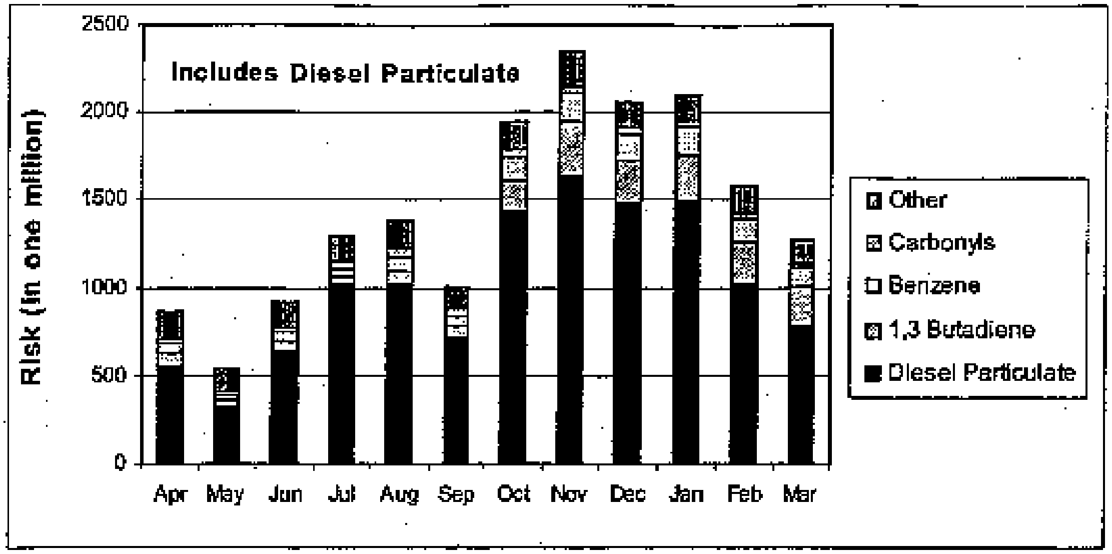


Figure 3-7. Monthly variation in cancer risks* including diesel particulate toxicity.

* Estimates to illustrate seasonal variation, not representative of lifetime exposure.

3.2.5 Species and Source Apportionment

Figures 3-8 and 3-9 compare the percentage contribution of each toxic to the total risks, excluding and including the diesel particulate toxicity respectively. The charts are a convenient way of illustrating species apportionment and indirectly source apportionment. Note that at the ten fixed sites the mobile source pollutants of 1,3 butadiene, benzene, formaldehyde, and acetaldehyde contribute 57 to 64 percent of the cancer risks. With the inclusion of diesel particulate toxicity, the percent contribution to the risk increases to about 90 percent. There is relatively little variability of this apportionment breakdown throughout the Basin. However, the percent contribution from mobile source actually increases at those sites with higher risks.

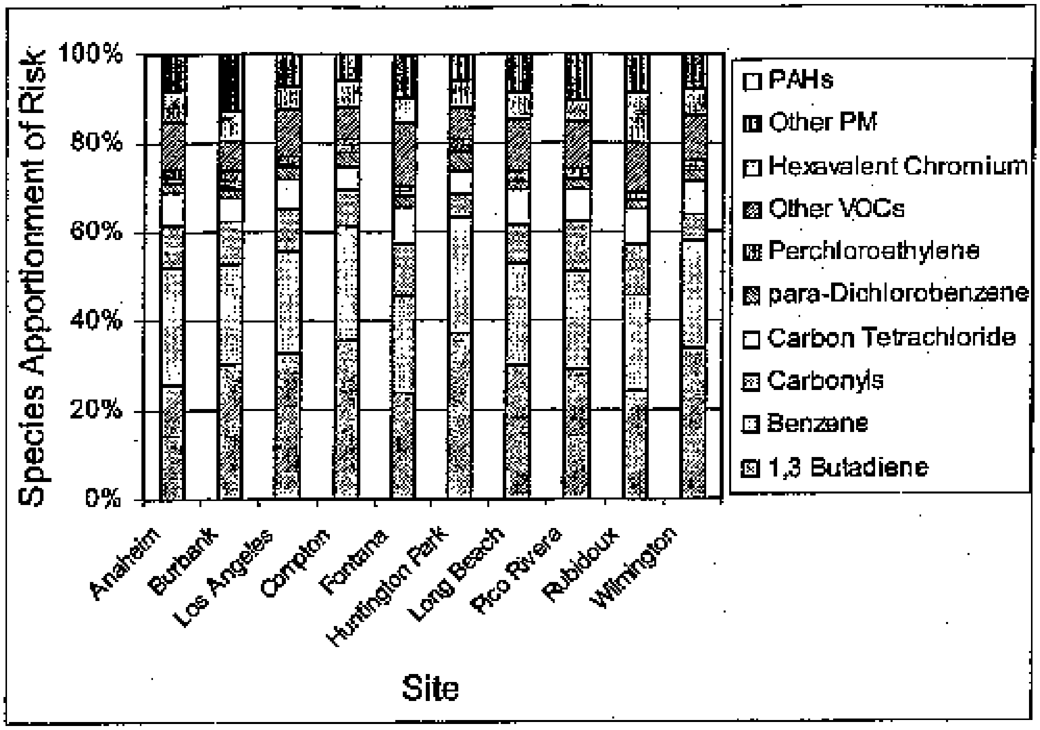


Figure 3-8. Species apportionment of cancer risks excluding diesel particulate toxicity.

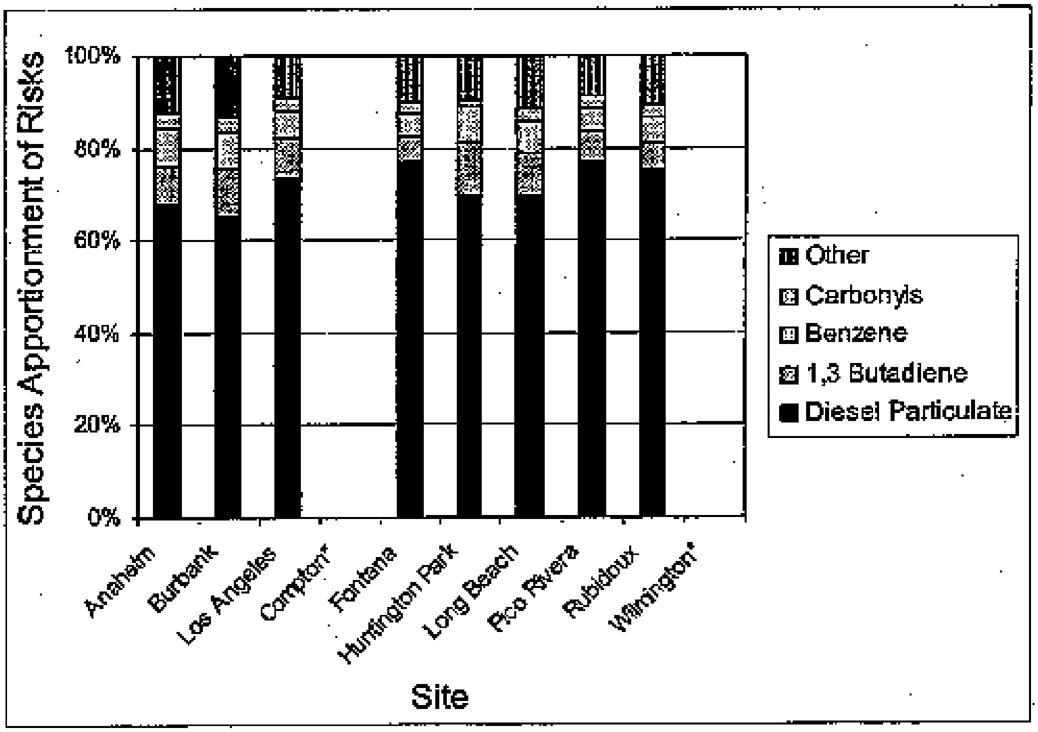


Figure 3-9. Species apportionment of cancer risks including diesel particulate toxicity.
***No elemental carbon measured at these sites.**

Chapter 4
Emissions Inventory Development

The toxic emissions inventory for MATES II consists of three components: (1) On-Road Mobile Sources; (2) Area and Off-Road Mobile Sources; and (3) Major Point Sources and AB2588 Sources. The following is the description of how each portion of the inventory was developed. More than 100 toxic compounds have been incorporated into the emissions inventory. In the following sections, only the high-risk compounds (as determined by their unit risk numbers and presented in Table 4.1) are presented.

4.1 On-Road Mobile Sources

On-Road Mobile Sources include cars, trucks, buses and motorcycles. The on-road mobile source emissions inventory is a product of: ARB's EMFAC7G emissions factors for 1998, developed by ARB; an interpolation of SCAG's transportation model between 1994 and 2000 for vehicle miles traveled (VMT) and speed corrections; and distribution of emissions using Cal Trans/ARB's model called DTIM2 to 2x2 km grids.

The above process produces the emissions inventory for criteria pollutants (VOC, NOx, PM, CO, SOx). Toxic compound emissions inventory is obtained by applying latest ARB speciation profiles to the VOC and PM emissions.

The diesel particle emissions are of special interest to this study since the California EPA has classified the particle portion of diesel exhaust (from internal combustion engines) as a toxic air contaminant. ~~These emissions are classified as PM emissions with profile codes 425 and 116, and~~ The method chosen to identify diesel particulate uses the referenced particulate speciation profile. Upon reviewing the set of particulate profiles available from the ARB, only two profiles were identified as internal combustion engines burning diesel fuel. The profile numbers and titles are as follows:

116 – Stationary Internal Combustion Engine – Diesel

425 – Diesel Vehicle Exhaust

Source categories referencing these two profiles are assumed to be sources of diesel particulate. As shown in Table 4-2 and 4-3 diesel particulate emissions are primarily generated by on-road diesel engines, off-road diesel engines, trains, motor ships, and commercial diesel boats.

4.2 Stationary Point Sources

The SCAQMD maintains two major emissions data banks: (1) The Annual Emissions Reporting (AER) system, containing emissions information on criteria pollutants and some toxic compounds; and (2) The Toxic Hot Spot (AB2588) program containing emissions information on numerous toxic compounds. For the MATES II project, a contractor was hired to update the emissions inventory of major toxic compounds by utilizing the existing information, augmented by special studies. The following steps were taken in developing the stationary point source toxic emissions inventory:

1. The AB2588 database was updated by conducting a survey of top emitters. The non-surveyed facilities' emissions were updated by applying growth factors to adjust for economic changes from the early 1990s to 1998. Appropriate control factors were applied to sources whose emissions have been reduced due to existing rules and regulations.

2. The non-AB2588 facilities' emissions were analyzed by utilizing the 1997 AQMP point source inventory. This data bank contains information on criteria pollutants such as particulate matter (PM) and volatile organic compounds (VOC). Appropriate PM or VOC speciation profiles were applied to these emissions in order to obtain specific toxic compound emissions. Appropriate growth and control factors were applied to the 1993 data to reflect 1998 conditions. In addition, several larger sources were reviewed to determine if their emissions are correctly projected to 1998.

4.3 Area and Off-Road Sources

Area and off-road sources represent numerous small sources of emissions that can collectively have significant emissions and can contribute to high risks. Examples of area sources are: dry cleaners, gasoline stations, auto body shops, and chrome platers. Examples of off-road sources are: construction equipment, motor boats and airplanes. Area source emissions are distributed throughout the modeling domain using surrogates such as population, retail and non-retail sales, or employment. For the MATES II study, appropriate growth and control factors were applied to the 1993 area and off-road source emissions to reflect 1998 conditions. Three area sources, namely dry cleaners, gasoline stations and chrome platers, were spatially distributed using surrogates as discussed below.

Perchloroethylene Dry Cleaning

Perchloroethylene dry cleaning countywide emissions were apportioned according to the permitted annual emissions and located at their specific address. The perchloroethylene dry cleaning emissions were derived from California import and domestic-production records. Total perchloroethylene emissions were approximately 6.6 tons per day and distributed over 1,300 facilities in SCAB.

Retail Gasoline Dispensing

The retail gasoline dispensing countywide emissions were apportioned according to the permitted annual emissions and located at their specific address. The retail gasoline dispensing emissions were derived from gasoline shipping and taxable sales records. Retail gasoline dispensing emissions of approximately 18 tons per day were distributed over 2,970 facilities in SCAB.

Hexavalent Chromium Plating

The AB2588 program contains the larger chromium plating facilities. There are approximately 74 plating facilities in the AB2588 program. In addition, there are approximately 84 aerospace facilities that may do plating in the AB2588 program. The facility counts are rough approximations because some of the plating facilities may not use (and thereby emit) chromium (specifically, hexavalent chromium). (Some aerospace companies contract out their plating needs, and some facilities that do chromium plating do not belong to specific emission source categories.)

To augment the AB2588 facility list, a search was performed to identify the smaller chromium plating facilities. Small chromium plating facilities were then represented by calculated annual emissions, and located at their specific address. Four types of sources were identified: hard chrome plating tanks, decorative chrome plating tanks, chrome anodizing tanks, and spray booths. Through the aforementioned process, 87 smaller chromium facilities were identified, assigned emissions, and added to the MATES II modeling inventory.

4.4 Summary of Toxic Emissions

Table 4-2 presents the emissions from selected compounds by source category. Figures 4-1 and 4-2 present the weighted emissions by the compounds' unit risk factor (URF). Table 4-3 presents the toxic emissions categorized by major source categories. Diesel emissions account for 80 percent of the overall cancer risk as shown in Figure 4-1. The other significant compounds are 1,3 butadiene, benzene, and hexavalent chromium. The on-road and off-road mobile sources contribute to the majority of the risks as shown in Figure 4-2. Figures 4-3 through 4-5 show the spatial distribution of the location of emissions for dry cleaners, gasoline stations, and chrome platers. Figures 4-6 through 4-10 show the spatial distribution of emissions for diesel particles, benzene, 1,3 butadiene, perchloroethylene, and hexavalent chromium, respectively.

Table 4-1

List of MATES II
Emissions Inventory Compounds

COMPOUNDS	PROBABLE EXAMPLES OF TYPE OF OPERATION
1,1 dichloroethane	landfill-flare, fugitive
1,3 butadiene	mobile sources; petroleum industry
acetaldehyde	combustion equipment
acetone*	solvent use; degreasing
arsenic	oil-fired equipment; flare; incinerator
benzene	mobile sources; petroleum industry
cadmium	plating operation; incinerator
carbon tetrachloride	solvent use; degreasing; coating
chloroform	coating
chloromethane/methyl chloride	printing; laboratory
diesel exhaust	diesel engines
1,4 dioxane	degreasing operation
elemental carbon	diesel exhaust; fugitive dust
ethylene dibromide	flare; incinerator
ethylene dichloride	flare; incinerator
ethylene oxide	sterilizer
formaldehyde	mobile sources; combustion equipment
hex chrome	plating operation
lead	flare; battery manufacturing; lead smelting
MEK	solvent use; degreasing
methylene chloride/dichloromethane	degreasing operation; coating
MTBE	gasoline consumption; mobile sources
nickel	plating operation; incinerator
organic carbon	diesel exhaust; charbroilers
para dichlorobenzene	consumer products, pesticide and herbicide mfg.
perc	dry cleaning; solvent use; degreasing; film cleaning
propylene oxide	chemical manufacturing
selenium	oil-fired equipment; flare; incinerator
silicon*	sand blasting
styrene	foam blowing
toluene	petroleum operation; solvent use; degreasing; coating
total chromium	oil-fired equipment; coating; incinerator
trichloroethylene	degreasing operation; coating; solvent use
vinyl chloride	incinerator

*Not toxic compounds: Emissions listed for evaluating model performance

Table 4-2

Annual Average Day Emissions for the South Coast Air Basin

Pollutant	Emissions (lbs/day)					
	On-Road	Off-Road	Point	AB2588	Area	Total
Acetaldehyde*	5485.8	5770.3	33.9	57.1	189.1	11536.2
Acetone**	4945.8	4824.7	3543.5	531.4	23447.4	37292.8
Benzene	21945.5	6533.4	217.7	266.8	2495.4	31458.8
Butadiene [1,3]	4033.8	1566.1	6.7	2.0	151.3	5759.9
Carbon tetrachloride	0.0	0.0	8.8	1.8	0.0	10.6
Chloroform	0.0	0.0	0.0	35.5	0.0	35.5
Dichloroethane [1,1]	0.0	0.0	0.0	0.1	0.0	0.1
Dioxane [1,4]	0.0	0.0	0.0	105.0	0.0	105.0
Ethylene dibromide	0.0	0.0	0.0	0.2	0.0	0.2
Ethylene dichloride	0.0	0.0	4.9	17.6	0.0	22.5
Ethylene oxide	0.0	0.0	58.1	12.3	454.1	524.4
Formaldehyde*	16664.9	16499.3	521.6	674.7	1107.5	35468.0
Methyl ethyl ketone*	905.1	906.9	3240.2	385.9	14535.4	19973.5
Methylene chloride	0.0	0.0	1378.6	1673.6	9421.7	12473.9
MTBE	58428.9	2679.2	40.5	434.4	5473.7	67056.7
p-Dichlorobenzene	0.0	0.0	0.0	4.5	3735.6	3740.1
Perchloroethylene	0.0	0.0	4622.0	2249.1	22813.1	29684.2
Propylene oxide	0.0	0.0	0.0	22.3	0.0	22.3
Styrene	1114.8	287.1	447.0	3836.7	21.4	5707.0
Toluene	63187.6	11085.9	5689.6	3682.4	52246.7	135892.2
Trichloroethylene	0.0	0.0	1.1	58.0	2550.3	2609.3
Vinyl chloride	0.0	0.0	0.0	4.3	0.0	4.3
Arsenic	0.1	0.3	2.7	0.7	21.4	25.2
Cadmium	1.6	1.5	0.5	0.7	27.5	31.8
Chromium	2.4	2.3	3.9	2.2	302.2	313.0
Diesel particulate	23906.3	22386.3	0.0	5.4	815.3	47113.4
Elemental carbon***	27572.1	6690.3	702.8	0.0	16770.5	51735.7
Hexavalent chromium	0.4	0.4	0.3	1.0	0.1	2.2
Lead	0.7	0.9	1.9	24.5	1016.3	1044.3
Nickel	2.5	2.2	2.9	21.6	85.6	114.9
Organic carbon	16426.2	15381.8	0.0	0.0	108612.1	140420.2
Selenium	0.1	0.1	3.0	5.7	2.6	11.6
Silicon**	68.6	67.6	167.2	0.0	248614.0	248917.4

* Primarily emitted emissions. These materials are also formed in the atmosphere as a result of photochemical reactions.

** Acetone and silicon are not toxic compounds. Their emissions are included here because they were measured in the sampling program and were subsequently modeled for the purpose of model evaluation.

*** Includes elemental carbon from all sources (including diesel particulate).

Table 4-3. 1998 Toxics Emissions (lbs/day) by Major Source Category for the South Coast Air Basin.

Code	Source Category	Benzene	1,3 Butadiene	p-Dichloro-benzene	Methylene chloride	Perchloro-ethylene	Trichloro-ethylene	Formalde-hyde	Acetalde-hyde	Diesel PM	Hex. chromium	Nickel
100	**Fuel Combustion**											
110	Agricultural	1.42	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.02	0.01
120	Oil and Gas Production	55.57	0.02	0.00	0.00	0.00	0.00	121.01	1.10	0.00	0.02	0.01
130	Petroleum Refining	1.12	0.01	0.00	0.00	0.00	0.00	2.44	0.12	0.00	0.01	0.03
140	Other Manufacturing/Industrial	150.93	3.48	0.00	0.00	0.00	0.00	598.79	109.87	815.34	0.10	0.24
150	Electric Utilities	12.63	0.04	0.00	0.00	0.00	0.00	31.58	0.41	0.00	0.01	0.28
160	Other Service and Commerce	94.48	3.82	0.00	0.00	0.00	0.00	255.41	17.76	0.00	0.14	0.18
170	Residential	171.61	0.00	0.00	0.00	0.00	0.00	437.33	85.34	0.00	0.02	0.01
199	Other	11.19	1.80	0.00	0.00	0.00	0.00	32.26	8.44	0.00	0.06	0.05
	Total	**498.96**	**9.16**	**0.00**	**0.00**	**0.00**	**0.00**	**1478.97**	**223.04**	**815.34**	**0.36**	**0.81**
200	**Waste Burning**											
210	Agricultural Debris	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
220	Range Management	0.00	13.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
230	Forest Management	0.00	135.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
240	Incineration	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
299	Other	0.00	0.00	0.00	0.00	0.00	0.00	9.53	0.00	0.00	0.00	0.00
	Total	**1.39**	**148.84**	**0.00**	**0.00**	**0.00**	**0.00**	**9.53**	**0.00**	**0.00**	**0.00**	**0.01**
300	**Solvent Use**											
310	Dry Cleaning	0.00	0.00	0.00	0.00	16106.30	0.00	0.00	0.00	0.00	0.00	0.00
320	Degreasing	0.00	0.00	0.00	8056.99	8594.22	2551.34	0.00	0.00	0.00	0.00	0.00
330	Architectural Coating	115.48	0.00	0.00	2117.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
340	Other Surface Coating	10.16	0.00	0.00	186.32	0.00	0.00	30.14	0.00	0.00	0.00	0.00
350	Asphalt Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
360	Printing	0.00	0.00	0.00	0.00	0.00	0.00	8.77	0.00	0.00	0.00	0.00
370	Consumer Products	0.00	0.00	3531.72	409.76	1034.15	0.00	58.54	0.00	0.00	0.00	0.00
380	Industrial Solvent Use	0.11	0.00	0.00	0.00	569.43	0.00	0.00	0.00	0.00	0.00	0.00
399	Other	8.74	0.00	0.00	0.00	351.78	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**134.49**	**0.00**	**3531.72**	**10770.55**	**26655.87**	**2551.34**	**97.44**	**0.00**	**0.00**	**0.00**	**0.00**
400	**Petroleum Process, Storage & Transfer**											
410	Oil and Gas Extraction	318.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
420	Petroleum Refining	2.44	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
430	Petroleum Marketing	205.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
499	Other	8.78	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
Total	**Petroleum Process, Storage & Transfer**	**534.63**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**

(continued)

Table 4-3. Continued.

Code	Source Category	Benzene	1,3 Butadiene	p-Dichlorobenzene	Methylene chloride	Perchloroethylene	Trichloroethylene	Formaldehyde	Acetaldehyde	Diesel PM	Hex. chromium	Nickel
500	**Industrial Processes**											
510	Chemical	0.00	0.00	0.00	0.00	0.00	0.00	37.81	0.00	0.00	0.00	0.30
520	Food and Agricultural	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
560	Mineral Processes	0.52	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.04	0.22
570	Metal Processes	0.00	0.00	0.00	0.00	0.00	0.00	1.64	0.00	0.00	0.04	1.88
580	Wood and Paper	0.06	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00
599	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**0.58**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**39.66**	**0.00**	**0.00**	**0.09**	**2.40**
600	**Miscellaneous Processes**											
610	Pesticide Application	1542.93	0.00	203.92	23.66	59.71	0.00	3.38	0.00	0.00	0.00	0.00
620	Farming Operations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72
630	Construction and Demolition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.33
640	Entrained Road Dust - Paved	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.48
650	Entrained Road Dust - Unpaved	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.83
660	Unplanned Fires	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
670	Fugitive Windblown Dust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.33
680	Waste Disposal	0.00	0.00	0.00	0.00	719.51	0.00	0.00	0.00	0.00	0.00	0.59
685	Natural Sources	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
690	NOx/SOx RECLAIM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
691	ERC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
692	Hi/LO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
693	NSR Exemption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
694	Rule 518.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
695	ODC Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
699	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**1542.93**	**0.00**	**203.92**	**23.66**	**779.22**	**0.00**	**3.38**	**0.00**	**0.00**	**0.00**	**85.29**
700	**On-Road Vehicles**											
710	Light-Duty Passenger	14133.12	2582.24	0.00	0.00	0.00	0.00	6922.97	1610.57	674.52	0.20	1.14
720	Light- and Medium-Duty Trucks	6204.22	1224.73	0.00	0.00	0.00	0.00	3104.16	698.20	346.85	0.09	0.50
730	Heavy-Duty Gas Trucks	522.93	86.42	0.00	0.00	0.00	0.00	303.18	63.13	0.00	0.08	0.46
740	Heavy-Duty Diesel Trucks	808.48	76.77	0.00	0.00	0.00	0.00	5945.02	2970.89	22769.86	0.00	0.36
750	Motorcycles	250.89	61.20	0.00	0.00	0.00	0.00	199.09	47.84	0.00	0.01	0.06
760	Heavy-Duty Diesel - Urban Bus	25.90	2.46	0.00	0.00	0.00	0.00	190.44	95.17	115.07	0.00	0.00
799	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**21945.53**	**4033.82**	**0.00**	**0.00**	**0.00**	**0.00**	**16664.85**	**5485.80**	**23906.30**	**0.39**	**2.52**

(continued)

Table 4-3.
Concluded.

Code	Source Category	Benzene	1,3 Butadiene	p-Dichloro-benzene	Methylene chloride	Perchloro-ethylene	Trichloro-ethylene	Formaldehyde	Acetaldehyde	Diesel PM	Hex. chromium	Nickel
800	Other Mobile											
810	Off-Road Vehicles	2836.70	695.27	0.00	0.00	0.00	0.00	2672.39	658.44	95.34	0.24	1.35
815	Commercial Boats	38.03	4.84	0.00	0.00	0.00	0.00	225.57	110.75	200.00	0.00	0.00
820	Trains	83.06	7.89	0.00	0.00	0.00	0.00	610.76	305.21	1053.15	0.00	0.02
830	Ships	191.17	16.81	0.00	0.00	0.00	0.00	1302.49	650.57	5176.44	0.00	0.08
850	Aircraft - Government	13.92	3.36	0.00	0.00	0.00	0.00	10.66	4.24	0.00	0.00	0.00
860	Aircraft - Other	474.73	269.57	0.00	0.00	0.00	0.00	1974.94	627.28	0.00	0.04	0.05
870	Mobile Equipment	1849.63	328.02	0.00	0.00	0.00	0.00	8799.08	3196.60	15861.37	0.02	0.38
880	Utility Equipment	996.13	240.35	0.00	0.00	0.00	0.00	903.47	217.18	0.00	0.06	0.33
891	Seeps/Biogenics	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
892	Channel Shipping	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
893	OCS and Related Sources	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
894	Tideland Platforms	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**6533.38**	**1566.10**	**0.00**	**0.00**	**0.00**	**0.00**	**16499.34**	**5770.27**	**22386.30**	**0.37**	**2.21**
900	Unspecified Sources	0.06	0.01	0.00	6.09	0.00	0.00	0.05	0.01	0.00	0.00	0.00
	AB 2588 Sources	**266.81**	**2.01**	**4.48**	**1673.60**	**2249.10**	**57.99**	**674.73**	**57.11**	**5.42**	**1.00**	**21.63**
Total	**Stationary and Area Sources**	**2979.85**	**160.02**	**3740.12**	**12473.90**	**29684.20**	**2609.33**	**2303.81**	**280.17**	**820.76**	**1.45**	**110.14**
Total	**On-Road Vehicles**	**21945.53**	**4033.82**	**0.00**	**0.00**	**0.00**	**0.00**	**16664.85**	**5485.80**	**23906.30**	**0.39**	**2.52**
Total	**Other Mobile**	**6533.38**	**1566.10**	**0.00**	**0.00**	**0.00**	**0.00**	**16499.34**	**5770.27**	**22386.30**	**0.37**	**2.21**
Grand	**Total**	**31458.76**	**5759.93**	**3740.12**	**12473.90**	**29684.20**	**2609.33**	**35468.00**	**11536.23**	**47113.37**	**2.20**	**114.88**

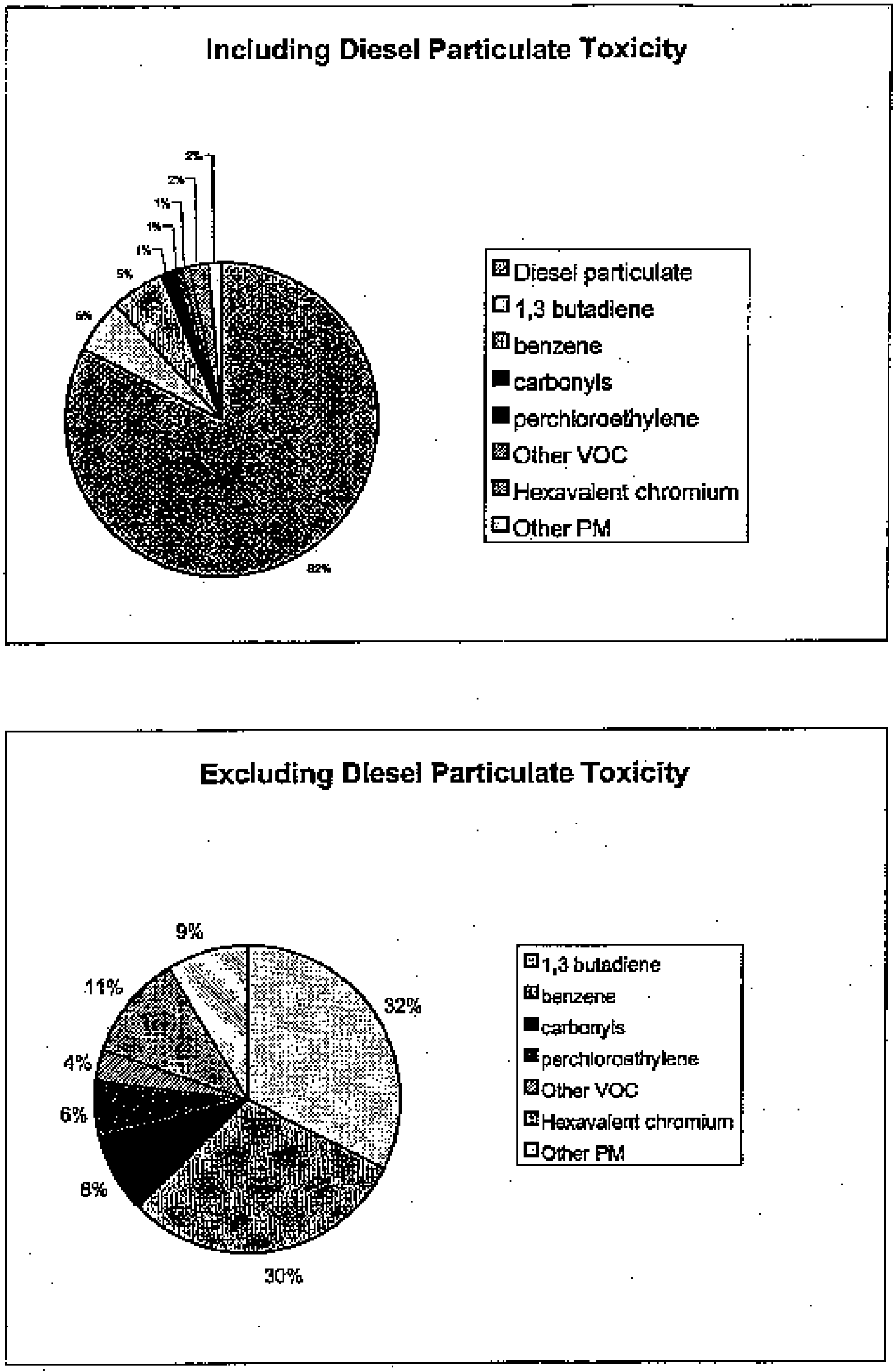
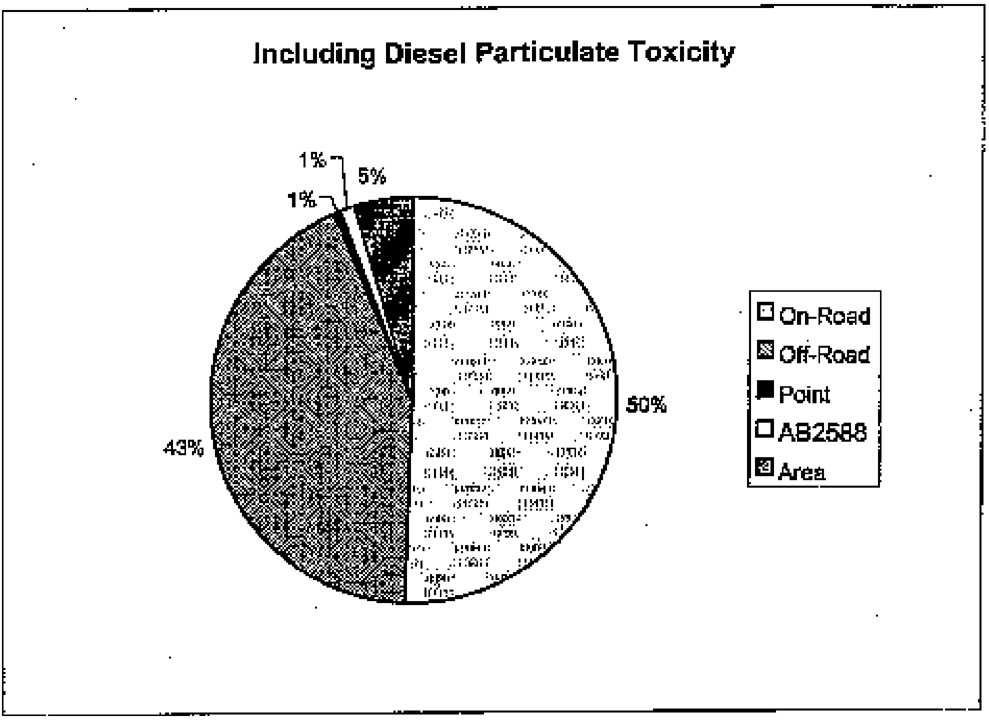


Figure 4-1. Species apportionment using toxicity-weighted emissions.



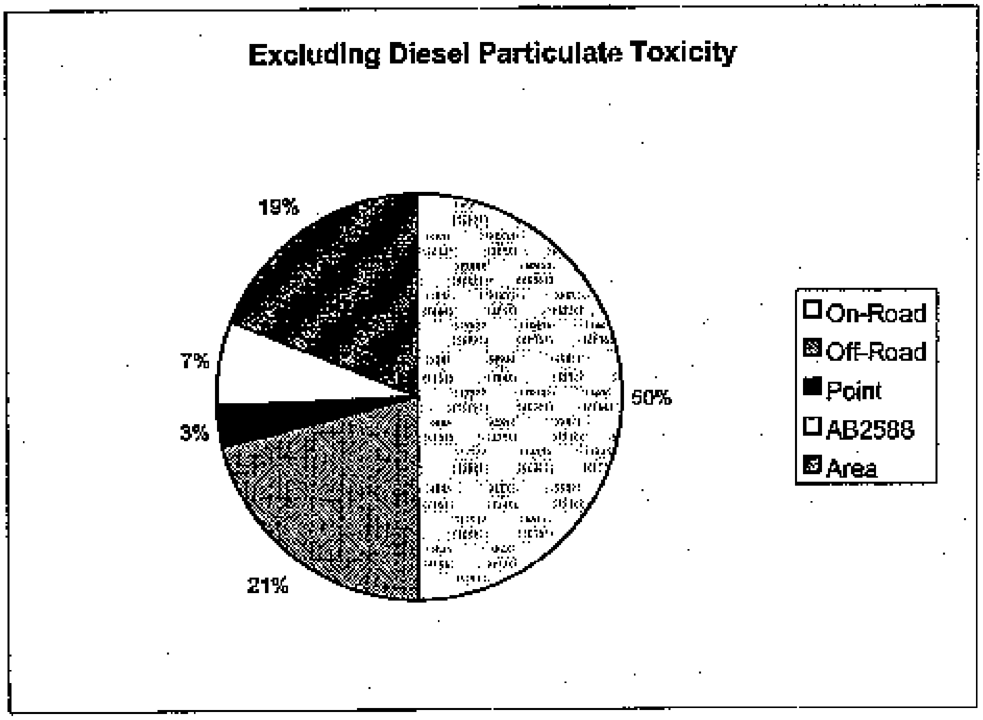


Figure 4-2. Source apportionment using toxicity-weighted emissions.

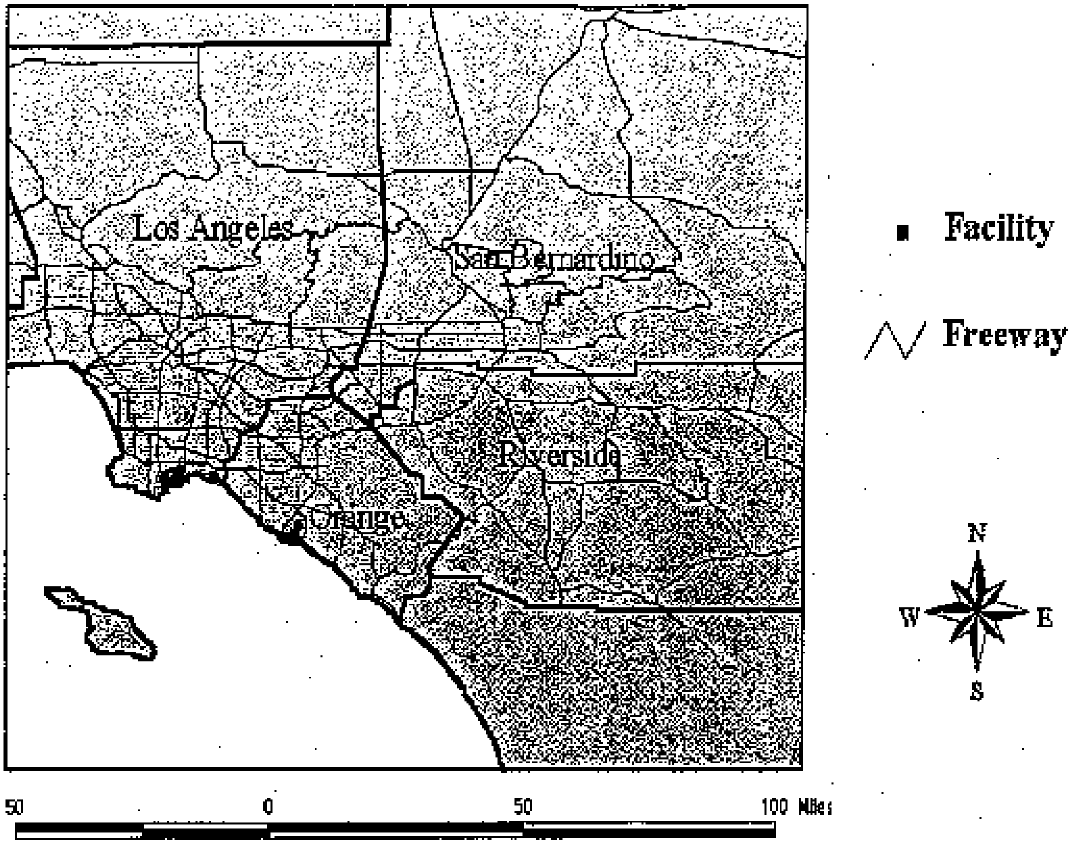


Figure 4.3 Spatial Distribution of Dry Cleaners

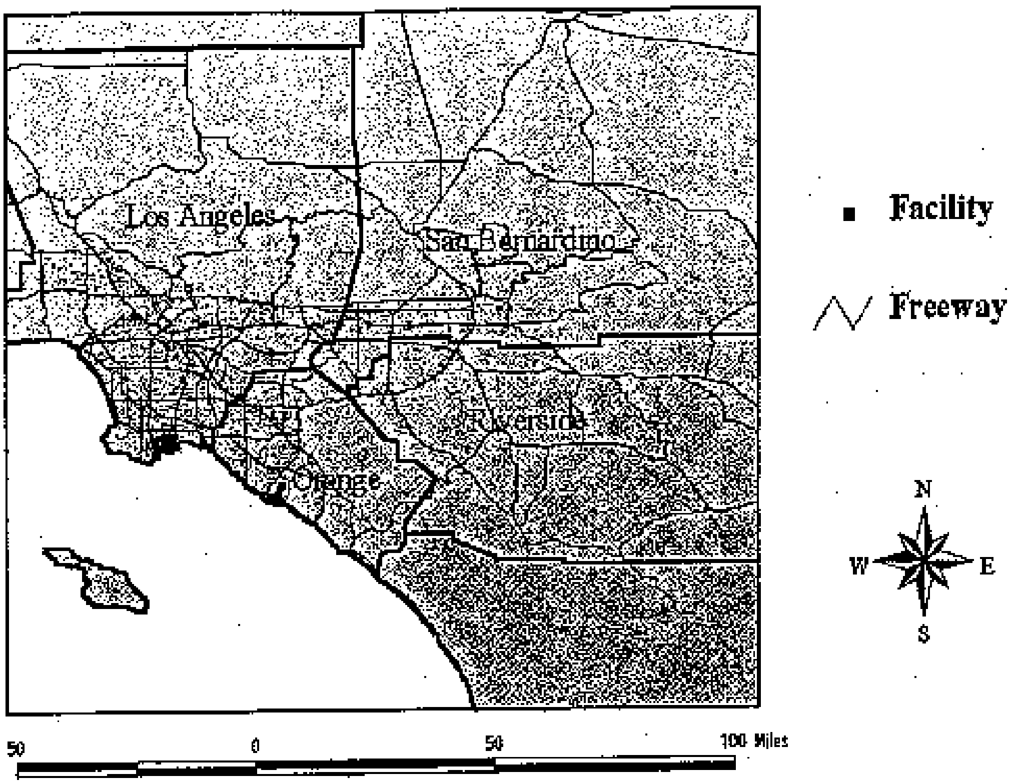


Figure 4.4 Spatial Distribution of Gas Stations

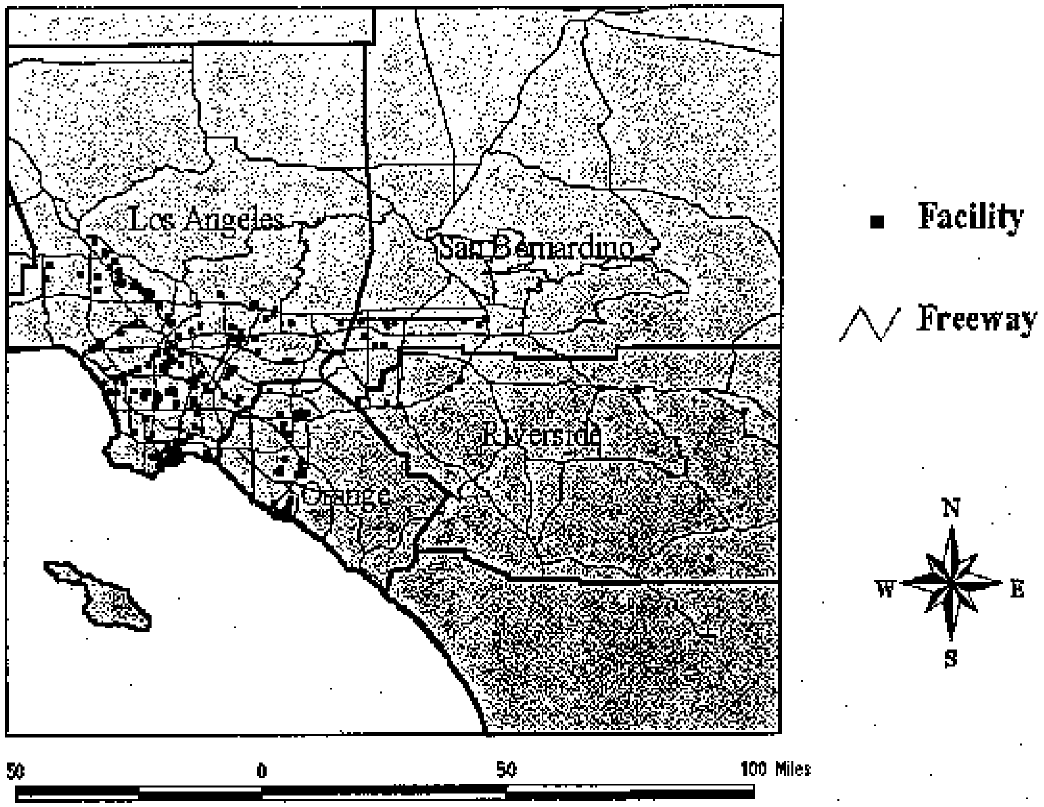
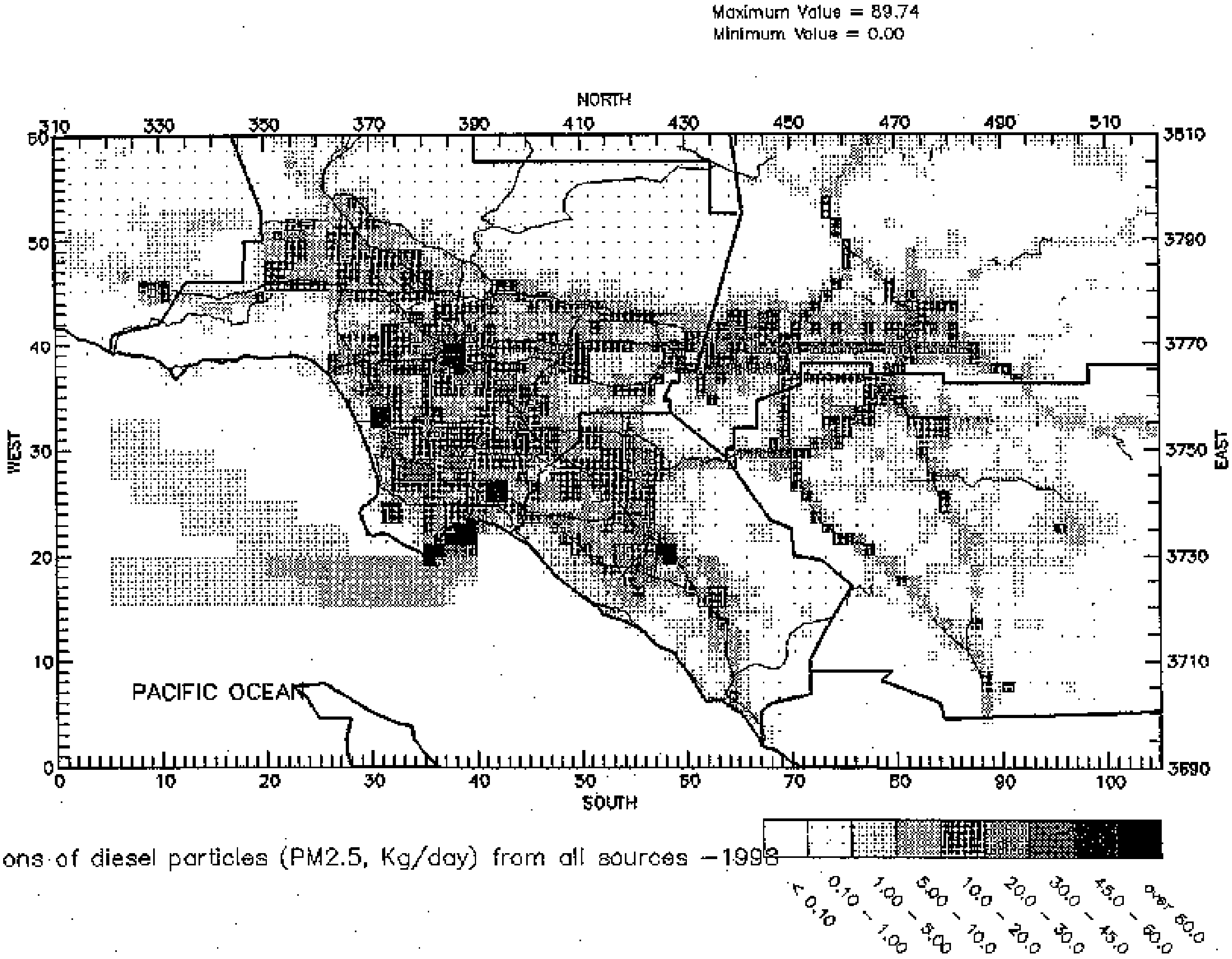
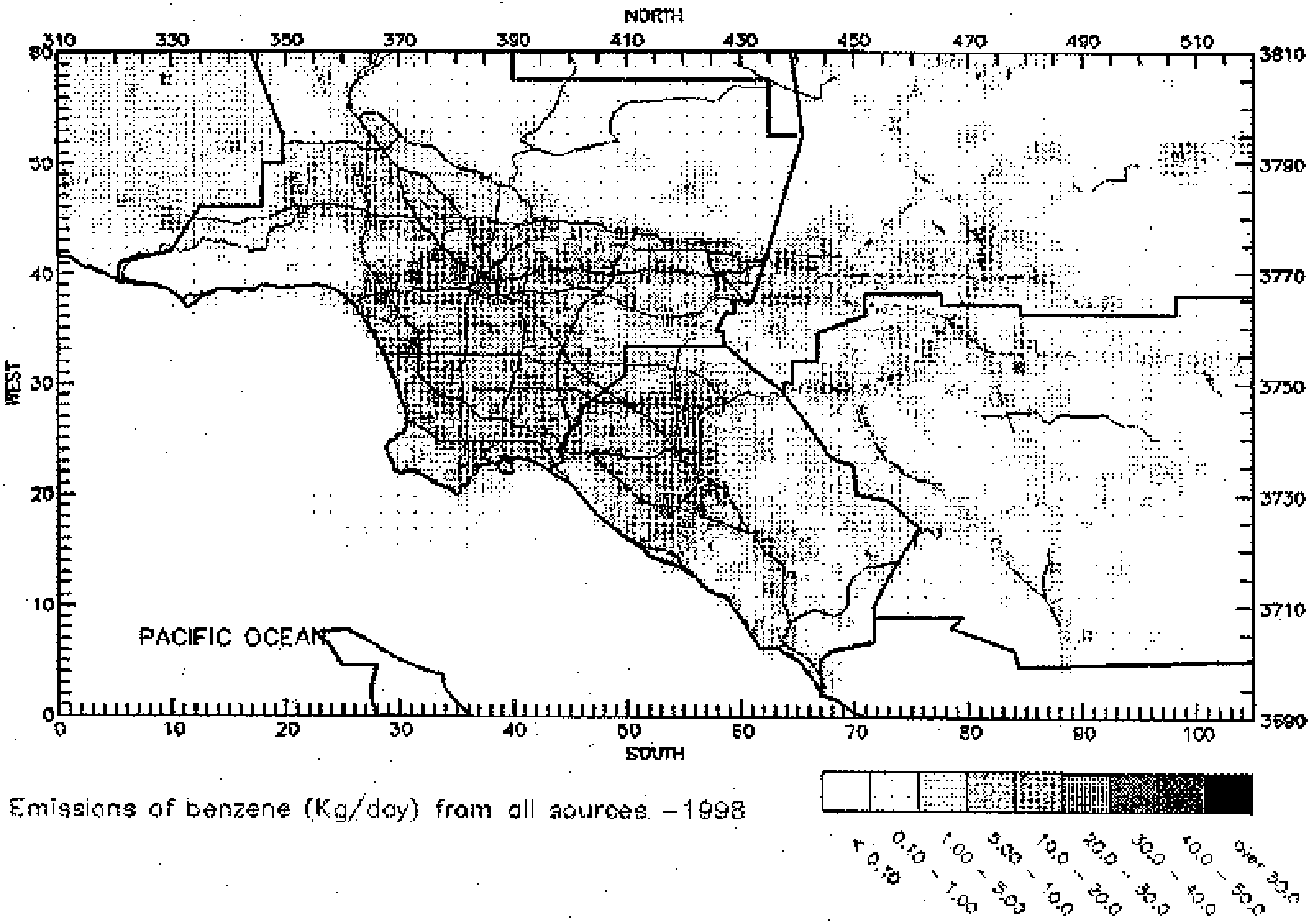


Figure 4.5 Spatial Distribution of Chrome Plating Facilities

Figure 4-6



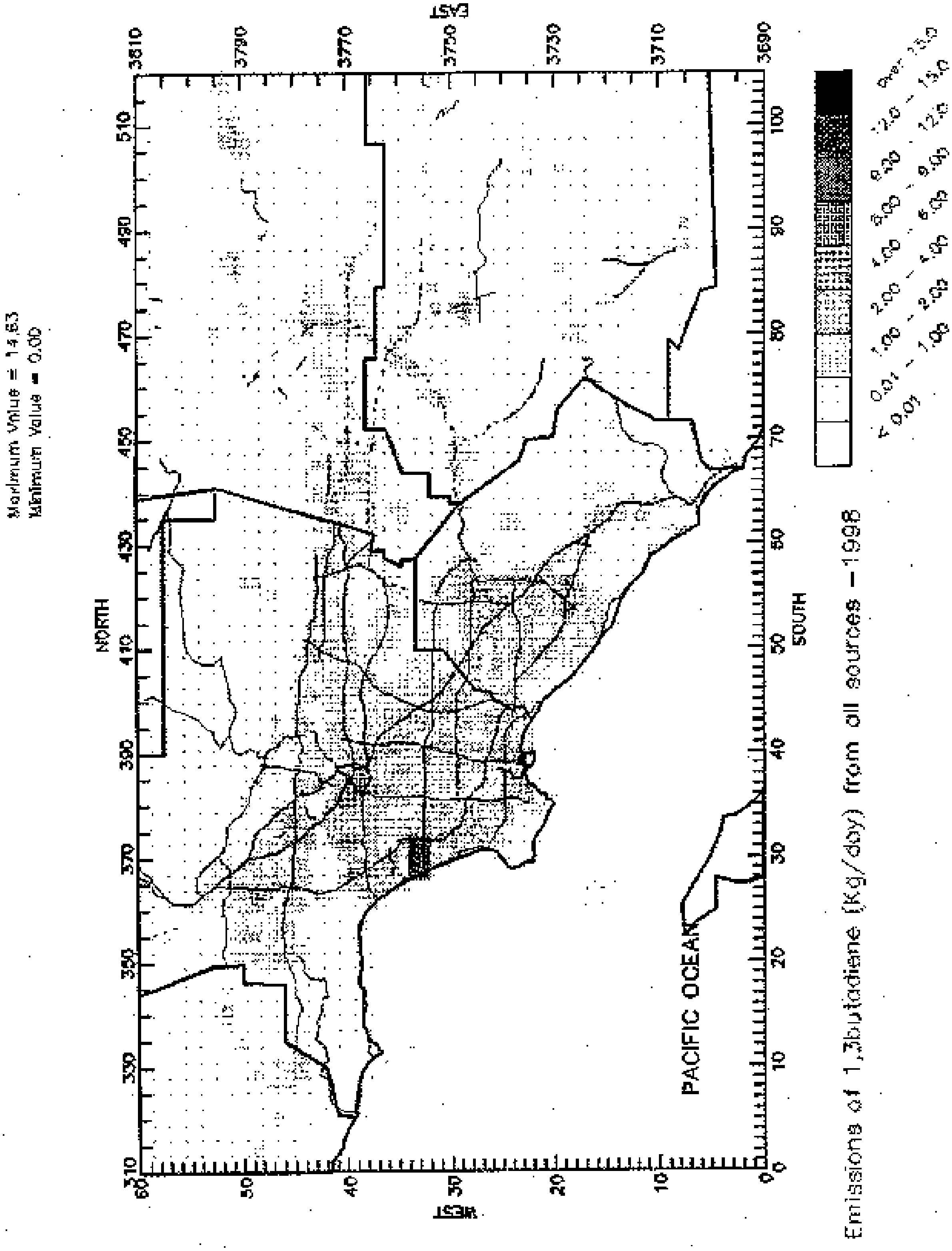
Emissions of diesel particles (PM2.5, Kg/day) from all sources —1998



Maximum Value = 40.89
Minimum Value = 0.00

Emissions of benzene (Kg/day) from all sources - 1998

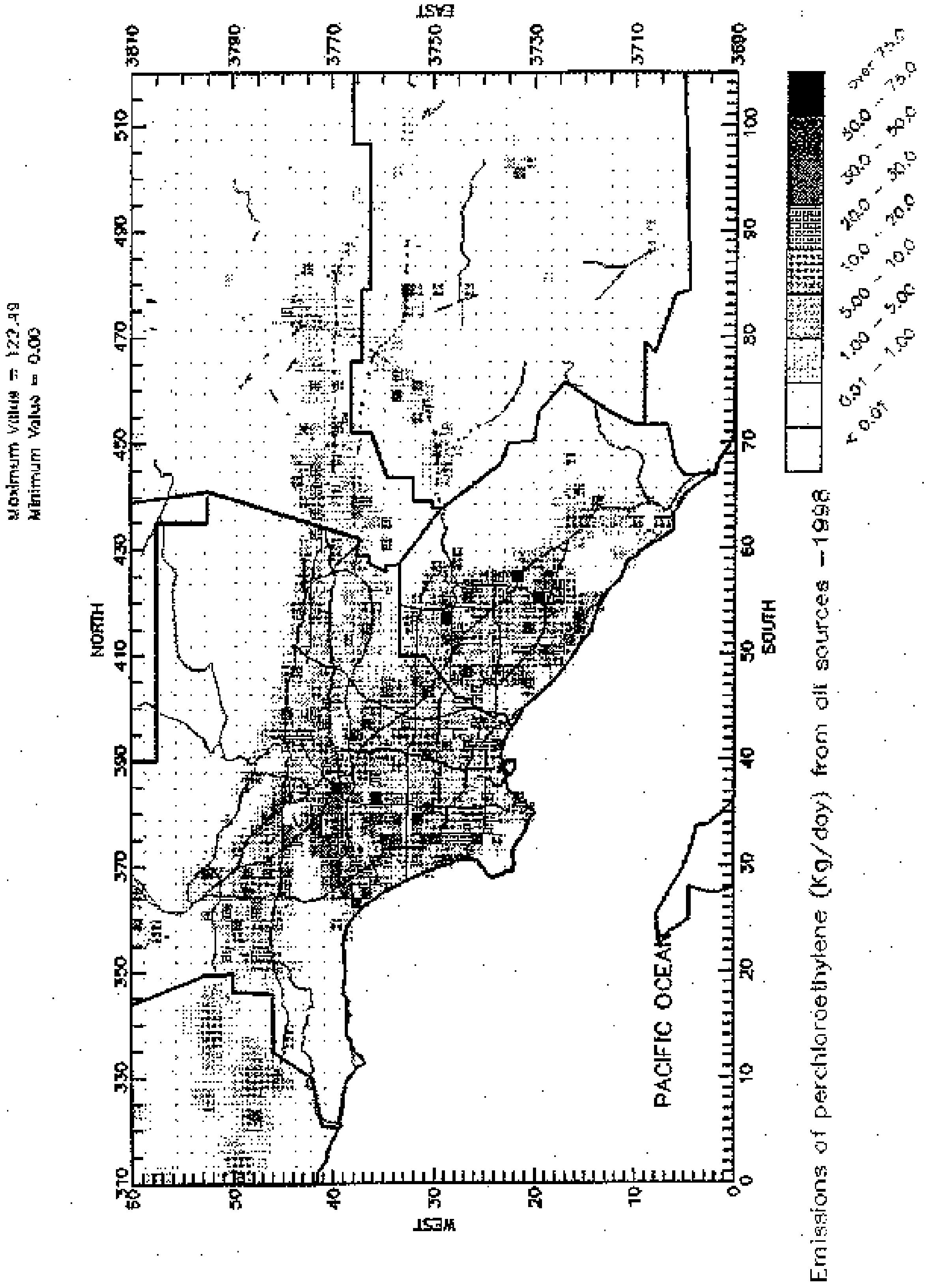
Figure 4-7



Maximum Value = 14.63
Minimum Value = 0.00

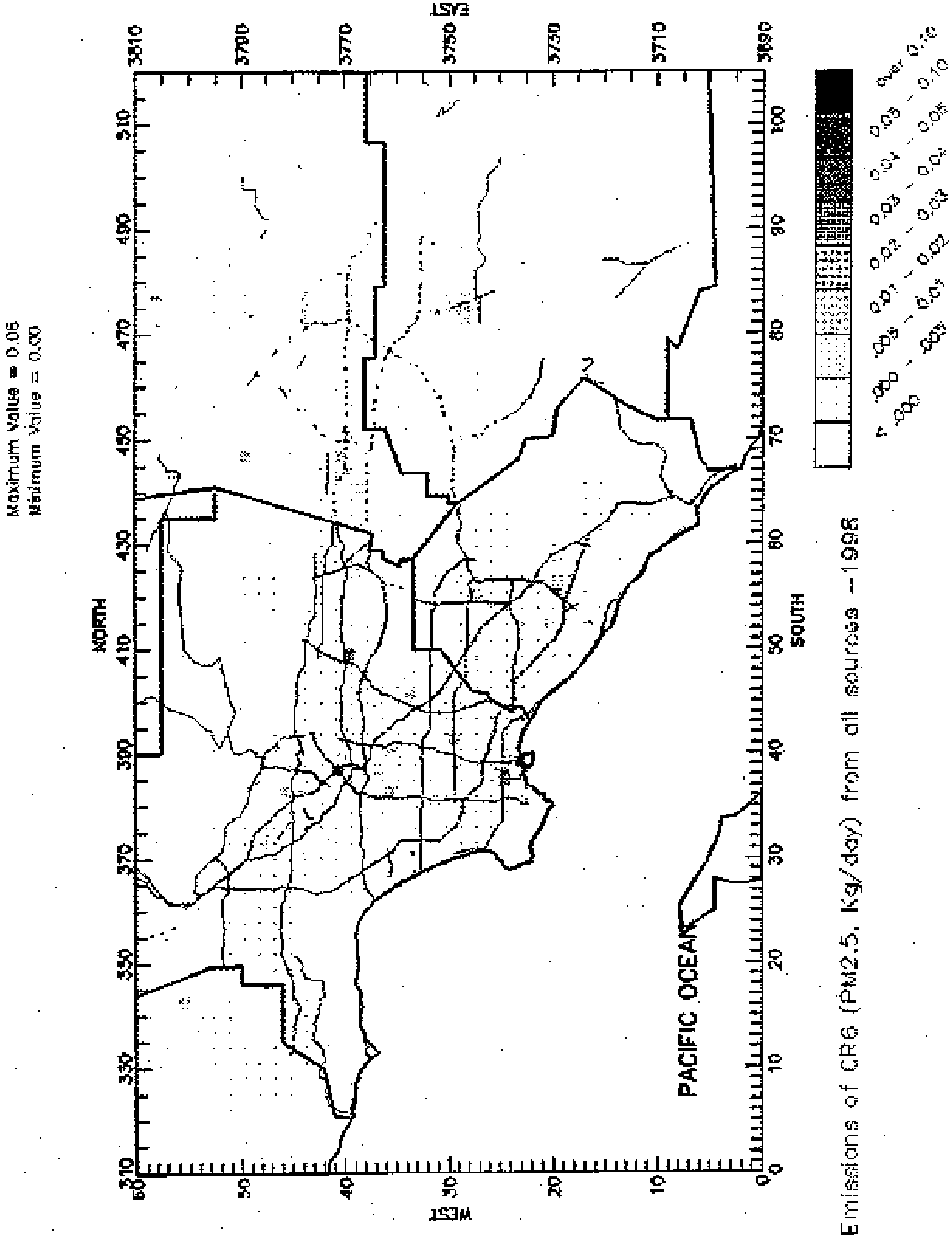
Emissions of 1,3butadiene (Kg/day) from all sources — 1998

Figure 4-8



Emissions of perchloroethylene (Kg/day) from all sources --1998

Figure 4-9



Emissions of CR6 (PM2.5, Kg/day) from all sources -1998

Figure 4-10

Chapter 5
Regional Model Evaluation

As part of the overall objectives of the MATES-II Program to estimate risk throughout the Basin, computer simulation models (state-of-science 3-dimensional computer models) were utilized. This chapter discusses the results of the regional modeling efforts. More detailed discussions of model input preparation are provided in Appendix V to this document.

5.1 3-Dimensional Simulation Models Evaluated

For the regional model simulations, the Urban Airshed Model (UAM) was used to simulate the dispersion of air toxic compounds based on their emission rates as discussed in Chapter 4. The UAM has been the U.S. Environmental Protection Agency's (U.S. EPA) recommended model for ozone attainment demonstrations. There are several models currently available for ozone simulation. These models are undergoing evaluations as potential models for the next Air Quality Management Plan (AQMP) revision. While the -U.S. EPA's version of the UAM may be considered dated, the model has been proven for ozone air quality analysis. Specifically, the dispersion algorithms are still appropriate to analyze the dispersion of inert species (or compounds). As such, the UAM is used to simulate the dispersion of the toxic compounds discussed in Chapter 4.

In addition to the U.S. EPA's version of UAM, a special version of UAM (called UAM-TOX) is applied to simulate the atmospheric reactions of volatile organic compounds (VOCs) and oxides of nitrogen (NOx) to account for the formation and/or destruction of several toxic VOC compounds. Specifically, the UAM-TOX is used to model VOC compounds such as 1,3 butadiene, toluene and styrene (which react in the atmosphere) and carbonyls such as formaldehyde and acetaldehyde (which form in the atmosphere).

Figure 5-1 shows the modeling domain used in the modeling analysis. The horizontal modeling domain covers 210 km from west to east and 120 km from south to north. Each horizontal grid cell is 2 x 2 km in resolution. Five vertical layers are used in the simulation. The UAM and UAM-TOX are applied to a full year of hourly meteorological data. The simulations are for the MATES-II monitoring period from April 1, 1998 to March 31, 1999.

5.2 Toxic Compounds Modeled and Model Performance Goals

A total of 34 compounds are modeled, and 29 of the modeled compounds have measurements collected at the 10 MATES II sites. Table 5-1 provides the 10 MATES II site average of the modeled and measured annual average concentrations of the 29 toxic compounds. The field instrument's monitoring detection limit for the 29 compounds are also provided in Table 5-1. Several toxic compounds have measured average concentrations at or slightly above the detection limit. As such, model simulations of these compounds are typically lower than measured and are often not comparable to the detection limit levels.

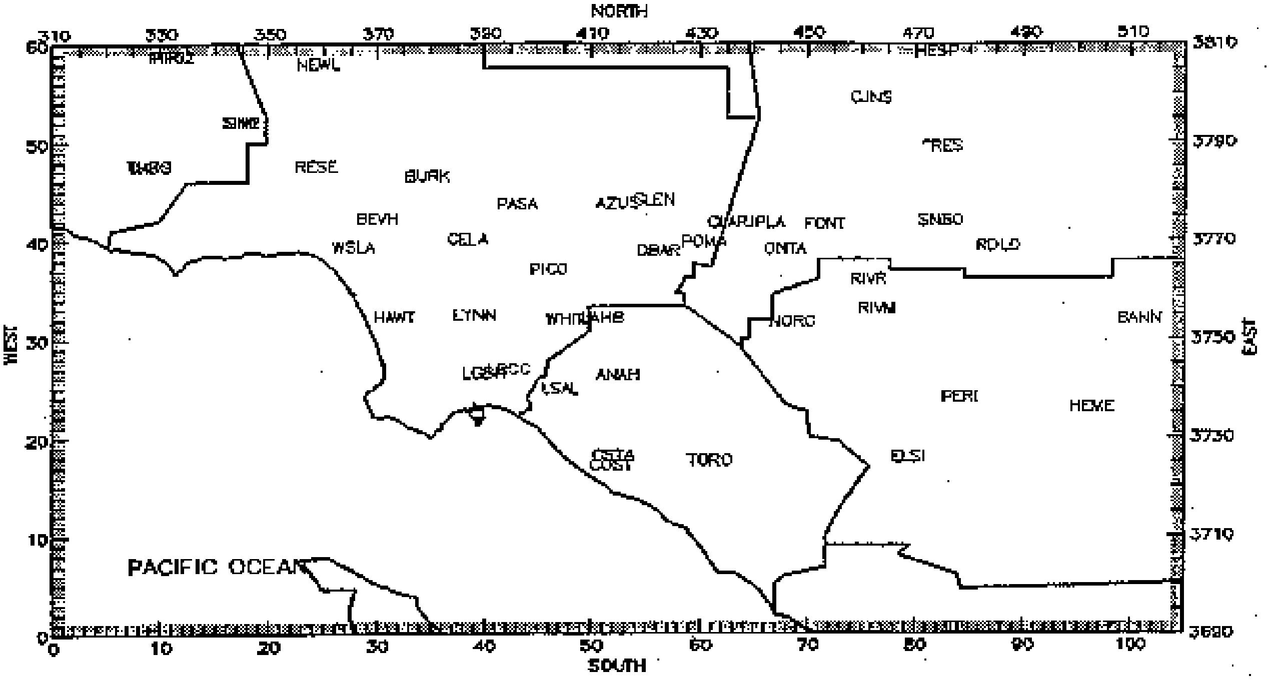


Figure 5-1 MATES-II Modeling Domain

The output of the UAM and UAM-TOX models is given as 24-hour average concentrations for the one-year period modeled. For the current analysis, the 24-hour average concentrations are compared to the corresponding measurements (that are also 24-hour average values). Traditionally, risk calculations are based on annual averaged concentrations. While variations may exist between model simulations and measurements on a daily basis, the longer-term averages tend to be more similar.

Model performance goals have not been established for simulating toxic compounds. However, based on prior ozone model evaluation experience, VOC model performance can vary by as much as an order of magnitude while ozone model performance can vary by as much as 50 percent. In addition, based on prior AQMP ozone modeling applications and recent information regarding mobile source emissions, it is anticipated that higher measured ozone levels will be underestimated in the current analysis. No attempt is made at this time to test the sensitivity of the model simulation. As such, it is expected that mobile source risk contributions will be underestimated by the simulation models.

Table 5-1
Toxic Compounds Modeled and Measured at the 10 MATES-II Sites

Toxic Compound	Modeled Annual Average ($\mu g/m^3$)	Measured Annual Average ($\mu g/m^3$)	Measurable Detection Limit ($\mu g/m^3$) [Percent Non-Detects]	
			ARB	AQMD
Benzene	3.13	3.53	0.639 [4]	0.319 [1]
1,3Butadiene	0.34	0.79	0.088 [4]	0.221 [14]
p-Dichlorobenzene	0.24	0.92	1.202 [-]	0.601 [47]
Methylene Chloride	1.08	2.65	3.476 [72]	0.348 [4]
Chloroform	0.08	0.24	0.098 [14]	0.488 [94]
Perchloroethylene	2.46	1.96	0.068 [3]	0.678 [17]
Trichloroethylene	0.26	0.43	0.107 [31]	0.537 [78]
Carbon Tetrachloride	0.78	0.65	0.126 [0]	1.258 [90]
Ethylene Dibromide	0.01	0.38	--	0.768 [100]
Ethylene Dichloride	0.10	0.26	--	0.405 [98]
Vinyl Chloride	0.01	0.26	--	0.511 [100]
Formaldehyde	5.49	4.82	0.123 [2]	0.123 [2]
Acetaldehyde	5.21	3.17	0.180 [3]	0.180 [3]
Acetone	2.78	5.00	--	0.238 [0]
Methyl Ethyl Ketone	1.72	1.06	0.295 [21]	0.295 [21]
Styrene	0.53	1.23	0.426 [-]	0.426 [25]
Toluene	12.17	12.98	0.754 [2]	0.377 [2]
1,1Dichloroethane	0.03	0.20	--	0.405 [100]
Chloromethane	1.24	1.31	--	0.206 [0]
Arsenic	1.69	1.56	0.003 [95]	0.004 [100]
Elemental Carbon	3.40	3.36	--	--
Organic Carbon	5.92	6.43	--	--
Chromium	0.01441	0.00487	0.002 [6]	0.002 [84]
Hexavalent Chromium	0.00024	0.00018	0.002 [84]	0.00006 [4]
Cadmium	0.00193	0.00605	--	0.001 [99]
Lead (point sources)	0.00292	0.0197	0.003 [0]	0.001 [-]
Lead (area sources)	0.04808	0.0197	0.003 [0]	0.001 [-]
Nickel	0.00775	0.00872	0.002 [9]	0.001 [2]
Selenium	0.00160	0.00197	0.002 [83]	0.001 [47]

However, when ARB finalizes the latest version of the on-road mobile source emissions factor model (EMFAC) and new off-road mobile source emissions, the model performance will be re-evaluated. Detailed discussions of the model performance are provided in Appendix V.

5.3 Model-Estimated Spatial Concentration Fields

Figure 5-2 shows spatial concentration fields simulated by the UAM for six of the 34 compounds (benzene, 1,3 butadiene, perchloroethylene, elemental carbon, hexavalent chromium and particulate emissions from diesel-fueled internal combustion engines). As seen in Figure 5-2, concentration levels vary throughout the Basin with higher concentrations generally seen close to their emission sources. For mobile source compounds such as benzene, 1-3 butadiene, and particulates associated with diesel fuels, higher concentration levels are seen along freeways and freeway junctions. In addition, higher concentrations of benzene and 1,3 butadiene are estimated in and around major airports. In particular, benzene and 1,3 butadiene tend to be higher around the Los Angeles International Airport area and in the south central portions of Los Angeles County. In addition, from Figure V-11 in Appendix V, it can be seen that particulate levels tend to be higher in the south central portions of Los Angeles County and offshore of San Pedro and Long Beach. ~~(Under the current ARB definition of a diesel-fueled internal combustion engines, engines associated with harbor crafts and commercial boats would be included. However, deep sea going vessels would not be considered.)~~

For perchloroethylene, higher concentrations are predicted in the Anaheim area as well as in the San Fernando Valley compared to other areas in the modeling domain. In addition to the higher perchloroethylene levels at Anaheim, high concentration levels of styrene are observed in November 1998 (see Appendix V). However, measured styrene levels during the other months are much lower. As seen in the spatial concentration field for styrene, (shown in Appendix V), model estimated annual values (located six to eight km from the Anaheim site) could be as high as the levels measured at the Anaheim location. This implies that the Anaheim monitoring site may be generally upwind of the sources of styrene.

5.4 Risk Assessment Calculations

Based on the spatial concentration fields estimated by the simulation models, risk estimates can be calculated for each grid cell of the modeling domain. There are two approaches for calculating risk [one is weighed by population, the other is using the model estimated concentrations and simply multiplying by the compound's unit risk factor (URF)]. The population weighted risk calculation is more appropriate. ~~However, this assumes that each person is outdoors all of the time.~~ The annual average concentration for the risk calculations are based on outdoor concentrations. (The annual average exposure to individuals from volatile chemicals may be higher if there are indoor chemical sources. For particulates, the indoor concentrations may be somewhat less. People may spend a large percentage of their time indoors.) The second approach does not assume any population in the calculation and is more appropriate when comparing with monitored concentrations. As such, both sets of numbers are provided in this Chapter.

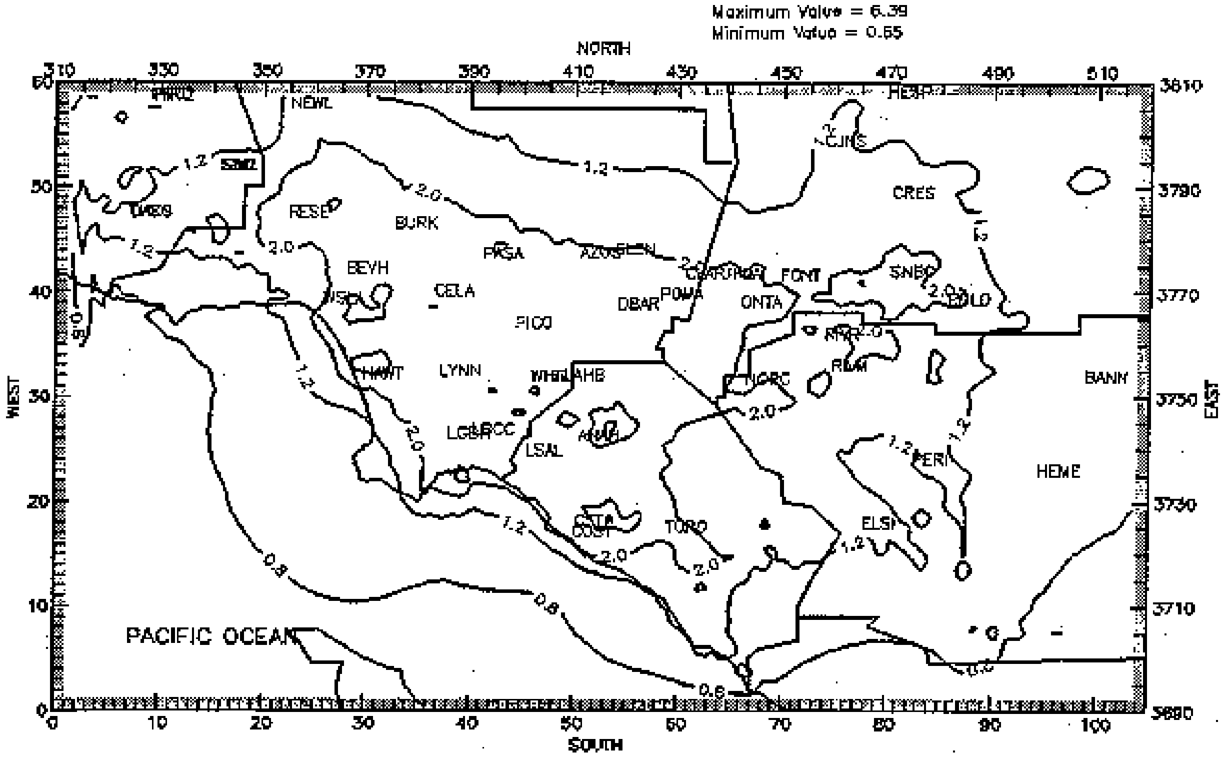


Figure 5-2a. Annual average benzene concentrations simulated for the Basin.

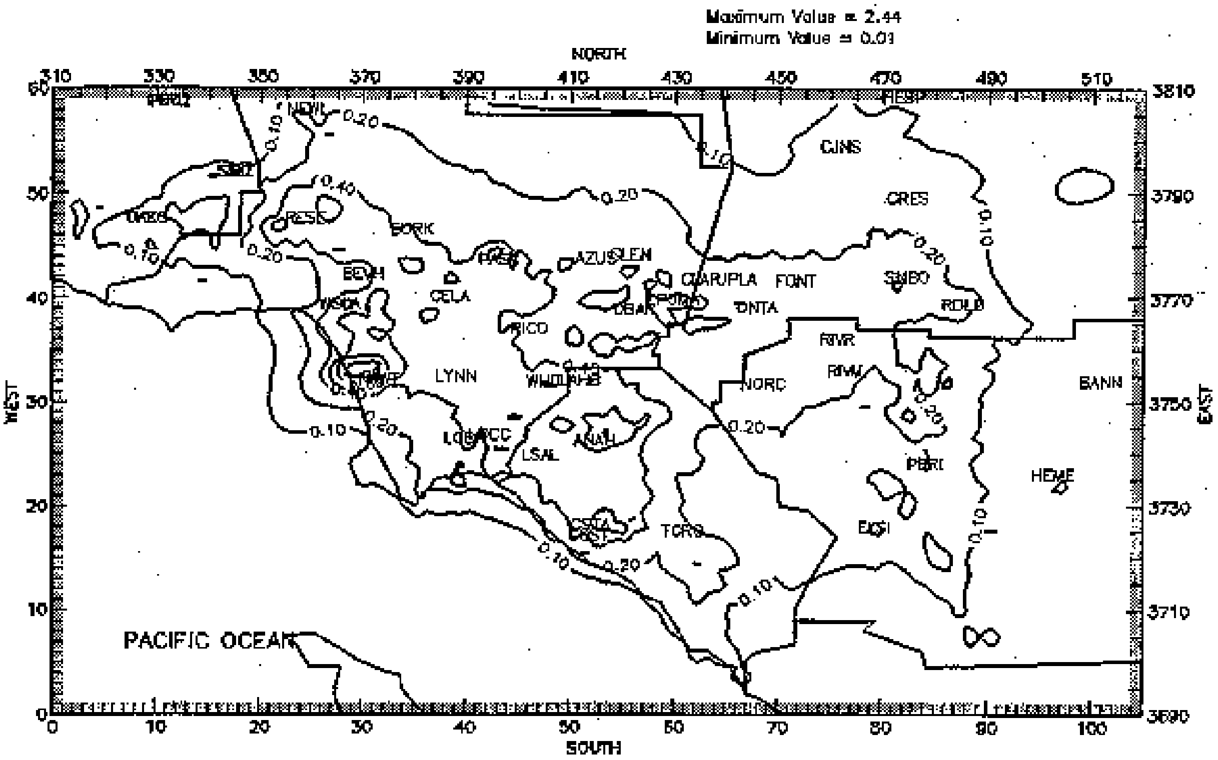


Figure 5-2b. Annual average 1,3 butadiene concentrations simulated for the Basin.

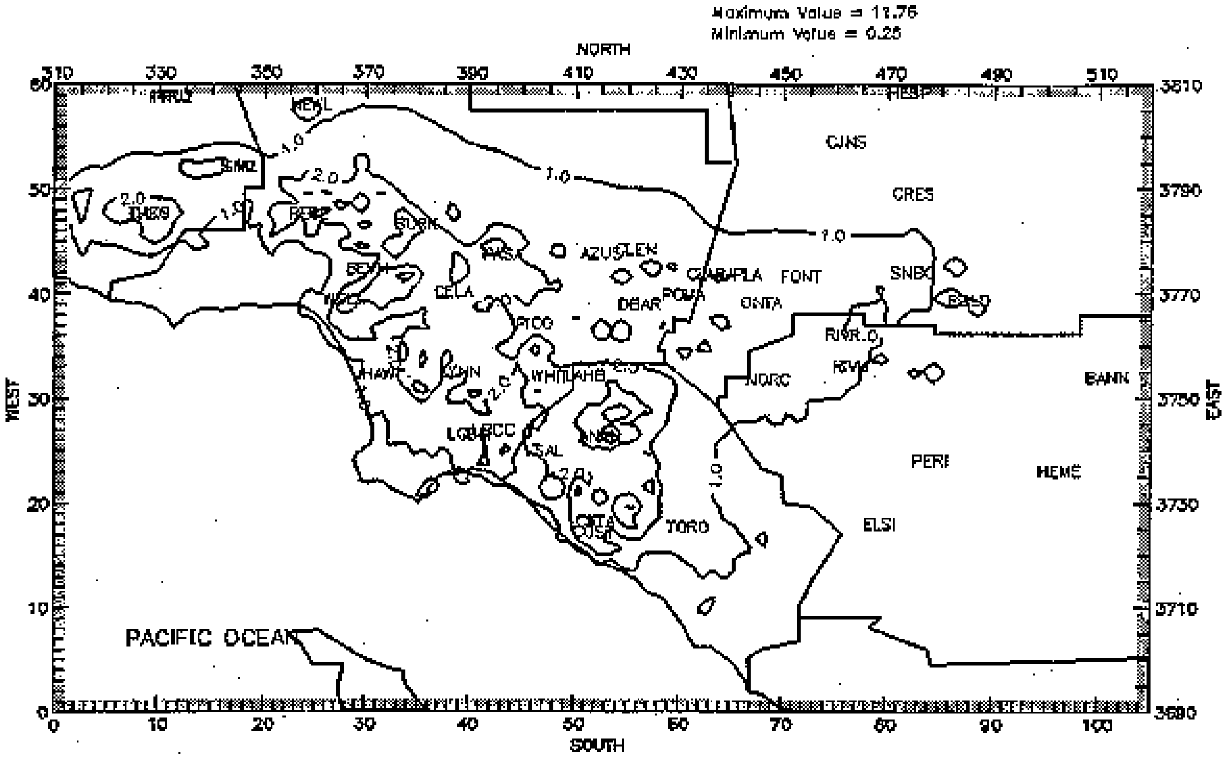


Figure 5-2c. Annual average perchloroethylene concentrations simulated for the Basin.

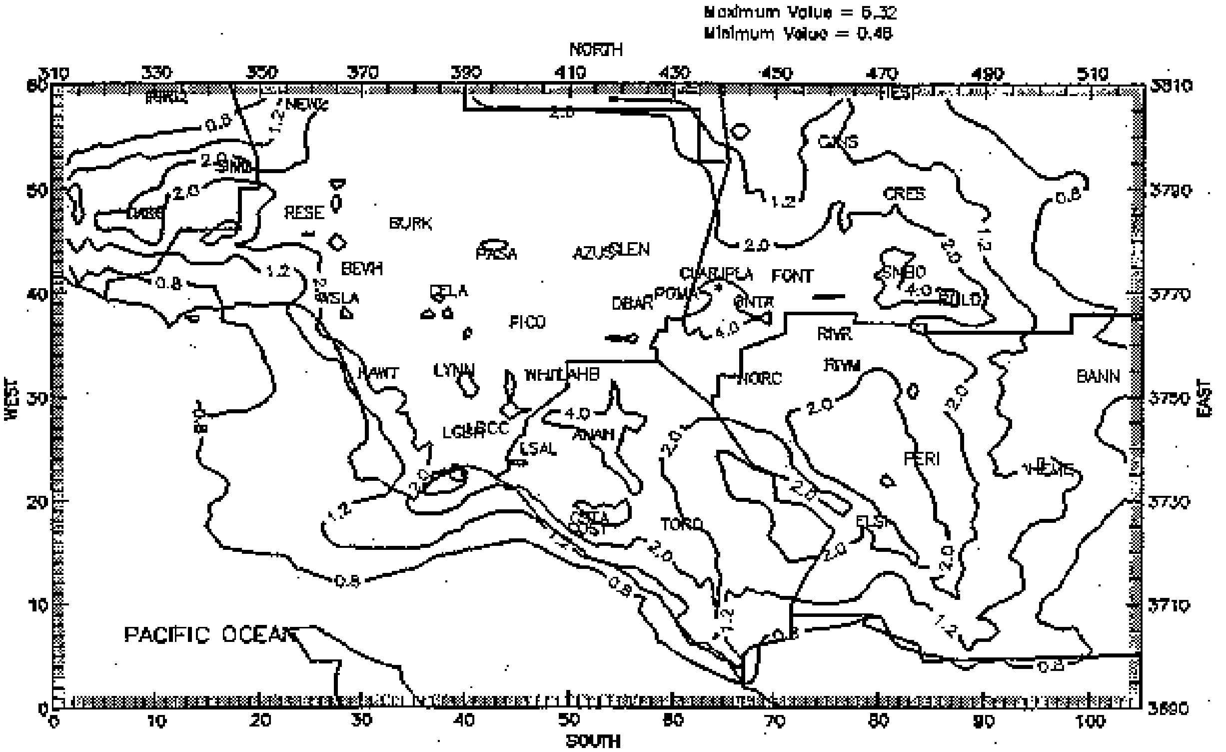


Figure 5-2d. Annual average elemental carbon concentrations simulated for the Basin.

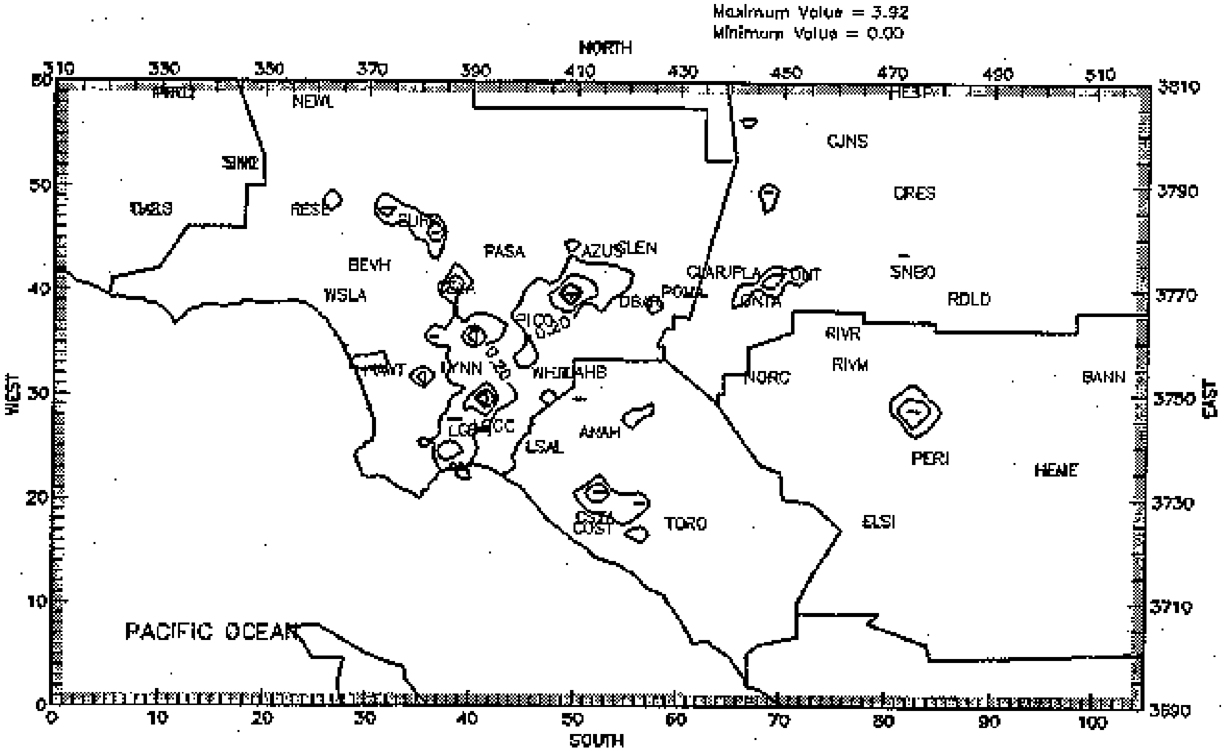


Figure 5-2e. Annual average hexavalent chromium concentrations simulated for the Basin.

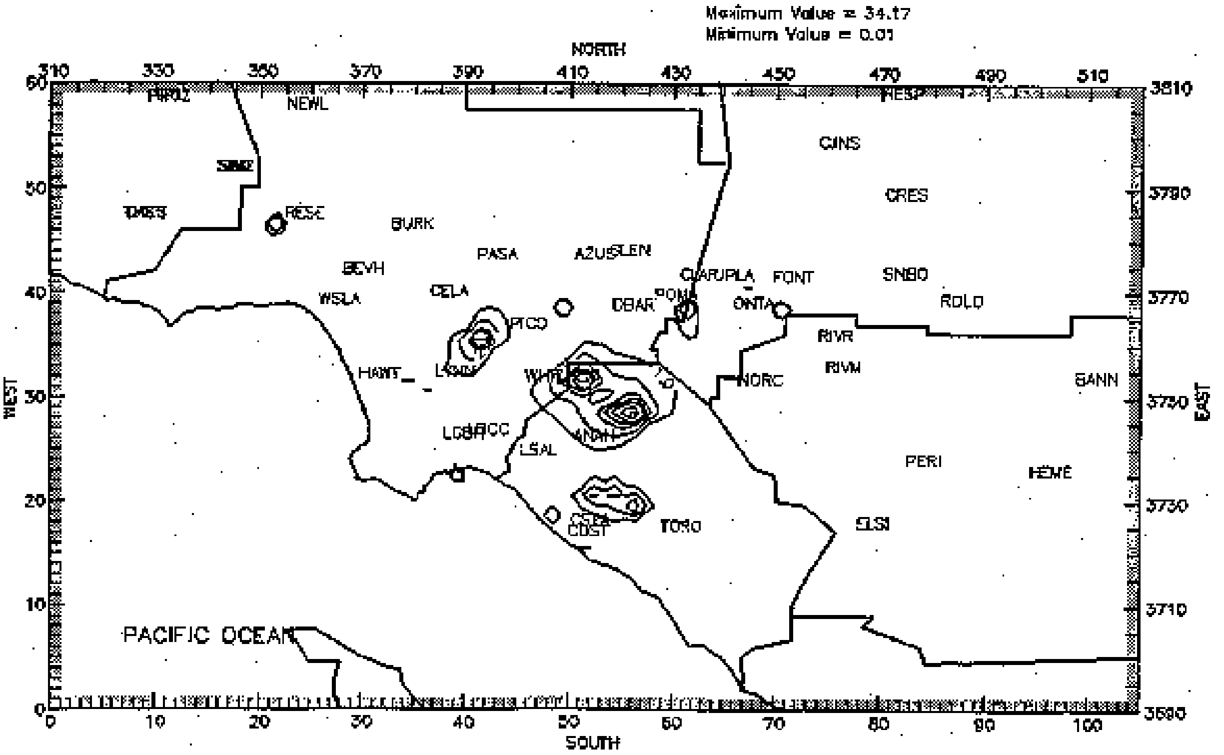


Figure 5-2f. Annual average styrene concentrations simulated for the Basin.

~~Figure 5-3a shows the model estimated risk at each grid cell for all modeled compounds with an associated URF. In addition to the total model estimated risk, Figure 5-3b shows the risk estimated excluding diesel sources. The cumulative risk averaged over the four counties of the South Coast Air Basin is about 980 in one million when diesel sources are included and about 260 in one million when diesel sources are excluded.~~

~~Table 5-2 shows the risk for the four counties in the South Coast Air Basin. The average risk levels ranges from 610 to about 1055 in one million with an overall Basin average of about 982 in one million. As seen from Table 5-2, Los Angeles County has the highest risk levels followed by Orange and San Bernardino counties. The lowest average risk is estimated in Riverside County.~~

~~Table 5-2~~
~~South Coast Air Basin Modeled Estimated Risk~~

	~~Population~~	~~Average Risk (per million)~~
~~Los Angeles County~~	~~9,305,726~~	~~1056~~
~~Orange County~~	~~2,579,974~~	~~940~~
~~Riverside County~~	~~1,249,554~~	~~612~~
~~San Bernardino County~~	~~1,269,919~~	~~922~~
~~Basin Average~~	~~14,404,993~~	~~985~~

~~To compare with the network average risk calculated based on concentrations measured at the ten MATES II sites, modeled concentrations in the grid cells of each of the ten sites are multiplied by their associated URFs (see Table 5-3). Table 5-3 presents the model estimated average risk over the ten sites. For comparison purposes to the monitored values an eight-site average is provided also (there were no measured elemental carbon at Compton or Wilmington). The overall average of the ten locations is about 1200 in one million (see Table 5-3) compared to the network average value of 1400 in one million based on measured concentrations. This analysis also indicates that the average basin risk may be 17% lower than the average risk based on the actual monitoring sites (i.e., 1170 in a million, rather than 1400 in a million).~~

Table 5-2 shows the risk for the four counties in the South Coast Air Basin. The average risk levels ranges from 619 to about 1048 in one million with an overall Basin average of about 981 in one million. As seen from Table 5-2, Los Angeles County has the highest risk levels followed by Orange and San Bernardino counties. The lowest average risk is estimated in Riverside County.

Table 5-2. South Coast Air Basin Modeled Risk and Expected Excess Cancer Cases

	Population	Average Risk (per million)
Los Angeles County	9,305,726	1048
Orange County	2,579,974	940
Riverside County	1,249,554	619
San Bernardino County	1,269,919	926
Basin Total	14,404,993	981

To compare with the network average risk calculated based on concentrations measured at the ten MATES-II sites, modeled concentrations in the grid cells of each of the ten sites are multiplied by their associated URFs (see Table 5-3). Table 5-3 presents the model estimated average risk over the ten sites. For comparison purposes to the monitored values an eight-site average is provided also (there were no measured elemental carbon at Compton or Wilmington). The overall average of the ten locations is about 1200 in one million (see Table 5-3) compared to the network average value of 1400 in one million based on measured concentrations. This analysis also indicates that the average basin risk may be 16% lower than the average risk based on the actual monitoring sites (i.e.. 1180 in a million, rather than 1400 in a million).

5.5 Conclusion

Overall, the UAM and UAM-TOX model perform within ±50 to 60 percent of measured annual values. However, the model performance varies significantly on short-term averaged concentrations. In addition, given that mobile source emissions are most likely underestimated with the current ARB mobile source emission factor models, the model performance would improve somewhat with the latest versions of the mobile source models.

The spatial concentration fields show that higher concentrations generally occur near their emission sources. Higher concentrations of compounds that are emitted primarily from stationary and area sources tend to be highest within a few kilometers from the source location. Mobile source related compounds such as benzene and 1,3 butadiene tend to be generally high throughout the Basin. However, the models estimate spatial variations with higher concentrations occurring along freeway corridors and junctions. In addition, higher levels of mobile source related compounds are estimated near major mobile source activities such as airports and other areas with major industrial activities such as south central Los Angeles County, and the industrial areas of Orange, Riverside, and San Bernardino counties.

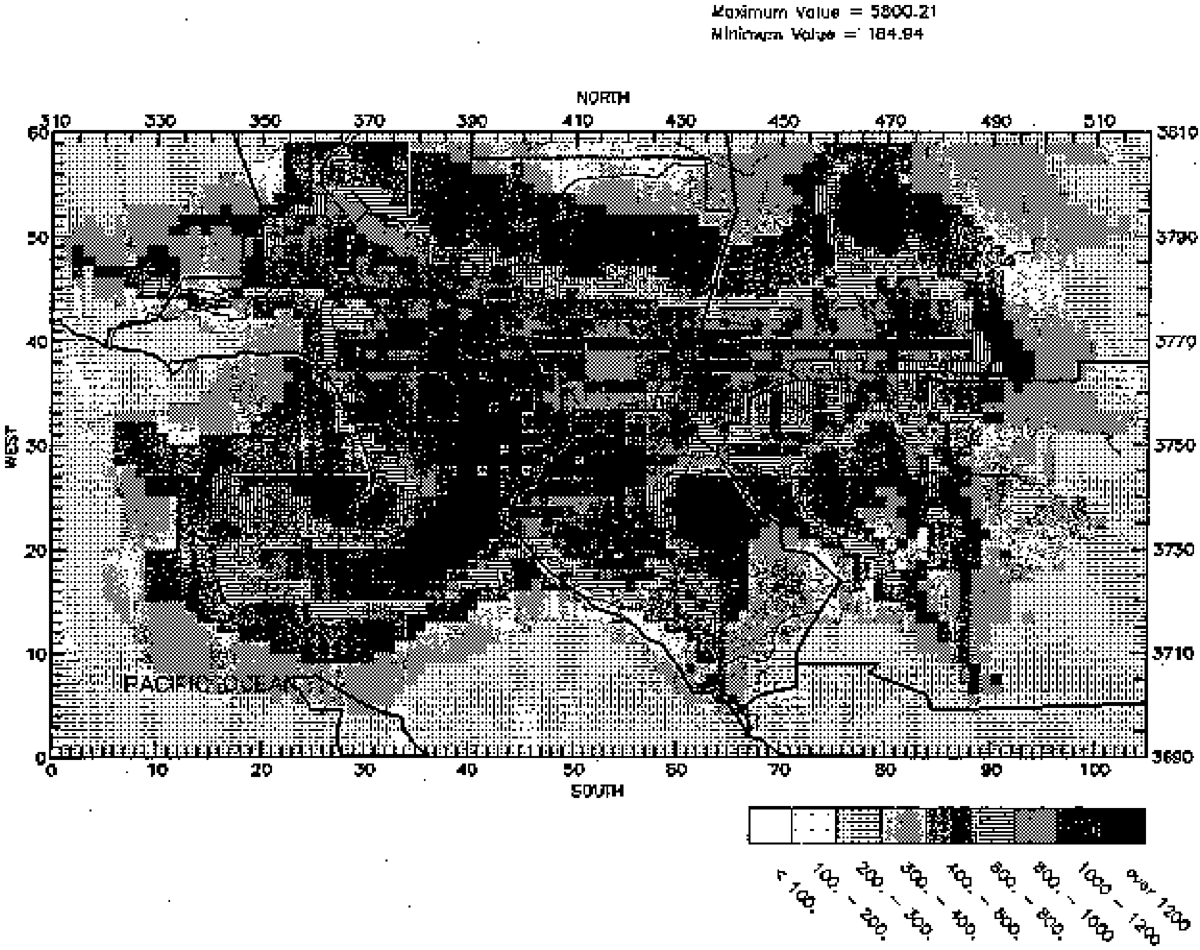


Figure 5-3a. Model estimated risk for the Basin
(Number in a million, all sources)

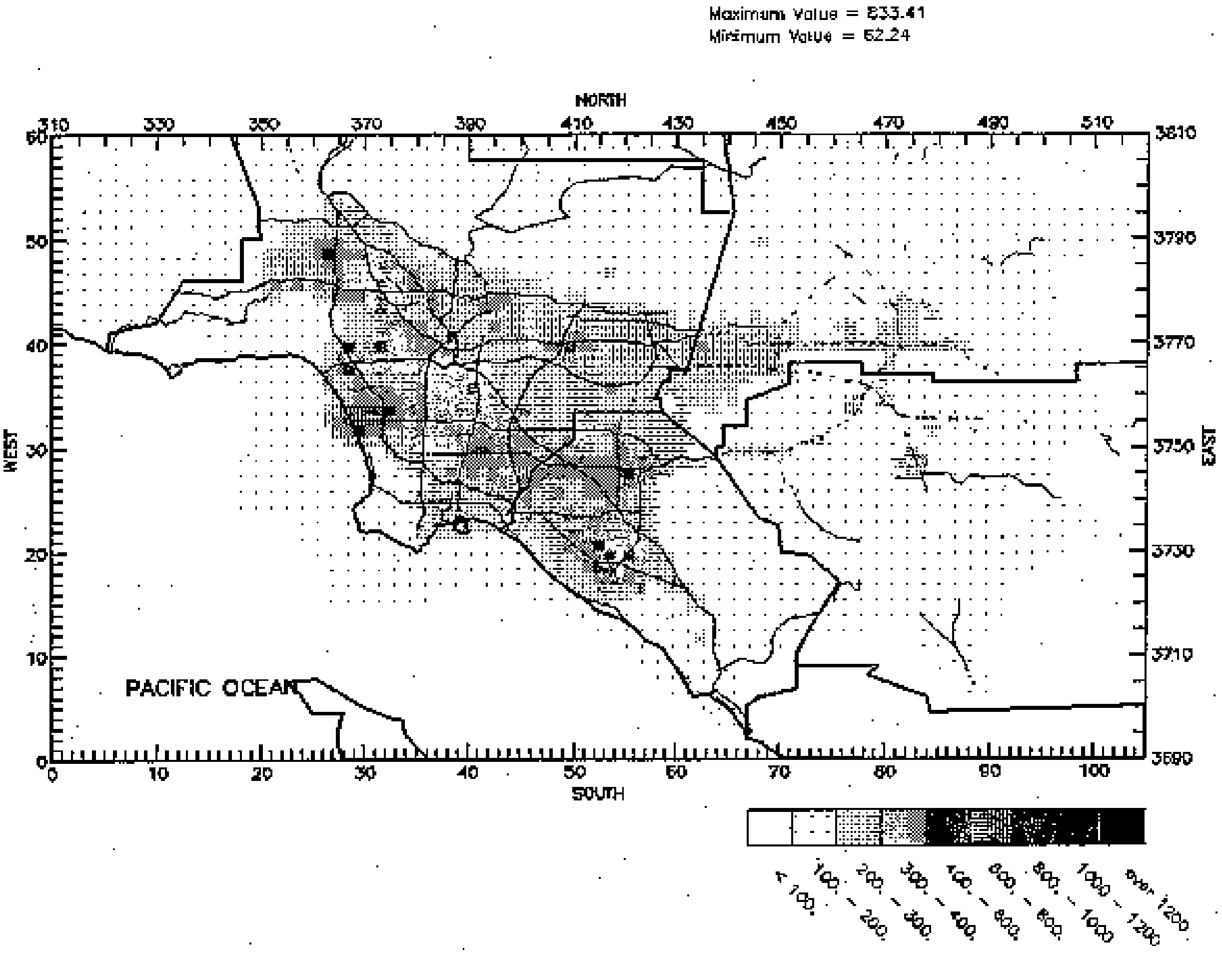


Figure 5-3b. Model estimated risk for the Basin (without diesel sources).

Table 5-3. Comparison of the Network Averaged Modeled Risk to Measured Risk at the Ten MATES-II Sites

	Benzene	1,3 Butadiene	Other	Diesel	Total
Anaheim	119	87	161	963	1330
Burbank	93	62	164	842	1161
Compton	96	65	147	994	1302
Fontana	48	19	120	752	939
Huntington Park	88	61	179	867	1195
Downtown L.A.	94	65	170	1176	1505
Long Beach	88	58	138	920	1204
Pico Rivera	77	43	142	869	1131
Rubidoux	57	26	107	797	987
Wilmington	81	46	222	1182	1531
Modeled Average	**84**	**53**	**155**	**936**	**1228**
Modeled Average*	**83**	**53**	**147**	**898**	**1182**
Monitored Average*	**92**	**118**	**187**	**1017**	**1414**

* Eight monitoring site average excluding Wilmington and Compton where elemental carbon was not measured.

Chapter 6

Microscale Study

6.1 Introduction

The microscale study utilized mobile platforms to sample for four-week periods at selected locations, then moved to other sites for similar sampling. The objectives for this element were to determine if communities are experiencing localized hot spots not otherwise determined by the fixed site MATES-II monitoring; to confirm hot spot areas indicated by modeling; to respond to public concerns; and to assess the localized representativeness of the monitoring. Two mobile platforms were employed to collect ambient toxics measurements to meet the objectives. Sampling was conducted on a more intensive basis than the MATES-II element, but for only four weeks at a time.

A third mobile platform was used to sample as a microscale site, but limited to only two locations, sampling at each site during each seasonal quarter. This platform represented more of a "hybrid" approach between the MATES-II fixed sites and the microscale sites.

It should be noted that the intent to investigate a number of different sites. ~~given limited~~with available -resources. limited the power of the microscale study to detect localized disparities in air toxic levels. The microscale study should therefore be regarded as more of a "pilot study" than as a study to definitively address possible differences in community air pollutant exposures within the South Coast Air Basin. These factors should be taken into consideration to avoid possible over-interpretation of the results.

6.2 Site Selection Process

For the microscale sites, a multi-step process was used. First, to determine appropriate locations for the mobile platforms, locations of known facilities which emit toxic air contaminants were plotted on maps to determine "clusters" of facilities. Next, aerial photos were used to determine locations where residential areas abutted, and were immediately downwind of these clusters. Seasonal wind patterns were considered such that predominant seasonal flows helped to determine the appropriate season for sampling. Most of the microscale sites were in Los Angeles County where the greatest levels of toxic emissions occur, but at least two microscale locations were selected from each of the other three counties. Of the 14 microscale sites, three (Montclair, Norwalk and Rialto) were selected because of influence and proximity to major mobile sources (e.g. congested freeways).

Two of the microscale sites were semi-fixed. These sites were in Pacoima and Hawthorne and were used to sample for the species of interest for the MATES-II. These two sites were incorporated to study seasonal variability of the pollutants species measured. Table 6-1 lists the addresses and sampling periods of the monitoring sites; Figure 6-1 shows the locations of the sites on a map of the Basin. Appendix VI contains location maps for each of the sites.

In Table 6-2, the expected winds used for the siting designs, and the actual prevailing winds as measured at the sites are shown. (Because of seasonal variability in prevailing wind directions, neither Hawthorne nor Pacoima were selected based upon expected wind condition.) It can be seen that for the most part, actual wind conditions were close to the expected conditions. Notable exceptions are at Norwalk and Corona, where prevailing winds were almost one quadrant (i.e., 90 degrees) different than expected. Thus at these sites, presumed influences from the facility clusters cannot be assumed. (Note that because the two "hybrid" sites, Hawthorne and Pacoima, were sampled over four seasonal months, there were no expected prevailing conditions; hence, these sites are not included in the table.) Descriptions of wind conditions and accompanying wind "roses," by site, are included in Appendix VI.

Table 6-1
Microscale Monitoring Sites

Abbrev.	Site	Period of Record	Address
Microscale Sites			
AN	Anaheim	12/31/98 – 02/02/99	1316 Paradise Ct., Anaheim 92806
BH	Boyle Heights	09/26/98 – 10/29/99	1100 Spence St., Los Angeles 90023
CO	Corona	10/22/98 – 11/25/98	1080 Pomona Rd., Corona 91720
CM	Costa Mesa	08/15/98 – 09/08/98	2045 Meyer St., Costa Mesa 92627
MO	Montclair	07/02/98 – 08/01/98	5450 Deodar St., Montclair 91763
NO	Norwalk	11/13/98 – 12/16/98	12901 Hoxie Ave., Norwalk 90650
RI	Rialto	03/19/99 – 04/30/99	200 W. Valley Blvd., Rialto 91720
RV	Riverside	03/10/99 – 04/21/99	J. W. North HS 1150 - 3rd. St., Riverside 92507
SP	San Pedro	03/25/99 – 04/27/99	202 S. Palos Verdes St., San Pedro 90731
EM	South El Monte	05/09/99 – 06/11/99	2550 Edwards Ave., So. El Monte 91733
TO	Torrance	07/21/98 – 09/05/98	631 Border Ave., Torrance 90503
VN	Van Nuys	01/09/99 – 02/17/99	16101-1/2 Roscoe Blvd., Van Nuys 91406
Microscale Seasonal Sites			
HA	Hawthorne	05/09/98 – 06/02/98 07/13/98 – 08/13/98 10/07/98 – 11/11/98 01/06/99 – 02/23/99	5234 W. 120th. St., Hawthorne
PA	Pacoima	06/27/98 – 09/14/98 11/18/98 – 12/13/98 01/15/99 – 02/23/99	11251 Glenoaks Blvd., Pacoima 91331

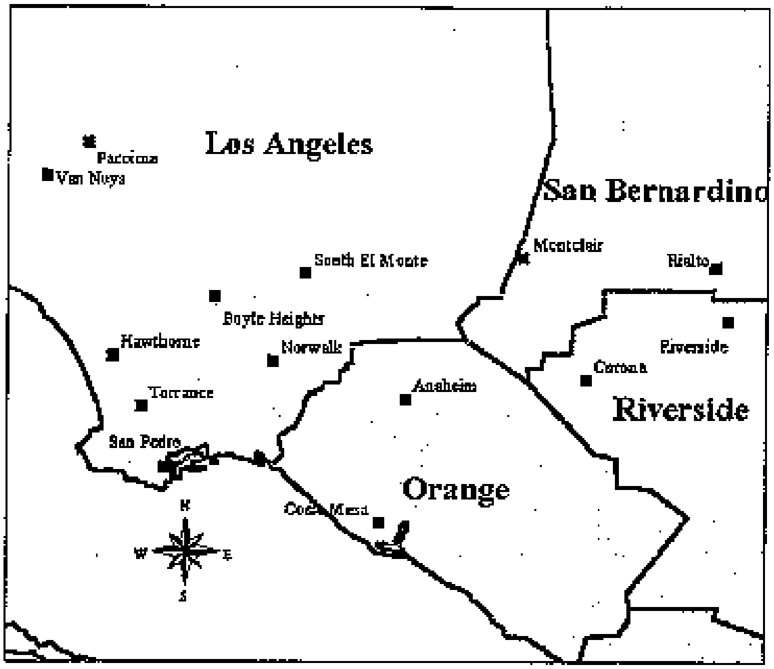


Figure 6-1
Location of Microscale Sites

Table 6-2

Comparison of Expected Versus Actual Prevailing Winds at the Microscale Sites

Microscale Site	Expected Wind Direction	Actual Prevailing Wind
Boyle Heights	WSW	WSW
Torrance	NW	W
Van Nuys	NNW	N
Norwalk	WNW	N
Montclair	W	W
Costa Mesa	SW	WSW
Anaheim	NE	NNW & WSW
Corona	N	WNW
Riverside	NW	W
Rialto	WSW	WSW
San Pedro	NW	WNW
South El Monte	WSW	WNW

6.3 Analytical Approach

The microscale program employed mobile platforms at 14 communities for more intensive sampling, but for a more limited period of sampling, than occurred at the 10 fixed sites. Typical sampling periods were four to five weeks, with two to three samples per week. This differed from the fixed site schedule of one sample every sixth day for a full year. At the outset, the microscale samples were collected to optimize field efficiency, irrespective of the fixed site schedule. It was noted by the ATSTRG that a better approach would be to have as many samples coincide with the fixed site schedule to gain a greater number of comparative samples. Thus, for the first six months of the study, two to three samples collected at a microscale site were taken on the same days as fixed site sampling. For the latter six months, the number of coincidental samples increased to five. (Because microscale samples were only analyzed by the AQMD laboratory, and because some differences in analytical results occurred between AQMD and ARB laboratories, for purposes of comparisons between microscale and fixed sites, only those samples analyzed in the AQMD laboratory were used.) Laboratory analytical techniques followed the same procedures as described for the MATES-II fixed sites, except that VOC samples were collected in 8-hour increments over the course of one day, from 0000-0800, 0801-1600, and 1600-2400. At the fixed sites, one 24-hour integrated sample for VOCs was collected.

6.4 Monitoring Results and Findings

As shown previously in the discussion on the MATES-II sites, there are strong seasonal variations in toxic concentration levels and associated carcinogenic risks. This presents a significant limitation in estimating annualized risk conditions with only a one-month period of sampling at the microscale sites. If there were no seasonal differences, then limited sampling could be used to reasonably approximate an annual condition. With strong seasonality, the ability to estimate annual conditions is predicated on statistical analyses to determined confidences in such estimates. These confidences are improved somewhat where coincident sampling dates occur. When sampling occurs on different dates, changes in meteorology or emissions on a day sampled at a microscale site as compared to a different day sampled at a fixed site, add another level of complexity which cannot be fully accounted for. Given these uncertainties, certain types of limited analyses can at least yield insights and dimensions which can add useful information to that obtained from the fixed site network. The most useful information is obtained by comparing a microscale site to its geographically closest fixed site during the period when the microscale site was operating. That way, comparisons are made for the same seasonal time frame without extrapolating to an annual condition. It also means that, where seasonal variability is large, one microscale site cannot be compared to another microscale site. It is the microscale-fixed site pairings that are most useful.

6.4.1 Microscale-Fixed Site Comparisons

To evaluate the data collected for each microscale site and its paired fixed site, statistical analyses were conducted and summaries were compiled. These are presented in Appendix VI, where complete descriptions for each of the microscale sites are presented, along with details about the data collected, the emissions inventories compiled, and the modeling conducted.

Table 6-3 summarizes the results of the paired analyses, which depict those comparisons in which the microscale sites are statistically greater than the paired fixed site. (Since the purpose of the microscale program is to focus on localized "hot spots," those situations where the fixed sites are statistically greater than the microscale sites are not shown.) As can be seen in this table, there are relatively few cases where the microscale sites are statistically greater than its corresponding fixed site. Most of these differences are with regard to the carbonyls, including formaldehyde, acetaldehyde, acetone, and methyl-ethyl-ketone (MEK). The latter two are not considered carcinogens. At 7 of the 13 paired sites, at least one of these compounds is statistically greater at the microscale sites. We believe this observation may be an artifact of the difference in sampling times. At the fixed sites, one 24-hour sample was collected on each sampling day, while at the microscale sites, three 8-hour samples were collected on each sampling day, with the results averaged to represent 24 hours. Experts on sampling carbonyls have suggested that reactions can take place over 24 hours which can reduce the level of some compounds by the time the laboratory analyses are conducted. Thus there may be a bias in favor of lowered measurements at the fixed sites, resulting in the higher number of significant differences for these compounds. Further, formaldehyde and acetaldehyde are more commonly associated with mobile sources, not stationary sources. With no significant differences observed for either benzene or 1,3 butadiene (key mobile source-related compounds) at any of the 13 paired sites, it is more likely that methodological differences are accounting for these results.

Table 6-3
Summary of Cases: Microscale Site > Fixed Site with 90% Confidence

Pollutant	Anaheim	Boyle Heights	Costa Mesa	Corona	Hawthorne	Montclair	Norwalk	Pacoima	Rialto	Riverside	San Pedro	Torrance	Van Nuys
Chloromethane [1]													
Chloroethane													
1,3 Butadiene													
1,1 Dichloroethane [1]													
Methylene Chloride	x												
1,1 Dichloroethane													
Chloroform						x							
Ethylene Dichloride													
Benzene													
Carbon Tetrachloride													
Trichloroethene						x	x						
Toluene [1]													
Ethylene Dibromide													
Perchloroethylene													
Ethylbenzene [1]													
(m+p)-Xylene [1]						x							
Styrene [1]	☒			x									
o-Xylene [1]													
p-Dichlorobenzene													
o-Dichlorobenzene [1]													
Formaldehyde *	x		x	x		x					☒		
Acetaldehyde *	x						x				x		
Acetone * [1]	x	x	x	x		x	x				x		
MEK * [1]	x												
Hexavalent Chromium													
Arsenic													
Nickel													
Selenium [1]													
Cadmium													

* Measurement methodological differences may be causing the statistical differences shown for these compounds.

[1] No risk factors established for these pollutants.

x Levels at Microscale site > levels at Fixed Site with 90% confidence.

☒ Subset of x, but with substantially greater concentrations at the microscale site

There is one exception, and that is for formaldehyde at San Pedro. Relatively few samples are available for the paired analyses because the sampling period extended beyond March 1999 when the fixed site network completed one year of sampling. Levels observed at San Pedro not only are statistically higher than its paired site at Wilmington, but the levels measured during this period were considerably higher than at any other fixed site in the network. Examination of the data from all samples for the carbonyls at San Pedro are shown in Table 6-4. What is unusual about the formaldehyde data is that there appears to be decreasing levels over time. If there was a local source, there would likely be significant changes among the three time periods as winds changed from daytime to nighttime flows. Since the within-day levels are reasonably constant, but the changes from the beginning of the sampling period in March to the end of the period in April are very substantial, an extremely close source is suspected. The San Pedro site was located on a vacant lot near an apartment complex, so there are no known nearby sources to account for the observed levels. Initially, it was suspected that modifications made to the platform may have caused "outgassing" of formaldehyde. Building materials and certain adhesives found in carpeting outgass formaldehyde for a limited period of time. However, modifications to the platform in response to meeting city permit criteria involved only electrical modifications which would not be a source of formaldehyde. It is suspected that contamination of the sampling equipment is the cause of this anomaly. Decreasing levels of formaldehyde over time coupled with insensitivity to wind directional changes are not characteristics of local source influences. Also, the relationship between formaldehyde and acetaldehyde, which was shown in the fixed site network to be highly correlated, did not exhibit the same relationship at the San Pedro site. Therefore, we believe these data are not representative of ambient conditions in the Basin, but rather an artifact of sample contamination.

Aside from the carbonyls, it can be seen from Table 6-3 that there are only seven cases of statistical significance for microscale compounds out of a total of 325 possible pairs (24 compounds times 13 paired sites.) For methylene chloride, one case was observed at the Anaheim-Anaheim pair. Because this compound does not show strong seasonal variation (as shown in Figure 3-5) it is reasonable to be able to compare to other fixed sites without introducing distortions that would otherwise occur for compounds which exhibit seasonal variations, such as benzene or 1,3 butadiene. Levels of methylene chloride measured at the Anaheim microscale site were close to levels observed at Huntington Park, Compton, and Burbank. Furthermore, the levels observed at the Anaheim fixed site were the lowest of any of the fixed sites used in the paired analyses. Thus we can conclude that the statistical difference observed was more a result of very low levels at the Anaheim fixed site than as a result of having unusually high levels at the microscale site.

V

Table 6-4
Carbonyl Results at San Pedro Site

Date Field		see below		Formaldehyde		Acetaldehyde		Acetone		MEK	
	Station	Interval	Cartridge	(ppbv)	MDL	(ppbv)	MDL	(ppbv)	MDL	(ppbv)	MDL
3/25/99	San Pedro	8A	826A	32.0	0.1	6.6	0.1	16.3	0.1	1.1	0.1
3/25/99	San Pedro	8B	827A	33.9	0.1	5.2	0.1	10.8	0.1	0.8	0.1
3/25/99	San Pedro	8C	828A	36.0	0.1	6.7	0.1	16.0	0.1	1.2	0.1
3/28/99	San Pedro	8A	845A	36.6	0.1	8.8	0.1	20.1	0.1	1.7	0.1
3/28/99	San Pedro	8B	846A	34.0	0.1	5.3	0.1	10.3	0.1	1.2	0.1
3/28/99	San Pedro	8C	847A	35.2	0.1	6.0	0.1	12.9	0.1	1.1	0.1
4/3/99	San Pedro	8A	862A	22.2	0.1	4.6	0.1	11.2	0.1	0.7	0.1
4/3/99	San Pedro	8B	863A	20.6	0.1	3.5	0.1	6.5	0.1	0.6	0.1
4/3/99	San Pedro	8C	864A	13.8	0.1	2.5	0.1	4.1	0.1	0.4	0.1
4/6/99	San Pedro	8A	857A	17.1	0.1	3.6	0.1	7.7	0.1	0.6	0.1
4/6/99	San Pedro	8B	858A	20.0	0.1	3.5	0.1	7.1	0.1	0.7	0.1
4/6/99	San Pedro	8C	859A	17.8	0.1	3.3	0.1	6.2	0.1	0.5	0.1
4/9/99	San Pedro	8A	855A	11.3	0.1	2.4	0.1	4.6	0.1	0.4	0.1
4/9/99	San Pedro	8B	884A	11.4	0.1	2.5	0.1	4.8	0.1	0.4	0.1
4/9/99	San Pedro	8C	885A	12.1	0.1	2.7	0.1	4.5	0.1	0.4	0.1
4/12/99	San Pedro	8A	873A	14.9	0.1	3.9	0.1	8.6	0.1	0.6	0.1
4/12/99	San Pedro	8B	874A	14.3	0.1	3.0	0.1	5.9	0.1	0.5	0.1
4/12/99	San Pedro	8C	875A	14.0	0.1	2.9	0.1	5.9	0.1	0.5	0.1
4/15/99	San Pedro	8A	887A	17.7	0.1	5.6	0.1	11.3	0.1	1.4	0.1
4/15/99	San Pedro	8B	888A	19.3	0.1	8.4	0.1	12.9	0.1	3.6	0.1
4/15/99	San Pedro	8C	889A	13.6	0.1	5.1	0.1	10.0	0.1	1.4	0.1
4/18/99	San Pedro	8A	890A	14.0	0.1	6.7	0.1	14.5	0.1	1.6	0.1
4/18/99	San Pedro	8B	891A	17.4	0.1	8.1	0.1	13.7	0.1	2.5	0.1
4/18/99	San Pedro	8C	892A	12.5	0.1	4.9	0.1	10.4	0.1	1.3	0.1
4/21/99	San Pedro	8A	893A	NS	0.1	NS	0.1	NS	0.1	NS	0.1
4/21/99	San Pedro	8B	894A	NS	0.1	NS	0.1	NS	0.1	NS	0.1
4/21/99	San Pedro	8C	895A	7.6	0.1	2.0	0.1	3.9	0.1	0.6	0.1
4/24/99	San Pedro	8A	896A	6.5	0.1	2.0	0.1	3.6	0.1	0.4	0.1
4/24/99	San Pedro	8B	897A	6.5	0.1	1.8	0.1	2.9	0.1	0.5	0.1
4/24/99	San Pedro	8C	908A	6.6	0.1	2.0	0.1	3.5	0.1	0.5	0.1
4/27/99	San Pedro	8A	910A	6.6	0.1	2.0	0.1	4.1	0.1	0.7	0.1
4/27/99	San Pedro	8B	911A	8.1	0.1	2.9	0.1	5.4	0.1	0.9	0.1
4/27/99	San Pedro	8C	912A	6.1	0.1	1.7	0.1	3.2	0.1	0.5	0.1

Interval = 8-hour, A=0000 to 0800; B=0800 to 1600 and C=1600 to 2400 hours

One statistical difference was observed for chloroform at the Montclair site. Chloroform measurements here were just slightly above the minimum detection limit of the instrument (0.05 ppb). The levels at Montclair were 0.06 ppb. The statistical inference is associated with the measurement detection limit, since the paired site at Fontana did not have any samples above the detection limit, and hence the Fontana site had no statistical variability. Levels at Montclair are consistent with levels measured at other fixed sites, and hence there is no unusually elevated level of chloroform at the Montclair site.

Trichloroethene (TCE) was found to be significantly higher at two sites, Montclair and Norwalk. Interestingly, these sites were selected because of their proximity to mobile sources, yet TCE is not associated with mobile source emissions. Examination of the data reveal a similar situation to that described above for chloroform: levels at these two microscale sites were barely above detection limits (0.07 ppb and 0.06 ppb, respectively) while their corresponding fixed sites did not exceed detection limits. Comparing to other fixed sites, the levels observed at these microscale sites were lower than those observed at other fixed sites. Hence, no unusually high levels of TCE are evident. Another compound found significantly higher at Montclair, as compared to the Fontana fixed site, is (m+p)-xylene. This compound is not considered an air toxic, and is primarily associated with mobile source emissions. Because mobile source emissions tend to have substantial seasonal variation, it is directly comparable to other fixed sites. The proximity of the Montclair site to the I-10 Freeway is likely the factor accounting for the statistical significance.

Lastly, styrene is statistically higher at Anaheim and Corona. Styrene ~~also is~~ has not currently been assigned ~~considered to be~~ a carcinogenic risk factor, although it has been associated with certain acute health effects. The levels at Anaheim are the highest (5.04 ppb) observed at any of the sites, either microscale or fixed. Additional analysis reveals the existence of three localized sources of styrene in the vicinity of the monitoring site, outside the prescribed wedge (see Section 6.5), contributing to elevated levels there. (See Figure 6-2) At Corona, though statistically higher, the measured levels (1.39 ppb) are not unusual compared to other fixed sites.

Discussions and general observations regarding each of the pairs are as follows:

1) Anaheim (micro) - Anaheim (fixed): Microscale site has localized influence from three sources of styrene emissions, which happened to be outside of the prescribed wedge (as shown in Figure 6-2~~1~~), and exhibits higher influence from mobile sources than is observed at the fixed site.

2) Boyle Heights (micro) - Huntington Park (fixed): No significant differences observed for any compounds except for acetone, not considered to be an air toxic. Huntington Park has greater mobile source influence.

3) Corona (micro) - Rubidoux (fixed): Corona may have higher levels of carbonyls (formaldehyde), but in general, mobile source influences are about the same at both sites. Higher levels of styrene observed at Corona, but not unusually high.

4) Costa Mesa (micro) - Anaheim (fixed): Generally similar, except that the Costa Mesa site has very low levels of benzene and 1,3 butadiene, indicating only small contributions from mobile sources.

5) Hawthorne (micro) - Compton (fixed): Nine compounds significantly higher at the fixed site (Compton) as compared to the microscale site. Both stationary and mobile source influence greater at Compton.

6) Montclair (micro) - Fontana (fixed): Montclair has greater mobile source influence as compared to Fontana, especially for carbonyls (formaldehyde). Chloroform and TCE are significantly higher than Fontana, but levels are just barely above instrument detection limits, and the levels of these two compounds are similar to observed at other fixed sites.

7) Norwalk (micro) - Compton (fixed): TCE and carbonyls higher at Norwalk. Although Norwalk was selected because of its proximity to mobile sources (at the convergence of the 105 and 605 freeways), there are no appreciable differences in observed levels of key mobile source compounds.

8) Pacoima (micro) - Burbank (fixed): Very similar, except that Burbank has significantly greater levels of perchloroethylene and formaldehyde.

9) Rialto (micro) - Fontana (fixed): Almost identical. No significant differences observed for any compounds.

10) Riverside (micro) - Rubidoux (fixed): Very similar. No significant differences observed for any compounds, although key mobile source compounds tend to be higher at Rubidoux.

11) San Pedro (micro) - Wilmington (fixed): This pair had a very limited number of comparative samples. Very high levels of formaldehyde were observed at San Pedro. (See earlier discussion.)

12) Torrance (micro) - Compton (fixed): Compton shows greater influence from mobile sources. Levels of mobile source emissions, mainly benzene and 1,3 butadiene, are especially low at Torrance.

13) Van Nuys (micro) - Burbank (fixed): Very similar. No significant differences observed for any compounds, although Burbank shows greater mobile source influence.

(Note: There is no comparison made for the South El Monte microscale site since that sampling did not occur until after the fixed site network had completed its one full year of sampling, and therefore there were no comparative sites available. However, as shown in the next section, the relationship between mobile and stationary sources at South El Monte is similar to other microscale sites.)

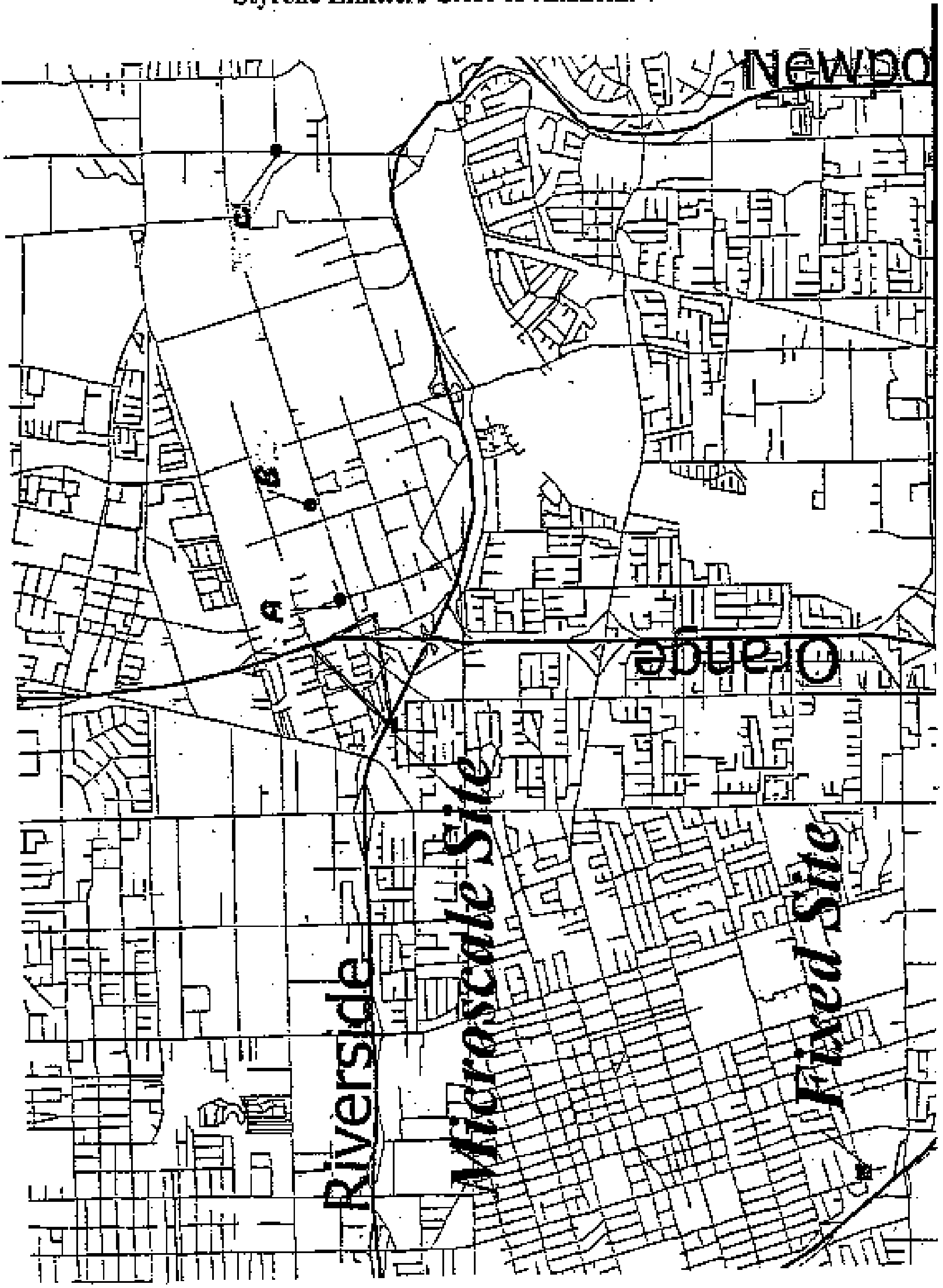
6.4.2 Mobile/Stationary Source Influences

Although the cancer risks at the microscale sites are not being estimated due to the limited nature of the sampling, the risk factors can be used to determine the relative importance, on a risk-weighted basis, of mobile versus stationary sources at each of the microscale sites. Using benzene, 1,3 butadiene, and 50% of the carbonyls as indicators of mobile source influences, and all other compounds as indicators of stationary source emissions, the relative risk-weighted importance of each source group is shown in Figure 6-3 for all 14 microscale sites*. There are some important caveats with this analysis. Since mobile source compounds vary substantially by season, whereas the stationary source compounds tend to be more seasonally invariant, those microscale sites sampled during the fall and winter months should show greater mobile source influences than would be expected on an annual basis. Conversely, those sites sampled during the spring and summer months would tend to show less mobile source influence than would be expected annually. Figure 6-3 is therefore arranged such that the first group of sites are those sampled in the fall/winter months; the second group in the spring/summer months; and the third group representing all seasons at Hawthorne and Pacoima.

In general, it can be seen that the mobile source influences are indeed greater at those sites sampled in the fall/winter months as compared to those sampled in the spring/summer months. In all but two cases (Torrance and Cost Mesa), all microscale sites show greater mobile source influence than from stationary sources. (The evaluation for San Pedro is not considered part of this statement because of the concerns about the local influence from the monitoring platform, as described previously.) Thus the efforts to locate monitors in neighborhood areas expected to have substantial stationary source influences from toxic emissions did not reveal such influences. (The two sites shown to have dominant fractions from stationary sources were not so much from elevated levels of compounds emitted from such sources, but rather from a noticeable lack of emissions from mobile sources.)

*Elemental carbon was not measured at microscale sites; hence contributions from diesel particulates cannot be estimated for these sites.

Figure 6-2
Styrene Emitters Close to Anaheim Site



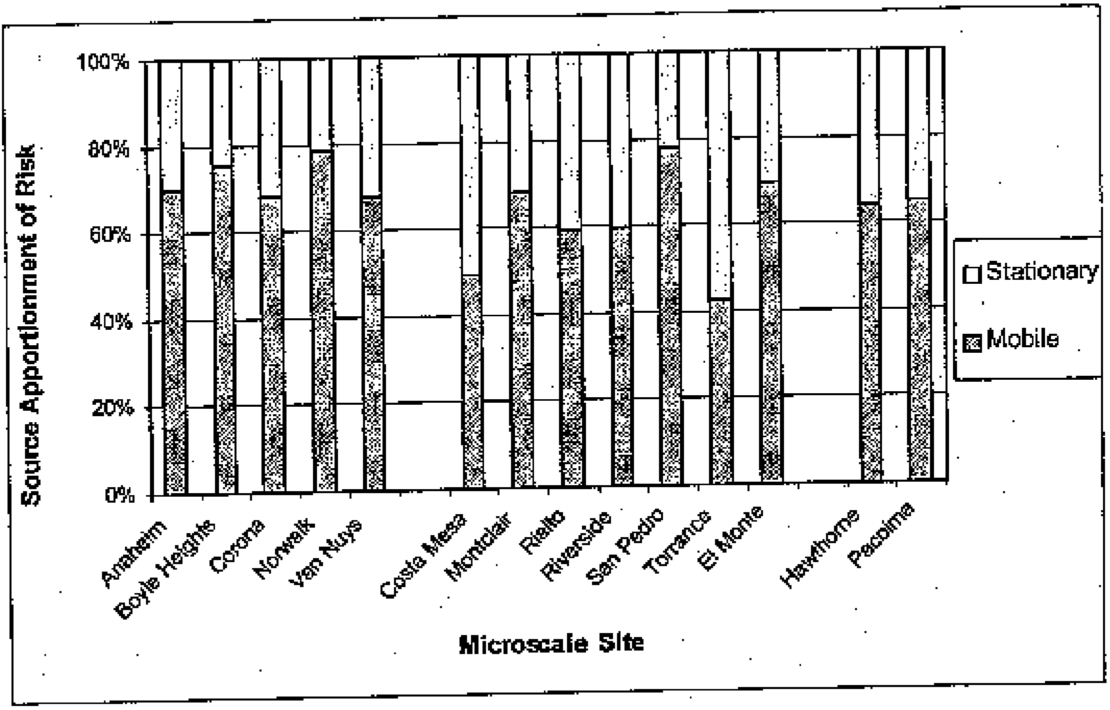


Figure 6-3. Relative Influence of Mobile and Stationary Sources at Microscale Sites, On a Risk-Weighted Basis, Excluding Diesel Particulates

6.5 Emissions Inventory

The purpose of the microscale emissions inventory effort was three-fold: 1) to inform the air monitoring staff about the possible presence of any unusual compounds so that specialized instrumentation could be included in the air monitoring station; 2) to correct for inconsistencies after the regional modeling effort is completed; and 3) to conduct microscale air dispersion modeling to determine the local impact of the emission sources.

For each of the fourteen microscale study sites, a wedge of influence was defined as a function of predominant wind direction and frequency. The sources of toxic emissions for non-AB2588 facilities within the wedge were determined utilizing numerous sources of information including District data, personal drive-by, and interviews with the owners/operators of the facilities. Quantification of emissions relied on estimates, facility feedback, District permit data, product information, and Material Safety Data Sheets. For facilities identified as AB2588 sources, District's AB2588 data base was used to generate the most recent emissions inventories.

Table 6-5 presents a summary of toxic emissions for all fourteen sites. Four of the sites (Anaheim, Hawthorne, Norwalk and Riverside) had no identified sources of toxic emissions within the prescribed wedge. Boyle Heights had the most number of sources of emissions identified within the wedge. Appendix VI contains all the emissions inventory information pertaining to the Microscale Study.

Table 6-5
Summary of Microscale Emissions Inventories by Site

Pollutant	Emissions (lbs/year)									
	Boyle Heights	Corona	Costa Mesa	Montclair	Pacoima	Rialto	San Pedro	South El Monte	Torrance	Van Nuys
1,3-Butadiene	–	–	0.70	--	–	--	–	0.01	2.29	--
1,4-Dioxane	--	–	–	–	--	–	–	--	10.48	–
2- butoxyethanol	--	--	--	–	--	–	–	131.04	--	–
Acetaldehyde	0.27	--	–	--	--	--	--	–	–	--
Acetone	116.48	1.25	–	–	61.15	–	–	4630.08	2812.99	–
Acrylonitrile	--	–	0.00	--	–	–	--	–	2.91	–
Aldehydes	–	--	–	--	0.05	–	–	--	–	–
Ammonia	–	–	–	–	124.80	–	–	2.75	--	–
Benzene	0.36	5.85	0.25	8.74	1.84	0.19	0.43	0.01	0.01	5.85
Benzo[a]pyrene	–	0.00	–	–	0.00	0.01	0.01	--	--	–
Cadmium	--	–	–	–	--	–	--	--	0.02	–
Carbon black	0.96	–	–	–	0.06	--	--	–	0.01	–
Chromic acid	--	–	--	–	–	--	–	1.41	–	–
Chromium, hexavalent	0.92	–	--	–	–	–	–	–	0.01	--
Cobalt	–	--	–	–	–	--	–	0.01	–	–
Copper	--	–	–	–	0.01	–	–	–	0.04	--
Cyclohexane	–	--	–	–	--	–	--	778.44	--	–
Dibutyl phthalate	–	--	–	–	22.71	–	–	–	--	–
Diesel, particulate	87.36	–	–	–	--	0.52	–	–	–	–
EGBE	–	--	–	--	--	–	–	148.51	–	–
Ethyl benzene	–	–	–	--	–	--	--	122.30	--	–
Formaldehyde	1.19	0.06	0.00	–	0.00	0.08	0.04	–	691.44	–
Furan	–	0.38	–	–	0.09	0.76	1.12	–	--	–
Glycol ethers	–	15.60	–	–	10.48	–	--	–	76.88	–
Hexamethylene-1,6	--	–	0.05	--	–	–	–	–	--	–
Hexane	–	–	–	–	18.35	--	--	–	2795.52	–
Hydrofluoric acid	–	–	--	–	--	--	--	0.05	–	–
Isopropanol	95.68	–	–	–	200.93	–	–	410.59	480.48	--
Lead	--	--	–	–	0.44	–	–	–	--	–
Manganese	0.78	–	–	--	–	0.64	--	0.01	0.05	–
Methanol	--	–	--	–	79.50	–	--	–	1135.68	–
Methyl ethyl ketone	–	–	194.69	–	253.34	–	–	--	–	--
Methylene chloride	95.68	24.96	–	–	--	--	13.00	--	--	–
Naphthalene	1.86	--	–	–	--	--	--	–	–	–
Nickel	1.13	–	–	–	--	--	--	–	0.00	–
Nickel acetate	--	–	--	--	–	--	–	0.79	–	--
Nitric acid	–	–	--	--	--	--	--	0.79	–	–
PAH	2.04	0.09	--	–	0.02	0.17	--	--	–	–
Perchloroethylene	1787.50	--	–	–	234.00	–	–	0.73	--	--
Phosphoric acid	--	--	--	--	0.42	--	--	0.00	–	--
POM	0.09	–	0.00	--	–	–	–	--	0.00	–
Propylene glycol	--	–	--	--	60.19	--	--	–	--	--
Propylene oxide	--	--	–	–	22.71	–	--	--	0.06	–
Silica	0.64	--	0.00	--	–	0.52	–	--	0.14	–
Silicon	0.05	–	–	–	--	0.04	--	–	--	--
Silver	--	–	--	--	–	–	--	--	0.00	–

Table 6-5 Cont'd.
Summary of Microscale Emissions Inventories by Site

Pollutant	Emissions (lbs/year)									
	Boyle Heights	Corona	Costa Mesa	Montclair	Pacoima	Rialto	San Pedro	South El Monte	Torrance	Van Nuys
Sodium hydroxide	--	--	--	--	--	--	--	18.30	--	--
Styrene	--	--	--	--	--	--	--	0.00	0.16	--
Sulfates	--	--	--	--	--	--	--	11.65	--	--
Sulfuric acid	--	--	--	--	2.50	--	--	41.60	--	--
Toluene	372.69	0.62	--	1.92	410.99	0.43	0.05	227.14	59.40	175.40
Trichloroethane-1,1,2	--	--	--	--	--	--	--	--	366.91	--
Trichloroethylene	--	--	--	--	--	--	--	7.25	--	--
Vinyl acetate	--	--	--	--	--	--	--	0.00	--	--
Xylenes	132.11	1.31	85.28	0.96	139.98	0.21	0.04	1257.98	--	1.31

6.6 Local-Scale Modeling

For purposes of local-scale modeling, the Industrial Source Complex (i.e., ISC3) air quality model is used for the subgrid level modeling presented here. The ISC3 model is included in the U.S. EPA "Guideline on Air Quality Models" (U.S. EPA, 1996a) and has been widely used for regulatory air quality assessment. The model is also recommended by the California Air Pollution Control Officers Association (CAPCOA) for estimating exposure to toxic air contaminants (CAPCOA, 1993). The model is a steady-state Gaussian plume model, which can be used to assess pollutant concentration from a wide variety of sources, associated with an industrial source complex. The model simulates the dispersion of emissions from point, area, and volume sources and can account for building downwash, dry deposition, and decay of chemicals. The short-term version of the model (ISCST3) accepts hourly meteorological data records to define the conditions of plume rise, transport, and diffusion. The model estimates hourly concentrations for each source and receptor combination and calculates averages for various user-selected short-term periods and for annual or longer averaging periods. The model is appropriate for transport distances less than 50 kilometers. The short-term version of the model is applied using hourly meteorological data at the microscale monitoring sites in the Basin. Important model options employed include: urban dispersion parameters (i.e., URBAN) and no calm wind processing (i.e., NOCALM). The URBAN option assumes atmospheric dispersion rates typical of an urban environment. The NOCALM option simulates dispersion even under calm wind conditions by assuming a minimum wind speed of 1 m/s. This is important because winds are often calm or near calm in southern California. All other model options assumed the default values.

Where detailed stack information was not available, for the surveyed sources, facility emissions are simulated using a ground-based volume source treatment in ISCST3. The volume source dimensions for all the sources are assumed to be 15m by 15m horizontal dimensions and 6m vertical dimension. The operating hours per day are unique for each facility but all facilities are assumed to operate 365 days per year.

A cartesian coordinate receptor grid is used to estimate peak concentrations in the local area within and surrounding the facilities modeled. The receptor spacing assumed is 25m with all receptors placed at ground level. The horizontal extent of the modeling domain is such that all the sources are within its boundaries. Each facility is assumed to have a 25m property line from the center of the volume source. In other words, impacts from the facility are estimated at receptors greater than 25m from the center of the source. Flat terrain is assumed, since emissions are treated as a non-buoyant volume source.

ISCST3 is applied with two distinctly different meteorological data sets: one based on the 1981 calendar year and another for the period from April 1998 to March 1999. The District has 1981 meteorological data (i.e., hourly winds, temperature, atmospheric stability, and mixing heights) at 35 sites in the Basin and vicinity. These data are available at the District's web site (www.aqmd.gov/metdata) and are in a format that can be directly read by ISCST3. These data are typically used by permit applicants to satisfy the modeling requirements of Regulations XIII, XIV, XVII, and XX.

Hourly three-dimensional fields of wind and temperature and hourly two-dimensional fields of mixing depth and atmospheric stability were developed for the period from April 1998 to March 1999 for the UAM simulations discussed in Chapter 5. The meteorological model called CALMET was used to develop these fields. These hourly meteorological data are extracted from each grid cell containing the microscale site and reformatted for ISCST3 input. Therefore annual simulations are performed using both the 1981 meteorological data and the 1998/99 meteorological data. Results of both simulations are provided in Table 6-6 and in Appendix VI. Appendix VI contains the complete modeling results and relevant background information for each microscale site including location, emissions, wind data, comparison to fixed sites, and model results for concentration as well as cancer risk.

From Table 6-6, it can be seen that none of the predictions for the monitoring sites exceeded a risk level of 10 in a million. (The highest risk from local influences at a monitoring site is only about 5 in a million at Boyle Heights.) This means that regional conditions overwhelm local influences. The model also shows that significant influences from local sources may occur (e.g., estimated 588 in a million at Boyle Heights), but that rapid decreases in concentrations occur over relatively short distances. In the case of Boyle Heights, the predicted maximum near the source was over 100 times higher than the level at the monitor, less than one mile away. At Torrance, the predicted ~~risk levels were about~~ maxima were approximately 10 times ~~lower at~~ greater than those predicted for the monitor.

Table 6-6
Summary of ISCST3 Predicted Cancer Risks* at the Microscale Sites

Microscale Site	Predicted Risks Using 1981 Meteorology		Predicted Risks Using 1981 Meteorology		Pollutants contributing 90% of cancer risk
	At Monitor	Maximum	At Monitor	Maximum	
Anaheim	0.0	0.0	0.0	0.0	No carcinogens emitted
Boyle Heights	4.8	464.0	4.5	588.0	Hexavalent chromium perchloroethylene, diesel PM
Corona	0.5	1.3	0.6	1.7	PAH, benzene
Costa Mesa	0.0	1.1	0.0	1.3	1,3 butadiene
El Monte	0.0	1.9	0.0	2.4	nickel acetate, trichloroethylene
Hawthorne	0.0	0.0	0.0	0.0	No carcinogens emitted
Montclair	0.0	3.2	0.0	2.6	benzene
Norwalk	0.0	0.0	0.0	0.0	No carcinogens emitted
Pacoima	0.1	14.0	0.1	21.0	benzene, PAH, perchloroethylene
Rialto	0.2	2.3	0.1	1.9	PAH, benzo(a)pyrene, diesel PM
Riverside	0.0	0.0	0.0	0.0	No carcinogens emitted
San Pedro	0.0	3.6	0.0	2.4	benzene, PAH,
Torrance	2.6	36.6	3.7	43.9	formaldehyde, trichloroethana
Van Nuys	0.0	1.9	0.0	2.4	benzene

*Per Million

Chapter 7

Findings and Conclusions

The key results/conclusions of the MATES II Study are:

7.1 Monitoring Program

1) The ~~average~~ estimated carcinogenic risk in the Basin from ambient measurements is about 1,400 per million people. It ranges from about 1,120 in a million to about 1,740 in a million among ~~the ten~~ eight fixed sites.

2) The sites with the greatest risk levels, based on measurements, were in the south-central and east-central portions of Los Angeles County. At these locations, the dominance of mobile sources is even greater than at other sites. The sites with the lower risk levels were mostly in the other three counties.

3) The contribution to risk is dominated by mobile sources (e.g., cars, trucks, trains, ships, aircraft, etc.). About 70% of all risk is attributed to diesel particulate emissions; about 20% to other toxics associated with mobile sources (including benzene, butadiene, and formaldehyde); about 10% of all risk is attributed to stationary sources (which include industries and other certain businesses such as dry cleaners and print shops.)

4) The differences in carcinogenic risk from one site to another are much more driven by the influence from mobile sources than from stationary sources.

5) The carcinogenic risk from one site to another, as ascribed to stationary sources, is rather uniform across the Basin. In this respect, there is not much difference among the four counties.

6) There are strong seasonal variations to the levels of toxic air contaminants, primarily with those pollutants associated with mobile sources. Elemental carbon (a surrogate for diesel particulates), benzene, and butadiene -- all have seasonal peaks in the late fall and winter months. The lowest levels are observed during the spring and summer months.

7) The seasonal variations with respect to toxic air contaminants from stationary sources are generally small. Levels are quite consistent across all months of the year.

8) Levels of risk are, for the most part, consistent with the long-term downward trends evident in the ARB data since 1990. Noticeable improvements have occurred for three major elements of toxic risk: hexavalent chromium, benzene, and butadiene. (Note: trends for diesel particulates are not available from the ARB data.; however recent studies (Christoforou, et al., 2000) show a decrease of about 32% over a decade.)

7.2 Modeling

1) Model results show similar ~~average~~ levels of carcinogenic risk across the Basin on an annual basis, as does the monitoring data. Models also show the strong domination of mobile sources contributing to risk, and support the findings from the monitored data that diesel particulates are the most significant contributor to carcinogenic risk.

2) The model results, which are more complete in describing risk levels across the Basin than is possible with the monitored data, show that the higherst risk levels occur in the south-central Los Angeles area and in the harbor area. Model results also suggest that the ~~average basin~~ basin-wide cancer risk levels may be 167 percent lower than the ~~average~~ corresponding risk levels estimated from the monitoring sites.

3) Overall, the UAM and UAM-TOX model perform within ± 50 to 80 percent of measured annual values. However, the model performance varies significantly on short-term averaged concentrations. In addition, given that mobile source emissions are most likely under-estimated with the current ARB mobile source emission factor models, the model performance would improve somewhat with the latest versions of the mobile source models.

4) The spatial concentration fields show that higher concentrations generally occur near their emission sources. Higher concentrations of compounds that are emitted primarily from stationary and area sources tend to be highest within a few kilometers from the source location. Mobile source related compounds such as benzene and 1,3 butadiene tend to be generally high throughout the Basin. However, spatial variations are estimated by the models with higher concentrations occurring along freeway corridors and junctions. In addition, higher levels of mobile source related compounds are estimated near major mobile source activities such as airports and other areas with major industrial activities such as south central Los Angeles County, and the industrial areas of Orange, Riverside, and San Bernardino counties.

7.3 Microscale Program

1) Thirteen pairs of sites (microscale vs. fixed) were analyzed (and limited to the same period of time in which sampling occurred at each pair).

2) Statistical significance at the 90% confidence level were calculated between the mean concentrations (for each of 24 toxic gaseous compounds and 5 toxic metals) at each microscale site and its geographically closest fixed site.

3) Most of the statistical differences were for carbonyls, including formaldehyde and acetaldehyde. Differences in measurement techniques may account for these observations.

4) Aside from the carbonyls, of 325 pairs of data between microscale and fixed site concentrations, only seven were shown to be significantly higher at the microscale sites. Of those seven, six were comparable to levels found at other fixed sites across the basin.

5) Styrene (a ~~non-carcinogenic~~ compound which currently has no assigned carcinogenic risk factor) measured at Anaheim indicates substantial influences from a local source or sources. Three nearby sources emitting styrene were located from the emission inventory data base. These sources were upwind of the monitoring site and contributed to the levels observed. Such levels are still well below established health limits.

6) Unusually high levels of formaldehyde were observed at San Pedro. Analyses of the patterns of the data strongly suggest a very localized influence, and it is suspected that contamination of the sampling equipment caused this result.

7) No significantly higher levels of key mobile source toxic compounds, benzene and 1,3 butadiene, were found at any of the microscale sites, including those sited near freeways specifically for mobile source influences.

8) A comparison of risk-weighted concentrations of toxic compounds at each of the 14 microscale sites indicates that mobile sources are the dominant contributor to toxic risk at 11 of these sites. At two sites, Torrance and Costa Mesa, stationary sources are dominant due to low levels of mobile source emissions. A determination for San Pedro is questionable because of the concerns about formaldehyde.

9) Of the fourteen microscale sites, at four sites (Anaheim, Norwalk, Hawthorne, and Riverside), no emissions of toxic compounds emitted by stationary sources were found within an approximate one kilometer upwind distance of each site.

10) Local-scale modeling was applied to each of the fourteen microscale sites using two different annual meteorological scenarios: (1) calendar year 1981; and (2) April 1998 to March 1999.

11) Model-estimated cancer risks at every microscale monitoring site, based on local upwind emission sources, was less than 5 in a million, with the greatest risk value of 4.5 in a million at Boyle Heights.

12) Model-estimated cancer risk maxima were generally found to be very close to the source(s), rather than at the monitoring sites. There are only three locations where modeled maximum risk levels were greater than 10 in a million:. Boyle Heights (588); Torrance (44) and Pacoima (21).

13) The modeling results indicated that there are most likely locations other than selected microscale sites that have concentration levels higher than the measured concentrations.

14) Because risk levels ascribed to nearby sources inventoried for the study are generally much lower than region-wide risk levels, region-wide risks tend to overwhelm any potential local "hot spots."

7.4 Caveats and Uncertainties

1) The caveats to consider in interpreting the above deal with the uncertainties associated with risk estimations, discussed in Chapter 3. In addition, improvements can be made in the development of emissions inventories. Specifically, the ARB is in the process of revising the mobile source emissions inventory; speciation profiles for VOC and PM can be updated; and stationary source emissions can be audited on a more frequent basis. Laboratory measurement techniques also can be improved to reduce uncertainties. None of the above improvements are expected to change the over-all conclusions of the report.

2) There is currently no technique to directly measure diesel particulates, the major contributor to basin-wide carcinogenic risk. Based on research results as reported by ARB, diesel particulates can be estimated by measuring elemental carbon, a black, sooty particulate. In essence, elemental carbon becomes a surrogate for diesel particulates. Although this estimating technique is likely to have uncertainties, the emissions inventory and modeling, which account for directly emitted diesel particulates, confirm that diesel particulates are the major contributor to carcinogenic risk.

3) The determination of risk values for each compound carries a level of uncertainty,~~.~~ which for some~~many~~ pollutants is large. Typically, the risk values are derived from animal or epidemiological studies of exposed workers or other populations. Uncertainty occurs from the application of individual results to the general population. When risk factors for specific compounds are determined, levels are usually established conservatively. There is considerable debate on

appropriate risk values, and often the levels established by the USEPA and CalEPA differ. For the purpose of this study, California values are used.

4) There is further debate as to the appropriate levels of risk ascribed to diesel particulates. CalEPA, in recommending a cancer risk level of 300 in a million per microgram per cubic meter of diesel particulates, considered evidence which suggested diesel risks as low as 150 in a million to as high as ~~1,500~~ 2,400 in a million. The USEPA has not yet declared diesel particulates as an air contaminant. Thus, the selection of a risk factor for diesel particulates can have a substantial effect regarding the importance of diesel exhaust in assessing cumulative risks. For purposes of this study, and to be consistent with the approaches used for other toxic pollutants, the CalEPA recommended value of 300 in a million is used.

5) There is an estimated uncertainty level of ± 25 percent associated with laboratory measurements of many toxic compounds. Part of this uncertainty is attributed to the fact that many of the toxic compounds measured are at extremely low concentration levels, at parts per billion (ppb) levels, and often near the detection limits of the instrumentation. A number of compounds cannot be detected at all. When non-detections occur, it is assumed that the actual levels are not zero, but are half of the instrument detection limit. In other words, if the detection limit is 1 ppb, and a compound is not detected at that level, it is assumed that the actual concentration is one-half of 1 ppb.

Chapter 8
References

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Chapter 9
Response to Comments

With the release of the Draft Final MATES-II report in November 1999, the AQMD provided the public an opportunity to review and comment over a period of time ending February 22, 2000, coincident with a public workshop on the MATES-II program. A listing of comment letters submitted is shown on Table 9-1. A total of 22 comment categories (listed in Table 9-2) were identified from the comment letters.

Responses to these comments are summarized in this chapter. In providing this summary as part of the report, it is AQMD's intent to give readers some perspective as to the nature of the comments along with AQMD's position as to how those comments affected changes from the draft version.

Table 9-1

List of Commentors on MATES II Draft Report

	Company/Organization	Contact/Commentor	Letter(s) Dated
1	Chemical Manufacturers Assoc. (CMA) - Acetone Panel	Courtney Price/Andrew Jacks	2/1/00
2	Chemical Manufacturers Assoc. (CMA) - Ketones Panel	Courtney Price/Andrew Jacks	2/1/00
3	Chemical Manufacturers Assoc. (CMA) - Olefins Panel	Courtney Price	1/31/00
4	City of Irvine	Joseph Farber	12/28/99
5	Communities for a Better Environment (CBE)	Julia May, Carlos Poras, Suzana Tapia	2/1/00
6	Cooper Environmental	Fred Cooper	1/18/00
7	County Sanitation District of Los Angeles County	Greg Adams	12/9/00, 12/23/99, & 1/13/00
8 & 8A	Engine Manufacturers Assoc. (EMA) & EMA/Environ	Joseph Suchecki	2/1/00 & 2/21/00
9	International Fuel Technology	(Concerned Citizen) Robert Wilson (Shareholder)	11/9/99
10	Latham and Watkins/Wash.D.C. (for) Navistar ITC (Int'l. Transp. Corp.)	Claudia O'Brien	1/31/00
11	Latham and Watkins/S.F. (for) Navistar TAC	Richard Raushenbush	2/1/00
12	Lorax	Karim Damji	1/31/00
13	Mendocino County AQMD	Dean Wolbach	1/21/00
14	Northrop Grumman	Millie Yamada	1/18/00
15	OEHHA	Robert Blaisdell	2/1/00
16	Pacific Environmental Services (PES)	Dean High	12/15/99, 1/6, 1/20, 1/25 & 2/10/00
17	Puget Sound Clean Air Agency	Naydene Maykut & Maggie Corbin	12/7 & 12/29/99
18	QSS Group, Inc.	Richard Bechtold	1/26/2000
19	WSPA/ARCO	Mark Saperstein	11/2/99, 11/19/99, & 2/3/00
20	City of Los Angeles	Lillian Kawasaki	2/1/00
21	Printing Industries of California	Tom Diep	2/2/00
22	Foothill Transit	Dan Phu	2/1/00
23	California Trucking Association	Stephanie Williams	2/22/00
24	Metal Finishing Assoc. of So. Calif.	Dan Cunningham	2/22/00

Table 9-2

Category of Comments

Category Number	Description of Category
1	Exclusion of Compounds as Toxic
2	• Using other than Cal EPA URF (i.e., USEPA's) • 70-Year Exposure Assumption
3	Styrene Categorization as a Carcinogen
4	Treatment of Monitoring Data
5	Modeling Issues: • Treatment of Non-Detect Values • Background Concentrations • Modeling Uncertainties
6	Definition of Cancer Risk
7	Indoor vs. Outdoor Risks
8	Inadequacy of Microscale Analysis
9	Other Health Effects of PM
10	Need for Further Analysis
11	Emissions Inventory Clarification
12	Detailed Data Availability
13	Definition of Hot Spots
14	Definition of Diesel Measured as Elemental Carbon (1.04 Factor)
15	Double-Counting of Diesel Contribution due to its Toxic Constituents (i.e., Other VOCs such as Benzene)
16	Definition of Average Risk
17	New Technology Solutions
18	Miscellaneous
19	Overview Document
20	Suggestions to Change Language of the Text
21	Identification of Sites vs. Regional Description
22	Vehicle Count vs. Elemental Carbon Measurements

Comment Category #1: Exclusion of Compounds as Toxic

Compounds such as acetones and methyl ethyl ketone (MEK) should not be listed as "toxic" or "high risk compounds" since they are not regulated as an air toxic in California or by the EPA, or have relatively low toxicity.

Commentors:
CMA Acetone Panel (Letter #1)
CMA Ketones Panel (Letter #2)

Response:

Table 4-1 and Table 4-2: Footnotes were added to clarify toxicity of compounds. Methyl ethyl ketone will continue to be identified as a toxic compound since according to Rule 1401 it has an acute reference exposure level of 13,000 $\mu g/m^3$.

Comment Category #2: • Using Other than Cal EPA URF (i.e., USEPA's)
• Exclusion of Compounds as Toxic

Several questions were raised about the appropriateness of using unit risk factors developed by Cal EPA, and the validity of assumptions incorporated in the values (70-year outdoor exposure, inadequacy of animal and epidemiology studies). Suggestions were made to use the USEPA unit risk factors and add further discussions about uncertainties associated with the development of URFs.

Commentors:
CMA Olefins Panel (Letter #3)
EMA (Letter #8)
Latham & Watkins for Navistar ITC (International Transp. Corp.) (Letter #10)
Lorax (Letter #12)
WSPA/ARCO (Letter #19)
City of Los Angeles (Letter #20)
Calif. Trucking Assoc. (CTA) (Letter #22)
Foothill Transit (Letter #23)

Response:

The AQMD recognizes that there are inherent uncertainties associated with the quantified risk factors established in California, and that on a national level, there has not been any recommendation for a quantified value for diesel. The AQMD further understands the concerns about earlier studies, which contributed to the California assessment of diesel. However, the AQMD staff relies upon the medical expertise within the Cal EPA for establishing pollutant toxicity factors (as well as the state ambient air quality standards for criteria pollutants), and believes the current estimate to be appropriately health protective. Also, the AQMD staff accepts risk factors established by Cal EPA as applicable to the entire state. The 70-year exposure is one of the parameters used by Cal EPA in their URF calculations.

Comment Category #3: Styrene Categorization as a Carcinogen

Questions were raised about the listing of styrene as a non-carcinogenic compound. References were made to studies being conducted that could lead to listing styrene as a toxic compound.

Commentors:

City of Irvine (Letter #4)
OEHHA (Letter #15)

Response:

The text was revised to reflect the most current status of identification.

Comment Category #4: Treatment of Monitoring Data

- Comments were received that trends showing elemental carbon reductions have not been addressed.
- Questions were asked about the modeling treatment of concentrations below the minimum detection limit.

Commentors:

EMA (Letter #8)
EMA/Environ (Letter #8a)

Response:

Trends in Elemental Carbon:
The AQMD is aware of the study by Christoforou et.al., which was published in January 2000. Appropriate references to the study have been added to the text to reflect findings of about a 32% decrease in elemental carbon in the South Coast Air Basin between 1982 and 1993, although staff has some concerns about the consistency of the analytical methods for measuring elemental carbon reported in the article.

Model performance estimation of contaminants set to ½ detection limit:
The model performance for those contaminants where observations were set to half of the detection limit is poor, in part due to the fact that at very low levels, variability in modeled results is compared against non-varying levels presumed from measurements.

While the performance was poor, the modeled risk contributions from these contaminants to the overall risk are minimal, and do not appreciably affect the results of the study.

Comment Category #5: Modeling Issues
- ***Treatment of Non-Detect Values***
- ***Background Concentrations***
- ***Modeling Concentrations***
- ***Risk Uncertainties***

Modeling Issues:

Treatment of Non-Detect Values
A request was made to further analyze and discuss model performances in view of the number of measurements at or near the minimum detection level.

Boundary Conditions
Questions were raised about the consistency of boundary conditions in AQMP/SIP and toxic modeling exercises.

Modeling Performance
No modeling performance goals were set; performance is poor; USEPA's performance goals should be met.

Risk Uncertainties
Comments were made that modeling underestimates the impact of stationary sources.

Commentors:

EMA & EMA/Environ (Letters #8 and 8a)
Lorax (Letter #12)
City of Los Angeles (Letter #20)
Metal Finishing Assoc. (Letter #24)

Response:

Treatment of Non-Detect:
There are situations where low levels of certain pollutants are below the detection limits of current laboratory methods of analysis. When such circumstances occur, the actual ambient concentrations are unknown and range between zero and the instrumentation limit of detection In the MATES-II study, when "non-detects" occurred, it was assumed that the measured level was half way between zero and the detection limit. This convention has been in use by the Air Resources Board since the reporting of monitored toxics in the state commenced in 1990. This convention allows the vast majority of the data users to statistically manage the data. Other methods of handling non-detects are often difficult to implement or offer no practical advantage. The method is a conservative one that protects the public when analytical shortcomings cannot address

real emissions that are known to exist. Although the one-half this convention is not a regulation, it is considered at this time to be the best available tool for addressing "non-detects." The text of the report has been modified to include this explanation.

Regarding different detection limits (as illustrated in the table below) for the same compound, as occurred for some pollutants that were measured at two different laboratories (AQMD and ARB), such limits are a function of the type and age of the laboratory equipment used. Newer equipment tends to have greater low-concentration detection capabilities as compared to older equipment. Thus in the MATES-II database, in some instances different detection limits (and non-detect values) were used depending upon which laboratory conducted the analyses.

For computational purposes, measurements below minimum detection levels (MDLs) are also assumed to be one-half the respective MDL. The MDLs for the pollutants sampled for both the ARB and AQMD laboratories are given in the table below. Also shown are the percentages of non-detects. An argument could be made that if 90 percent or more of the samples are below the detection level then the ambient concentrations are probably closer to zero than to one-half the detection level. Note that the percentage of non-detects only exceed 90 percent for ethylene dibromide, ethylene dichloride, arsenic, and cadmium. Assuming that the ambient concentrations of ethylene dibromide, ethylene dichloride, arsenic, and cadmium are zero reduces the estimated risks on average for the ten fixed sites by 65 in a million. The total estimated risk is approximately 1413 in one million including diesel and 406 in one million excluding diesel toxicity. This should be considered as another source of uncertainty in the risk estimate.

	Minimum Detection Level		Non-detects
Toxic	**ARB**	**AQMD**	**(%)**
1,3 Butadiene	0.04 ppb	0.10 ppb	9
Acetaldehyde	0.10 ppb	0.10 ppb	3
Benzene	0.20 ppb	0.10 ppb	3
Carbon tetrachloride	0.02 ppb	0.20 ppb	46
Chloroform	0.02 ppb	0.10 ppb	58
Ethylene dibromide	--	0.10 ppb	100
Ethylene dichloride	--	0.10 ppb	98
Formaldehyde	0.10 ppb	0.10 ppb	2
Methylene chloride	1.00 ppb	0.10 ppb	37
Para-dichlorobenzene	0.20 ppb	0.10 ppb	47
Perchloroethylene	0.01 ppb	0.10 ppb	10
Trichloroethylene	0.02 ppb	0.10 ppb	55
Arsenic	3 ng/m^3	4 ng/m^3	97
Cadmium	--	10 ng/m^3	99
Hexavalent chromium	0.2 ng/m^3	0.06 ng/m^3	50
Nickel	2 ng/m^3	1 ng/m^3	5
Lead	3 ng/m^3	--	0
Selenium	2 ng/m^3	1 ng/m^3	65

Boundary Conditions:
The set of boundary conditions for the toxic contaminants modeled for the MATES-II analyses are presented in Table V-6 of the Appendix. The boundary conditions were determined from a variety of sources including a technical study conducted for EPA, monitored data, and estimated global background concentrations. For several contaminants, the background concentrations were set to near zero concentrations. We recognize that for 13 contaminants, the background concentration was set at levels that when multiplied by the corresponding URF contribute at least 1-in –1,000,000 to the background risk. The assumption of an 18 percent contribution from the boundary concentrations to the overall modeled risk, however, is overstated.

We can further examine the impacts by examining the highest four boundary concentrations from diesel, carbon tetrachloride, benzene and secondary formaldehyde. First, carbon tetrachloride has a recognized global background concentration. For formaldehyde, the boundary concentration was based on UAM speciation information used in the 1997 AQMP ozone attainment demonstration. The net impact to modeled formaldehyde resulted in less than 5 percent. For benzene, the boundary was extracted from the EPA technical study; and with its low reactivity, it is expected to have a long residence time in the atmosphere.

The largest contribution to the background risk arose from the diesel contribution. The diesel boundary concentration was set at 0.41µg/m3 for PM2.5 and 0.04 µg/m3 for the coarse fraction. These estimated levels were based on PM2.5 observations of elemental carbon (EC) taken at San Nicholas Island (SNI) where the EC concentration was measured at 0.18 µg/m3. SNI is located 80 miles offshore, approximately 40 miles further offshore that the western boundary for the modeling domain. The SNI EC concentration was extrapolated to the western modeling boundary with the assumption that the concentration would increase slightly at the coastal shoreline as compared to NSI. Since there are no direct ambient measurements of diesel particulate emissions, the diesel contribution to the boundary condition was set to be equivalent to the EC concentration as a conservative assumption.

Model Performance:
EPA has set performance goals for episodic modeling demonstration used in control program evaluation. These goals are designed to estimate model performance for an ozone simulation that evaluates model performance for a limited set of days. No specific model performance criteria have been defined for an annual simulation of toxic compounds. We recognize that model performance can improve. One major limitation of the UAM analysis was the potential underestimation of mobile source emissions for the simulation. As stated in the MATES-II report and Appendix V, underestimation of the mobile source emissions was a contributing factor to lower model performance estimates. Uncertainties in the meteorological characterization may have also contributed. More recent work by ARB indicates that mobile source VOC emissions will be higher.

Under-Estimation of Risk from Stationary Sources:
Since the UAM uses a 2-km by 2-km grid resolution, emissions (both stationary and mobile) are assumed to be evenly distributed over the grid cell. As such, the model calculated concentrations are more regional in nature. The relative contribution between stationary and mobile emissions is accounted for in the model. The mobile source contribution would not be overstated relative to the concentrations calculated by the model.

Comment Category #6: Definition of Cancer Risk

Comments were made that the definition of cancer risk needed further clarification.

Commentors:

OEHHA (Letter #15)
WSPA/ARCO (Letter #19)

Response:

The language in the text was revised.

Comment Category #7: Indoor vs. Outdoor Risks

Comments were made about the assumption of total outdoor exposure in calculating URFs. Other comments were made that in Southern California, indoor and outdoor exposures could be very similar.

Commentors

EMA (Letter #8)
OEHHA (Letter #15)
City of Los Angeles (Letter #20)

Response:

Ideally, one would like to estimate risk based on total exposure an individual experiences while moving from one microenvironment or activity (such as a home, an office, or driving a car) to another. The MATES-II study only considers outdoor exposure so the risks estimated from the ambient measurements represents those experienced outdoors. The modeled risks discussed in Chapters 5 and 6 also represent outdoor exposures. The text was modified, as appropriate.

Comment Category #8: Inadequacy of Microscale Analysis

Questions were asked about the exclusion of mobile source emissions in the microscale modeling efforts. Suggestions were made on how to explain the purpose of the microscale study.

Commentors:

OEHHA (Letter #15)
Metal Finishing Assoc. (Letter #24)

Response:

Microscale modeling was designed primarily to analyze concentrations of toxic air pollutants in areas of expected localized higher stationary source impact. Although the modeling did not, in most cases, include mobile sources, the monitored results provide some indication of the relative risks between mobile and stationary sources. Please also see response to comment category #10.

The language on Page 6-1 was modified to better reflect the purpose of the microscale study.

Comment Category #9: Other Health Effects of PM

Comments were made regarding the potential risks and health effects of fine particulates (e.g., PM2.5) that were not characterized in the report.

Commentors:

City of Irvine (Letter #4)

Response:

The purpose of the study was to evaluate the risk of toxic compounds in the Basin. Other impacts of air pollution, including non-toxic health effects, are extensively analyzed in the development process for the National and State Air Quality Standards. These types of issues are extensively addressed in various Air Quality Management Plans.

Comment Category #10: Need for Further Analysis

Various commentors suggested that further analyses should be conducted in order to improve the report and to further clarify issues. Among the suggestions were:

- Monitoring platforms were not properly situated and need to be close to identified stationary toxic sources.
- Plans should be made to perform year-round microscale monitoring.
- Accidental releases should be addressed.
- The reason for higher PM at Burbank should be explained.
- The results of microscale modeling should be compared with measured data.
- Continue the development process and resolve the uncertainty in the diesel risk factor.

Commentors:

CBE (Letter #5)
Northrop Grumman (Letter #14)
City of Los Angeles (Letter #20)

Response:

Location of Microscale Monitors:
The microscale study was intended to sample in residential areas immediately downwind of clusters of facilities that are known to emit toxic pollutants. Because the objectives of the microscale monitoring program were to be within residential areas immediately downwind of facility clusters, and because logistical factors were crucial to the exact location of the monitoring platforms (due to permission to use private property; available

power; security considerations; etc.), the model predictions of maximum source impact did not coincide with the location of the measurements. It is important to recognize that local maximal impacts could indeed occur at locations which were not monitored, but the data collected at least provided some indication of what was occurring in the residential area around the monitoring platform. As indicated in changes to the text of the report, the microscale study can, in many respects, be considered a "pilot" study for any future microscale sampling programs.

Year round monitoring and accidental-release monitoring at microscale sites:
We agree that ideally, year round monitoring, or special monitoring for accidental releases would be desirable, however, the program was constrained by available resources. In total, the entire MATES-II study cost approximately $1.3 million. With the technical guidance from the Air Toxics Study Technical Review Group, staff believes that MATES-II represents the most comprehensive toxics monitoring program that could be conducted within the available resources.

Unusual "Other PM" measurements at Burbank:
The commentor is correct in pointing out the higher levels of "other PM" reported at Burbank. On 11/13/98, a cadmium level of 192 ng/m3 was measured at Burbank, whereas all other Burbank samples were near or below the detection limit of 10 ng/m3. It turns out that elevated cadmium levels were also detected on PM10 and TSP samples collected simultaneously at Burbank on that date, indicating that there was a source of airborne cadmium, as opposed to an instrument malfunction. We are unable to determine the cause of that singular event. Since the measurement is considered to be valid, it is included in the MATES-II averages, and it is the reason why "other PM" at Burbank are elevated as compared to other sites, and also why November is slightly higher than other months as depicted in Figure 3-6 (bottom).

Uncertainty in the Diesel Risk Factor:
Please see response to comment category #2.

Microscale Model vs. Measurements:
Requests were made to compare the results of microscale modeling with measured data. Given the limited length of microscale monitoring, this exercise would be beyond the scope of the study and will not be technically sound at this time. Please also refer to the response to comment category #8.

Comment Category #11: Emissions Inventory Clarification

Questions were asked about how the emissions of some specific source categories were allocated to specific locations. Comments were received about typical sources of emissions for specific compounds. Requests were made for more detailed emissions data.

Commentors:

CBE (Letter #5)
Puget Sound Clean Air Agency (Letter #17)
City of Los Angeles (Letter #20)
Metal Finishing Assoc. (Letter #24)

Response:

Area source emissions for dry cleaners, gas stations, and chrome plating operations were distributed to their exact location (specific point location) as shown in Figures 4-3, 4-4, and 4-5.

Table 4-1 was revised and matched to the inventory.

Emissions inventory Table 4-3 "Emissions by Major Source Category" was added to the report.

Comment Category #12: Detailed Data Availability

Requests were made to make the entire MATES-II database available on the AQMD web site. Specific requests for data were submitted to the District.

Commentors:

CBE (Letter #5)
Pacific Environmental Services (Letter #16)

Response:

Detailed data are available upon request through the AQMD's Public Records Request.

Comment Category #13: Definition of Hot Spots

Questions were asked about the definition of "Hot Spots".

Commentors:

Cooper Environmental (Letter #6)
Printing Industries of California (Letter #21)
City of Los Angeles (Letter #20)

Response:

AQMD staff believes that there is no well-accepted definition of "hot spots," and indeed there many be many different interpretations of that term. Within the context of this report, AQMD staff has used "hot spots" to denote conditions where measured concentrations at microscale sites were significantly (in a statistical sense) greater than at the closest paired fixed site, and also higher than observed at all other locations during the study. So that future uses of "hot spots" in air monitoring programs can have a more consistent definition, the AQMD will seek input from the ATSTRG to develop a consensus definition.

Comment Category #14: Definition of Diesel Measured as Elemental Carbon (1.04 Factor)

Comments were made about the validity of using elemental carbon as a surrogate for measuring diesel particulate, and the incorrectness of the 1.04 multiplier factor.

Commentors:

County Sanitation District of Los Angeles County (Letter #7)
EMA & EMA/Environ (Letters #8 and 8a)
Latham & Watkins (S.F.Ofc.) for Navistar TAC (Letter #11)
QSS Group, Inc. (Letter #18)
City of Los Angeles (Letter #20)
California Trucking Assoc. (CTA) (Letter #23)

Response:

Based on the 1982 inventory of fine particle emissions, Gray derived a factor 1.04 to estimate diesel as a function of EC. Gray's method relied on estimates that the elemental carbon portion of diesel particulate was 64 percent of the total diesel particulate load and that 67 percent of the fine elemental carbon mass in the Los Angeles atmosphere comes from diesel emissions.

Mathematically (to address questions in letter #23):

$0.64\ TD = DEC$
$DEC = 6.67\ EC$
$0.64\ TD = 0.67\ EC$

$$\boxed{TD = 1.04\ EC}$$

TD = Total Diesel PM
DEC = Elemental Carbon Portion of Diesel
EC = Elemental Carbon

Using the 1998 emissions inventory, a more direct estimation of the Diesel/EC ratio can be made. The SCAB modeling emission inventory for PM2.5 diesel and PM2.5 EC from all sources are as follows:

	Emissions (TPD)			
	On-Road	Area and Off-Road	Point	Total
Diesel	10.92	10.63		21.55
EC	6.57	10.49	0.37	17.44

The 1998 ratio of diesel emissions to EC emissions equals 1.24.

Similarly, the modeling analysis for the ten MATES-II sites suggests that a slightly higher ratio of 1.39 exits between diesel particulate and elemental carbon from all sources. The following table summarizes the modeling results.

MATES-II Site	Diesel PM2.5 (µg/m3)	EC2.5 (µg/m3)	Diesel/EC
Anaheim	2.85	2.33	1.22
Burbank	2.52	2.13	1.18
Compton	3.20	2.16	1.48
Fontana	2.25	1.95	1.15
Huntington Park	2.70	2.22	1.22
Los Angeles	3.53	2.42	1.46
Long Beach	3.01	1.85	1.63
Pico Rivera	2.68	1.95	1.37
Rubidoux	2.24	1.95	1.15
Wilmington	3.43	1.71	2.01
Average			1.39

One of the advantages in dealing with PM2.5 inventories and PM2.5 modeling results is that the concerns over the influence by coarse particulates are eliminated. In the AQMD's TEP-2000 study, elemental carbon for both PM10 and PM2.5 fractions were sampled over one year, which predominantly coincided with the MATES-II sampling program. Five sites were common to both sampling programs: Long Beach, Los Angeles, Anaheim, Fontana, and Rubidoux,. The percent of PM2.5 elemental carbon contained within PM10 elemental carbon is 98.6%, 87.9%, 100%, 94.4%, and 86.7%, respectively for each of the five sites, indicating that fine particulate elemental carbon is dominant, and the coarse fraction is very small. Accordingly, for each of these sites, we can calculate the diesel particulate levels using the 1998 measured data to get PM2.5 elemental carbon, coupled with the modeled diesel/elemental carbon ratios. On a site-specific basis, these results can be compared with the methods used in the MATES-II report, that is, using the 1.04 factor multiplied by the PM10 elemental carbon levels. The results are shown below:

	Measured			Estimated	EC-PM10

Site	EC-PM10 (ug/m3)	TEP-2000 EC PM2.5/ PM10 Ratio	Modeled Diesel/EC Ratio	Diesel Particulate (ug/m3)	x 1.04 Diesel Partic. (ug/m3)
Long Beach	2.54	.986	1.22	3.06	2.64
Los Angeles	3.53	.879	1.46	4.53	3.67
Fontana	3.38	.944	1.15	3.67	3.51
Rubidoux	3.39	.867	1.15	3.38	3.52
Anaheim	2.44	1.00	1.22	2.97	2.53
Average				3.522	3.174

It can be seen that in every case, the 1998 estimates for diesel particulates are greater than the estimates based on the 1.04 factor developed in 1982. On average, the 1998 results are about 11% greater than the results with the 1982 factor.

While each method gives a different ratio for estimating potential risk due to diesel emissions, when examining monitored ambient concentrations, the most direct approach is to model diesel particulate emissions. When using measured data, the results above show that the use of the 1.04 factor does not overestimate diesel particulates.

Comment Category #15: Double-Counting of Diesel Contribution due to its Toxic Constituents (i.e., Other VOCs such as Benzene)

Questions were asked about possible double counting of diesel toxicity in the monitoring program. Specifically, the diesel unit risk factor is meant to reflect the toxicity of all compounds in diesel exhaust emissions. However, the District measured elemental carbon (surrogate to diesel), and some of the other compounds that are included in the diesel exhaust, separately. How significant is the double counting in the risk calculations?

Commentors:

County Sanitation District of Los Angeles County (Letter #7)
Puget Sound Clean Air Agency (Letter #17)
QSS Group, Inc. (Letter #18)
City of Los Angeles (Letter #20)

Response:

The inventoried emissions from diesel engines incorporated diesel particulates as well as several additional species including benzene, 1,3butadiene, formaldehyde, acetaldehyde, cadmium, lead, and nickel. Both gaseous and particulate diesel emissions were modeled and the resulting concentrations were used for the risk calculation. However, the unit risk factor assigned to diesel particles alone accounts for the whole diesel exhaust. Consequently, when the risk was calculated for the non-diesel particulate components of the diesel exhaust an overlap or double counting of estimated risk occurred. The overlapping count of risk amounted to approximately about 1% of the total from diesel emissions.

The on-road diesel truck emissions can be used to demonstrate the effect of the overlapping risk estimation. Shown below is the risk calculation done for the two separate components of the diesel emissions: diesel emissions other than "diesel particulate", and diesel particulate emissions.

Species	Emissions (lbs/day)	URF ($x10^{-6}$)	URF Weighted Emissions
(a) Diesel Emissions Other Than "Diesel Particulate"			
Benzene	834	29	24186
1,3Butadiene	79	170	13430
Formaldehyde	6136	6	36816
Acetaldehyde	3066	2.7	8278
Cadmium	1.54	4200	6468
Lead	0.68	12	8
Nickel	0.36	260	94
Total			**89280**
(b) "Diesel Particulate" Emissions			
Diesel Particulate	**22890**	**300**	**6867000**

Since the total risk from diesel exhaust is represented by that calculated for diesel particulate, the additional risk calculated from (a), above, represents the overlap. From the calculation, a 1.3 percent increase in total risk is incurred. This margin of error is not viewed by AQMD staff as significant, given other counterbalancing factors such as those discussed in comment category #14.

Comment Category #16: Definition of Average Risk

Comments were received about the inappropriate use of the term "average risk", and comments were provided to clarify it.

Commentors:

EMA (Letter #8)
WSPA/ARCO (Letter #19)

Response:

In the MATES-II report, the term "average" was used to convey the average of the conditions across all fixed monitoring sites. The AQMD staff recognizes that the term "average cancer risk" may misconstrue the fact that potency factors are taken to reflect the upper limit of the confidence intervals, not the average. To avoid confusion, the term "basinwide cancer risk" will be used instead of "average cancer risk," and this term will be explained in the report to represent the risk derived from the average concentration of pollutants measured at the fixed monitoring sites.

Comment Category #17: New Technology Solutions

A product was presented to reduce diesel emissions.

Commentors:

International Fuel Technology (Letter #9)

Response:

The evaluation of new technology is outside of the scope of this study. Evaluation of advances in fuel or any other technology are regularly pursued by the AQMD's Office of Science and Technology Advancement (TAO), and/or the California Air Resources Board's Mobile Source and Research Division. A copy of the commentor's letter has been forwarded to TAO. (Of course, engine manufacturers and fuel producers are very interested in emission reducing technologies.)

Comment Category #18: Miscellaneous

- The final report should discuss the monitoring of accidental releases from stationary sources.
- There are inconsistencies between the federal PM2.5 standard of $15\mu g/m^3$ and the unit risk factors used by the District.
- There are inconsistencies in the report about carbon tetrachloride.
- The AQMD should establish a formal process to determine how to best use the information in MATES-II.
- Various other questions were asked that are mostly answered in the report.

Response to Comments
MATES-II Draft Report

Commentors:

Communities for a Better Environment (CBE) (Letter #5)
EMA/Environ (Letter #8a)
WSPA/ARCO (Letter #19)
City of Los Angeles (Letter #20)
Foothill Transit (Letter #22)

Response:

Accidental Releases:
The assessment of potential impact of accidental releases was beyond the scope of this study.

Inconsistency between Risk Factor for Diesel and PM2.5 Standard:
AQMD staff believes the considerations made in establishing the PM2.5 standard of 15 ug/m3 as an annual average did not take into account toxic pollutants, since these are individual compounds handled separately under the toxics programs. By analogy, hexavalent chromium is a potent carcinogen measured in the atmosphere at levels around 1 nanogram per cubic meter. If hexavalent chromium, which has been listed as a federal hazardous air pollutant long before the new PM2.5 standards were promulgated by U.S. EPA, were part of that consideration, then a particulate standard at the nanometer level would be expected. We therefore do not believe there are inconsistencies between specific PM carcinogenic risk factors and the PM2.5 federal standards.

Carbon Tetrachloride:
The text was revised.

Application of the Report:
The AQMD Board will consider all available information in establishing the process by which MATES-II will be used.

Various Issues:
The report discusses issues listed.

Comment Category #19: Overview Document

Questions were asked about the Overview Document.

Commentors:

EMA (Letter #8)

Response:

Since the release of the Draft Report, there has not been any noticeable interest (as expressed by requests from the public) for the Overview Document. Therefore, AQMD will not be providing a separate overview document with the release of the Final MATES-II Report. Staff intends, rather, to provide stand-alone copies of the Executive Summary to those who express interest in a condensed version of the report.

Comment Category #20: Suggestions to Change Language of the Text

Suggestions were made to change the language of the text.

Commentors:

Northrop Grumman (Letter #14)
City of Los Angeles (Letter #20)

Response:

Comments were incorporated as deemed appropriate.

Comment Category #21: Identification of Sites by Region

Questions were raised about the validity of identifying a region by the name of a specific city.

Commentors:

ATSTRG Committee

Response:

For the MATES-II fixed sites, locations were selected based on "neighborhood scale" guidance as developed by the U.S. EPA. As such, the fixed sites may represent conditions in areas that may include adjacent communities. Because the release of the draft report referred to specific locations, those will be retained, however, text has been added to clarify that these sites may represent more than just the community where the monitor was placed. For the microscale sites, on the other hand, site placement was very specific to localized conditions, and it is not expected that such sites would be representative of larger areas.

Comment Category #22: Vehicle Count vs. Elemental Carbon Measurements

Comments were received illustrating that truck counts conducted on freeways close to MATES-II sites do not correlate with measured elemental carbon concentrations at those sites.

Commentors:

California Trucking Assoc. (Letter #23)

Response:

Truck counts at a nearby freeway do not necessarily relate to elemental carbon measurements at a monitoring site. Other factors such as traffic data on all roads, proximity of the roads to the measuring site, level of congestion, meteorology, and emission factors need to be considered. These parameters can then be used as inputs to a point/line source air quality model. For the grid-based regional model used in the MATES-II study, many of these important elements were included as part of the model. Please also refer to the last part of comment category #5.