

**CHAPTER 1**  
**INTRODUCTION**

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## Chapter 1. Introduction

### 1.1. Background

The South Coast Air Basin (Basin), a highly urbanized area, is home to about 16 million people who own and operate about 11 million motor vehicles and contains some of the highest concentrations of industrial and commercial operations in the country. It also has the poorest air quality in the U.S. In 1986, SCAQMD conducted the first MATES Study to determine the Basin-wide risks associated with major airborne carcinogens. At the time, the state of technology was such that only ten known air toxic compounds could be analyzed. In 1998, a second MATES Study (MATES II) represented one of the most comprehensive air toxics measurement programs conducted in an urban environment. MATES II included a monitoring program of 40 known air toxic compounds, an updated emissions inventory of toxic air contaminants, and a modeling effort to characterize health risks from hazardous air pollutants.

Since these studies were conducted, several emissions control programs have been implemented at the national, state, and local levels; and toxics emissions have been declining. However, at the community level, there is heightened awareness of toxic air contaminant exposures. There are also environmental justice concerns that programs designed to reduce emissions may not be effective in reducing risks from toxic air contaminants in certain areas, particularly in communities with lower income or multiple sources of air toxics.

In September 2003, the SCAQMD Governing Board approved several enhancements to the District's Environmental Justice Program. Initiative I-5 of these enhancements called for a one-year sampling program for air toxics. Staff initiated the MATES III Study in April 2004, to provide current data on air toxic levels and exposures, address environmental justice issues, establish an updated baseline of toxic emissions, exposures, and risk levels.

During the fall and winter of the study, there were unusual weather patterns that resulted in a near record rainfall in the Basin. To determine if these weather patterns affected the ambient levels of air toxics, the study was extended to two years through March, 2006. In this report the two years will be referred to as MATES III Year One (year 1) and MATES III Year Two (year 2).

### 1.2. Objective

The objective of MATES III was to characterize the ambient air toxic concentrations and potential exposures in the Basin. This project included two years of ambient monitoring for air toxics. The project developed an updated toxics emissions inventory and conducted air dispersion modeling to estimate ambient levels and the potential health risks of air toxics.

It is anticipated that the results of this study additionally would serve to inform an update of the District's Air Toxics Control Plan.

This study focuses on the carcinogenic risks from exposures to air toxics. It does not include an analysis of noncancer mortality from exposure to particulates. An analysis of mortality and other health effects from exposure to particulates was conducted as part of the 2007 AQMP. The results of this effort can determine the spatial concentration pattern of important hazardous

air pollutants in the Basin, assess the effectiveness of current air toxic control measures, provide trend data of air toxic levels, and be used to update and develop appropriate control strategies for reducing exposures to toxics associated with significant public health risks.

There are three components to the study, as listed below:

- Air Toxics Monitoring and Analyses
- Emissions Inventory Enhancements
- Air Toxic Modeling and Risk Assessments

These components are further described in the chapters that follow.

### **1.3. Estimates of Risks**

A health risk assessment evaluates the potential health impacts from exposures to substances released from a facility or found in the air. These assessments provide estimates of potential long-term cancer and noncancer health risks. The assessments do not collect information on specific individuals but are estimates of potential effects in a population at large.

Potential health risks were estimated using methodology consistent with the procedures recommended in the 2003 OEHHA “Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments” (Guidance Manual). As discussed in the Guidance Manual, the risk assessment process generally consists of four parts, namely hazard identification, exposure assessment, dose response assessment, and risk characterization. The risk assessment steps, as applied in this study, are briefly summarized below.

#### *Hazard Identification*

Hazard identification involves determination of whether a hazard exists; and, if so, if the substance of concern is a potential human carcinogen or is associated with other types of adverse health effects in humans. For this study, the list of air toxics in the OEHHA Guidelines was used in conjunction with information on ambient levels of air toxics from previous studies, as well as input from the Technical Advisory Group, to determine which substances on which to focus for this assessment. This list is provided in Appendix I.

#### *Exposure Assessment*

The purpose of an exposure assessment is to estimate the extent of public exposure for a substance. This can involve quantification of emissions from a source, modeling of environmental transport and fate, and estimation of exposure levels over some period of time. In this study, annual averages of the air toxics of concern were estimated in two ways. For the fixed site monitoring station data, annual averages were calculated and used as an estimate of exposure. For the modeling analysis, emissions over the Basin were estimated and allocated to 2 kilometer geographic grids, and a regional dispersion model was used to estimate the annual average concentrations in each grid space.

### *Dose Response Assessment*

The dose response assessment characterizes the relationship between exposure to a substance and the incidence of an adverse health effect in an exposed population. For estimating cancer risk, the dose-response is expressed in terms of a potency slope that is used to calculate the probability of cancer associated with a given exposure. These cancer potency factors are expressed as the 95<sup>th</sup> statistical upper confidence limit of the slope of the dose response curve assuming a continuous lifetime exposure to a substance at a dose of one milligram per kilogram of body weight.

For effects other than cancer, dose-response data are used to develop acute and chronic Reference Exposure Levels (RELs). The RELs are defined as the concentrations at or below which no adverse noncancer health effects would be found in the general population. The acute RELs are designed to be protective for infrequent 1 hour exposures. The chronic RELs are designed to be protective for continuous exposure for at least a significant fraction of a lifetime.

For this study, the dose-response estimates developed by OEHHA are used to estimate the potential for adverse health effects. It may be pointed out that these estimates sometimes differ from those developed by the U.S. EPA. For example, OEHHA has developed a cancer potency factor for diesel exhaust, whereas the U.S. EPA has elected not to do so. The U.S. EPA does state, however, that diesel exhaust is likely to be carcinogenic to humans and has adopted extensive regulations designed to reduce diesel exhaust exposure. While some of the potency estimates OEHHA has developed for other air toxics produce different estimates of risks than those that would be calculated using the U.S. EPA values, the risk from diesel exhaust calculated using OEHHA's cancer potency factor is the dominant contributor to the estimated air toxics cancer risk in this study.

### *Risk Characterization*

In this step, the estimated concentration of a substance is combined with the potency factors and RELs to determine the potential for health effects. In this study, the estimated or measured annual average levels for potential carcinogens were multiplied by the potency factor expressed as unit risks. The unit risk is the probability associated with a lifetime exposure to a level of one microgram per cubic meter of air of a given substance. The unit risk factors developed by OEHHA and used in this study are listed in Appendix I.

The potential cancer risk for a given substance is expressed as the incremental number of potential cancer cases that could be developed per million people, assuming that the population is exposed to the substance at a constant annual average concentration over a presumed 70-year lifetime. These risks are usually presented in chances per million. For example, if the cancer risks were estimated to be 100 per million, the probability of an individual developing cancer from a lifetime exposure would be one in a million. This would predict an additional 100 cases of cancer in a population of a million people over a 70-year lifetime period.

### *Perspectives of Risk*

It may be useful to compare risks estimated from assessments of environmental exposures to the overall rates of health effects in the general population. For example, it is often estimated that

the incidence of cancer over a lifetime in the U.S. population is about 1 in 4, to 1 in 3. This translates into a risk of about 300,000 in a million. It has been also estimated that the bulk of cancers from known risk factors are associated with lifestyle factors such as tobacco use, diet, and being overweight. One such study, the Harvard Report on Cancer Prevention, estimated that of cancers associated with known risk factors, about 30% were related to tobacco, about 30% were related to diet and obesity, and about 2% were associated with environmental pollution related exposures.

#### *Source of Uncertainty*

The estimates of health risks are based on the state of current knowledge, and the process has undergone extensive scientific and public review. However, there is uncertainty associated with the processes of risk assessment. This uncertainty stems from the lack of data in many areas necessitating the use of assumptions. The assumptions are consistent with current scientific knowledge, but are often designed to be conservative and on the side of health protection in order to avoid underestimation of public health risks.

As noted in the OEHHA guidelines, sources of uncertainty, which may either overestimate or underestimate risk, include: (1) extrapolation of toxicity data in animals to humans, (2) uncertainty in the estimation of emissions, (3) uncertainty in the air dispersion models, and (4) uncertainty in the exposure estimates. Uncertainty may be defined as what is not known and may be reduced with further scientific studies. In addition to uncertainty, there is a natural range or variability in the human population in such properties as height, weight, and susceptibility to chemical toxicants.

Thus, the risk estimates should not be interpreted as actual rates of disease in the exposed population, but rather as estimates of potential risk, based on current knowledge and a number of assumptions. However, a consistent approach to risk assessment is useful to compare different sources and different substances to prioritize public health concerns.

#### **1.4. References**

The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, 2003.

Harvard Report on Cancer Prevention Volume 1: Causes of Human Cancer  
Cancer Causes & Control, Volume 7 Supplement November 1996

## **CHAPTER 2**

### **AIR TOXICS MONITORING AND ANALYSES**

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## Chapter 2. Air Toxics Monitoring and Analyses

### 2.1. Substances Monitored

The chemical compounds (Table 2-1) to be monitored in MATES III include the toxics posing the most significant contributors to health risks as found in previous studies in the Basin. Additional measurements include organic carbon, elemental carbon, and total carbon, as well as Particulate Matter (PM), including PM<sub>2.5</sub>. Acrolein was initially considered to be included. However, there was no suitable method available for routine analyses at the time the study began. Other compounds are also reported, since they are additionally captured in both the sampling and analytical protocols proposed.

**Table 2-1 Substances Monitored in MATES III**

Benzene	1,3-Butadiene	Carbon Tetrachloride
Chloroform	Dichlorobenzene	Methylene Chloride
MTBE	Perchloroethylene (Tetrachloroethylene)	Dichloroethane
Dibromoethane	Ethyl Benzene	Toluene
Trichloroethylene	Xylene	Styrene
Vinyl Chloride	Acetaldehyde	Formaldehyde
Acetone	Methyl ethyl ketone	
Arsenic	Cadmium	Hexavalent Chromium
Copper	Lead	Manganese
Nickel	Selenium	Zinc
Elemental Carbon	Organic Carbon	Naphthalene
PAHs	PM <sub>10</sub>	PM <sub>2.5</sub>

Naphthalene and other polycyclic aromatic hydrocarbons (PAHs), components of both mobile source and stationary source emissions, were measured. Recent reports have shown that annual averages of naphthalene are at levels hundreds to thousands of times higher than that of other PAHs. The National Toxicology Program has listed naphthalene as a potential human carcinogen. Additionally, the California EPA's Office of Environmental Health Hazard Assessment (OEHHA) recently evaluated the health risk of ambient naphthalene under California's Air Toxics Program and developed a cancer potency factor. The International Agency for Research on Cancer considers naphthalene to be possibly carcinogenic to humans. Given the likely importance of naphthalene to public health, it is of value to obtain additional information on ambient levels and emissions of this compound.

PAHs were measured at three of the MATES III monitoring stations using EPA method TO-13A as a guideline. The West Long Beach and Central Los Angeles sites were selected because of their proximity to mobile emissions sources. Also, Lu, et al. (2005) incorporated ambient data from the Southern California Children's Health Study and showed the highest naphthalene emissions rate in those regions. The Rubidoux site was selected as a receptor site and also for its particle-bound PAH measurement history as part of the ARB toxics network.

Details of the methodology are given in Appendix IV.

## **2.2. Siting of Monitoring Stations**

The MATES III project conducted air toxics monitoring at ten locations over a two-year period. In addition to the ten fixed sites, the movable monitoring platforms were deployed that focused on “microscale” studies at five locations for periods up to several months.

The combination of fixed and microscale sites was done to ensure sufficient resolution to monitor representative concentrations of varying land use types and characterize spatial gradients in the Basin.

## **2.3. Ambient Sampling Schedule**

Sampling for MATES III followed a one-in-three day, 24-hour integrated-sampling schedule, which is double the schedule utilized during the MATES II Study. In the microscale studies, a 24-hour integrated-sampling schedule was maintained for carbonyls, PM, and volatile organic compound (VOC) measurements, but in addition, three eight-hour integrated canister samples for VOCs were collected for higher temporal resolution over a single day. All data will be submitted to the U.S. EPA’s Air Quality System (AQS) after review and validation.

## **2.4. Monitoring Sites**

### **2.4.1. Fixed Sites**

The fixed monitoring sites are those used in the MATES II Study, other than for the West Long Beach site. These sites were selected 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. The West Long Beach site for the MATES III Study is about 2.5 miles east of the MATES II site, as the previous site was no longer available.

The locations for the ten fixed sites reflect key locations within the Basin and are geographically dispersed. Fixed site locations include areas varying in land-use types to obtain a good spatial representation of the Basin which includes expected areas of possible elevated toxics levels (e.g. industrial and commercial) and those areas that are not directly near source emissions (neighborhoods). The sites also reflect resource constraints and the leveraging of existing specialized equipment. In addition, using these sites utilized in MATES I and MATES II allows for trend analysis. The sites used in MATES III are shown in Figure 2-1.

The ten sites were selected with the input from the MATES II Technical Review Group and the Environmental Justice Task Force, and locations are listed in Table 2-2. Five were selected to provide continuity with the ARB long-term trend sites (Los Angeles, Burbank, Long Beach, Rubidoux and Inland Valley San Bernardino). 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. West Long Beach, Compton, and Huntington Park were 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 2-2 Mates II Fixed Site Locations**

Site	Address
Anaheim	1010 S. Harbor Blvd.
Burbank	228 W. Palm Ave.
Compton	720 N. Bullis Rd.
Inland Valley San Bernardino	14360 Arrow Highway
Huntington Park	6301 S. Santa Fe Ave.
North Long Beach	3648 N. Long Beach Blvd.
Central Los Angeles	1630 N. Main St.
Pico Rivera	3713 B-San Gabriel River Parkway
Rubidoux	5888 Mission Blvd.
West Long Beach	1903 Santa Fe Ave.

At each site, sampling equipment included particulate samplers, canisters, and carbonyl samplers, as well as equipment to measure key meteorological parameters.



**Figure 2-1 Location of MATES III Monitoring Locations**

**2.4.2. Microscale Sites**

The purpose of the microscale sites is to monitor air contaminants on a neighborhood level at locations of concern within the Basin. This information is used to determine if communities may

be experiencing localized gradients of air toxics not otherwise determined by modeling as related to issues of environmental justice.

The microscale sites utilize the SCAQMD's movable monitoring platforms. As in MATES II, each microscale site will be paired with a nearby fixed site for comparison to determine if toxic air emissions at these microscale sites statistically exceed a neighboring fixed site. Due to the limited number of mobile monitoring platforms, each microscale site study lasts only a few months. Other considerations for site selection include the following: (1) power availability; (2) security; (3) accessibility to SCAQMD staff; and (4) availability of the premises for a six-to ten-week period.

Since the sampling periods for the microscale sites are limited, annual averages for measured substances cannot be calculated. However, comparing the levels from the microscale sites to those from the nearest fixed site during the timeframe that the microscale site was operating can yield insights on potential community gradients.

Microscale sites were selected using the following criteria, in consultation with the MATES III Technical Advisory Group:

- Proximity to emissions source(s);
- Areas identified with environmental justice issues;
- Potential for neighborhood gradients;
- Elevated risks from MATES II modeling analysis;
- Community concerns; and
- Geographic equity.

Input on potential types of sites has come from several sources, including the following:

- Community concerns from public outreach and Town Hall meetings;
- Public complaints;
- MATES II modeling data;
- Data from existing studies; and
- MATES Technical Advisory Group.

The locations of the microscale monitoring sites are shown in Figure 2-1 and are listed below.

- Commerce
- Indio
- San Bernardino
- Santa Ana
- Sun Valley

## **2.5. Monitoring and Laboratory Analysis**

For MATES III, meteorological equipment and sampling equipment for canisters, PM<sub>10</sub> and PM<sub>2.5</sub> filters, and carbonyl cartridges from the existing air monitoring network were used to the extent possible. The SCAQMD laboratory provided the analytical equipment and conducted the routine analysis. The analytical methods to measure the ambient species are briefly described

below and in Table 2-3. Detailed protocols are described in Appendix III.

**Table 2-3 Sampling and Analysis Methods for MATES III**

<b>Ambient Species</b>	<b>Sampling Method</b>	<b>Laboratory Analysis</b>
Volatile Organic Compounds (VOCs)	Summa Polished/ Silica-Lined Canisters	Gas chromatograph – Mass spectrometer (GC-MS) with automated pre-concentration and cryo-focusing
Carbonyls	DNPH Cartridge	Solvent recovery and subsequent analysis via high performance liquid chromatography (HPLC)
Hexavalent Chromium	Cellulose Fiber Filters	Treatment with buffer solution to maintain proper pH for unwanted conversions and then subsequent analysis via ion chromatograph(IC)
Elemental and Organic Carbon (EC/OC)	PM Filters	Section of PM filter removed and analyzed on a laser corrected carbon analyzer
PM <sub>10</sub>	High-Volume Quartz Filters	Mass determined by analytical balance; metals determined Energy Dispersive X-Ray Fluorescence Spectrometry; ions extracted with water from filter and then subsequently analyzed on IC
PM <sub>2.5</sub>	Medium-Volume Teflon Filters	Mass determined by Micro-balance; metals determined by Energy Dispersive X-Ray Fluorescence Spectrometry, ions extracted with water from filter and then subsequently analyzed on IC

**Volatile Organic Compounds (VOCs)** are measured from air samples collected in either summa polished or silica-lined six-liter canisters using an automated canister sampler to fill at a constant rate over a 24-hour or eight-hour time period depending upon the site. The filled canisters are brought back to the laboratory for analysis within 48 hours of the sample being collected. VOCs are identified and measured using gas chromatograph mass spectrometry (GC-MS). The SCAQMD currently has two GC-MS instruments that are based upon the U.S. EPA's TO-14 and TO-15 methods. These instruments are equipped with automated canister pre-concentrators attached to the GC to enable continuous analysis.

**Carbonyl Compounds** are sampled by drawing a continuous amount of air through a DNPH (2,4-Dinitrophenylhydrazine) cartridge. The carbonyl compounds undergo derivatization with DNPH, and the derivatives are analyzed using High Performance Liquid Chromatography (HPLC) in conjunction with U.S. EPA method TO-11.

**Hexavalent Chromium (Chrome VI)** is analyzed using ion chromatography (IC). Sample collection involves drawing air at a prescribed rate for 24-hours through a cellulose fiber filter. The filter is treated with sodium bicarbonate to prevent conversion of Chrome VI to Chrome III. Chrome VI is extracted from the filter by sonication and subsequently analyzed using IC.

**Particulate Matter** less than 10 microns ( $PM_{10}$ ) and less than 2.5 microns ( $PM_{2.5}$ ) are collected separately over a 24-hour period using size selective inlet (SSI) samplers according to the method based on U.S. EPA's Federal Reference Method 40CFR50. All  $PM_{10}$  and  $PM_{2.5}$  samples are collected upon quartz filters and are analyzed for total PM mass, metals, ions, organic carbon (OC) and elemental carbon (EC). Metal analysis for particulate samples are determined using Energy Dispersive X-Ray Fluorescence Spectrometry. Identification of ions within the PM samples is also done by IC. Carbon analysis is conducted by taking a small circular disk from sampled  $PM_{10}$  or  $PM_{2.5}$  filters. The small circular disk is placed into a carbon analyzer which utilizes either a thermal optical reflectance or thermal optical transmittance method (IMPROVE method) to measure the OC and EC content of the filter. As part of this effort, speciation air sampling system (SASS) samplers were deployed to characterize specific PM species.

**Diesel PM.** For MATES II, diesel PM was estimated using ambient measurements of EC and using EC emissions inventories to determine the contribution of diesel emissions to ambient PM levels. For MATES III, several methodologies to assess the levels of diesel PM were explored. These methods include the following:

- Using ambient EC levels as in MATES II
- Using ambient EC and the ratio of  $PM_{2.5}$ , EC, and diesel PM emissions from the 2005 emissions inventory
- Using the EPA Chemical Mass Balance model (CMB) to apportion source emissions to  $PM_{2.5}$
- Using Positive Matrix Factorization (PMF) to apportion source emissions to  $PM_{2.5}$

The results of these analyses are presented in the monitoring results section below.

### 2.5.1. Quality Assurance and Quality Control (QA/QC)

The SCAQMD is committed to achieving the highest possible data quality level in the MATES III Program. To achieve this data quality level, the SCAQMD has an implemented QA/QC Plan which follows U.S. EPA's *Quality Assurance Project Plan for the Air Toxics Monitoring Network* (EPA-454/R-01-007). The SCAQMD objectives, procedures, documentation, and data review techniques assure the MATES III Program will produce accurate and precise data. The technical procedures for QA/QC include annual system audits on all equipment in the laboratory and at the MATES III sampling sites. Quality control procedures include proper record keeping, standard checks, and routine calibrations of the sampling and analytical equipment. These procedures include operating collocated samples greater than 10% of samples collected. For example, the SCAQMD is currently conducting a collocated sampling of its Rubidoux station using multiple samplers.

## 2.6. Findings

The findings are presented in terms of the concentrations of air toxics and by the estimated cancer risks resulting from exposures to the average concentrations found. Data are presented by year of the study, and these time periods are referred to as MATES III Year One (April '4 – March '05) and MATES III Year Two (April '05 – March '06). In the following charts, the data are presented as annual means, and the error bars denote the 95% confidence interval of the mean.

For the second year of the study, a complete data set was not available for the Huntington Park and the Pico Rivera sites, and summary data is not included.

Summary results are presented below by site and are compared to levels found in the MATES II Study to assess trends in levels of air toxics in the Basin. In general, concentrations of most toxics substantially decreased compared to levels measured during MATES II.

In the charts below, the data is presented as the annual average by site and as the overall sites average. The error bars represent the 95% confidence interval of the average.

### **2.6.1. Volatile Compounds**

Figures 2-2 and 2-3 present levels for 1,3 butadiene and benzene, which are emitted predominantly from mobile sources. Both substances show a substantial reduction in annual levels compared to MATES II, with benzene lower by 50% and 1,3-butadiene down by 73%. As in the MATES II Study, Compton and Huntington Park sites had the highest average levels. These decreases are likely reflective of reduced emissions from vehicle turnover and use of reformulated gasoline.

Levels of the chlorinated solvents perchloroethylene and methylene chloride are shown in Figures 2-4 and 2-5. Both of these substances also show decreases from the MATES II Study. The decreases reflect the reduced usage of these substances as industrial solvents and in dry cleaning. Perchloroethylene and methylene chloride were lower on average by 78% and 53%, respectively. For methylene chloride, the North Long Beach site shows an increased level for year 1. This was due to high levels measured over three sampling days in February, 2005. No known sources are nearby. These levels may reflect an unusual use of this solvent over this time period.

Formaldehyde and acetaldehyde concentrations are shown in Figures 2-6 and 2-7. There was about a 9% reduction in the average levels between the MATES II and MATES III studies. Formaldehyde is emitted from mobile sources and is also formed as a secondary pollutant through chemical reactions in the atmosphere.

### **2.6.2. Metals**

Levels of several metals are shown in Figures 2-8 to 2-12.

Arsenic and cadmium levels are shown in Figures 2-8 and 2-9. Both metals show declines, but this may be more a result of lower reporting limits for MATES III compared to MATES II. Figures 2-10 and 2-11 show the levels of lead and nickel. Lead concentrations were reduced compared to MATES II, and the values are well below the Ambient Air Quality Standard for lead of 1,500 ng/m<sup>3</sup>. Nickel concentrations were also lower, other than for the West Long Beach site. This may be a reflection of the increased shipping activity at the ports, as nickel is a component of bunker fuel used in ships.

Hexavalent chromium concentrations are shown in Figure 2-12. It should be noted that from previous studies, localized increases can occur near facilities using hexavalent chromium, such

as metal platers or facilities using paints containing hexavalent chromium. The monitoring locations in this study, however, are focused on a regional look at air toxics levels. Emissions that could result in a localized area of increased exposure thus may not be picked up in the monitoring.

For comparison purposes, only the data from the SCAQMD lab analyses from MATES II are shown. This is because in MATES II half of the samples were analyzed by ARB and showed a lower overall average than did the SCAQMD analyzed samples. The ARB laboratory also reported higher method detection limits, which may be part of the reason for the differences. Some sites, such as Burbank and Huntington Park, show declines in average levels, whereas others show little change. The Rubidoux site actually showed an increase in average levels. If Rubidoux is not included, the average hexavalent chromium level is about 13% lower compared to MATES II.

Subsequent efforts by staff to determine the source of the hexavalent chromium near the Rubidoux site led to a cement plant in the area. The results of the intensive monitoring and analyses are available from the District's web site at <http://www.aqmd.gov/RiversideCement/RiversideCement.html>.

It is recognized that there can be a measurable value for hexavalent chromium in blank filters. To determine the extent of this, trip blanks were periodically taken at Rubidoux; and the average values are also shown in Figure 2-12. One can note that the blank values are about a third of the sites average values. When estimating risk from exposure to hexavalent chromium, the average blank value is subtracted out from the sites average.

### **2.6.3. Elemental Carbon**

In the MATES II Study, elemental carbon (EC) was measured in the PM<sub>10</sub> samples. In addition, the MATES III Study measured the levels of EC in the PM<sub>2.5</sub> samples. The results are shown in Figures 2-13 and 2-14.

In the PM<sub>10</sub> samples, EC showed a decrease (~38%) between MATES II and MATES III. One source of the reduction is the use of updated analytical instruments. For MATES III, new instruments were used to analyze for carbon. When compared with the older instrument used in MATES II, the new instruments showed about 10% lower results, on average. Thus, about a 28% reduction remains after correcting for difference in the analytical instruments. This may be a reflection of reduced carbon emissions and meteorological differences. The Huntington Park and West Long Beach sites showed the highest levels. West Long Beach and Compton did not have data for EC from MATES II, so a comparison over time at these sites cannot be made.

For the PM<sub>2.5</sub> samples, year 2 levels on average were somewhat higher than for year 1 for the sites with data for both years. This may reflect weather differences and/or an increase in emissions during the second year of the study. Huntington Park and West Long Beach showed the highest levels for year 1 where data were available for all sites.

### **2.6.4. Diesel PM**

In the MATES II Study, EC was used as a surrogate for diesel particulate levels, as staff

determined that this was the best method available during the MATES II Study. For the present study, staff used the Chemical Mass Balance (CMB) source apportionment technique to estimate the contribution from diesel, as well as from other major source categories, to the measured particulate levels. The CMB model was used on the recommendation of the Technical Advisory Group.

To compare different methods to estimate diesel particulate levels, the method used in MATES II, which was based on the emissions ratios of diesel particulate and elemental carbon from a study conducted in the South Coast in the 1980's and a method based on the ratio of  $PM_{2.5}$  emissions from the 2005 emissions inventory were also calculated. For MATES II, the  $PM_{2.5}$  elemental carbon levels were multiplied by 1.04 to estimate diesel particulate. The 2005 inventory finds a ratio of diesel particulate to elemental carbon emissions of 1.95. The emissions and ratio are shown in Table 2-4. Multiplying the  $PM_{2.5}$  elemental carbon levels by 1.95 gives another estimate of diesel particulate.

**Table 2-4 2005 Emissions of Diesel PM and EC, lbs./day**

<b><math>PM_{2.5}</math> Diesel PM</b>	<b><math>PM_{2.5}</math> EC</b>	<b>DPM/EC Ratio</b>
55,983	28,761	1.95

The estimates using these methods compared to using the CMB model are shown in Table 2-5. The CMB model used several species of substances from emissions source profiles to estimate the contribution of these sources to ambient PM levels. The details of this calculation are given in Appendix VII.

Table 2-5 gives the sites average estimates for diesel PM using the CMB model and compares the level with the methods based on emissions inventory ratios. For the CMB model, the estimates were sensitive to the species profile used for gasoline vehicles. Table 2-5 shows the range of values using two different gasoline profiles. The estimates used for the risk calculations were the midpoint of the range.

As shown in the table, both the CMB model and the  $PM_{2.5}$  emissions ratio method give higher estimates than the MATES II method. Thus the MATES II Study method may underestimate the levels of diesel particulate.

**Table 2-5 Estimates of Average Diesel PM,  $\mu g/m^3$**

<b>Estimation Method</b>	<b>MATES III Year One</b>	<b>MATES III Year Two</b>
MATES II: $PM_{10}$ EC x 1.04	2.18	2.14
2005 Inventory: $PM_{2.5}$ EC x 1.95	3.37	3.70
CMB	2.87 – 3.13	3.52 – 3.84

### 2.6.5. Naphthalene and Other PAH Compounds

Limited measurements of naphthalene and other PAHs (Polycyclic Aromatic Hydrocarbons) were taken at three sites. Summary data for naphthalene are shown in Figure 2-15, and the other

PAHs measured are shown in Figure 2-16.

Naphthalene levels were on average much higher than that of other PAHs, in line with previous observations in the Basin. For the three sites, Central Los Angeles showed the highest average levels of naphthalene and Rubidoux the lowest. For the sum of the other PAHs, West Long Beach showed the highest levels.

## 2.7. Cancer Risk Estimates

In the MATES II Study, cancer risks were estimated for exposure to the measured ambient levels of air toxics. The estimates assumed that a lifetime exposure (70 years) occurs to these levels, consistent with guidance on risk assessment established by OEHHA. We use the same methodology to estimate risks for the levels of toxics measured during MATES III.

There are inherent uncertainties in risk assessment, as discussed in the Introduction of this report and in the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines (August 2003)<sup>1</sup>. Despite these uncertainties, risk assessment remains the most useful tool to estimate the potential health risks due to low level environmental exposures. This tool is also useful as a yardstick to measure progress in attaining healthful air quality.

Figures 2-17 and 2-18 show the estimated cancer risks for the toxics measured by site summed by substance for each year of the MATES III Study. The second year includes the levels for naphthalene and other PAHs for which there are adopted cancer potency values for the three sites where measurements were collected. The sites average also includes the PAHs using the available three-site average. The PAHs are relatively small contributors to the overall average risk. The average level of naphthalene was 180 ng/m<sup>3</sup> over the three sites. This equates to a 70-year risk of about six per million.

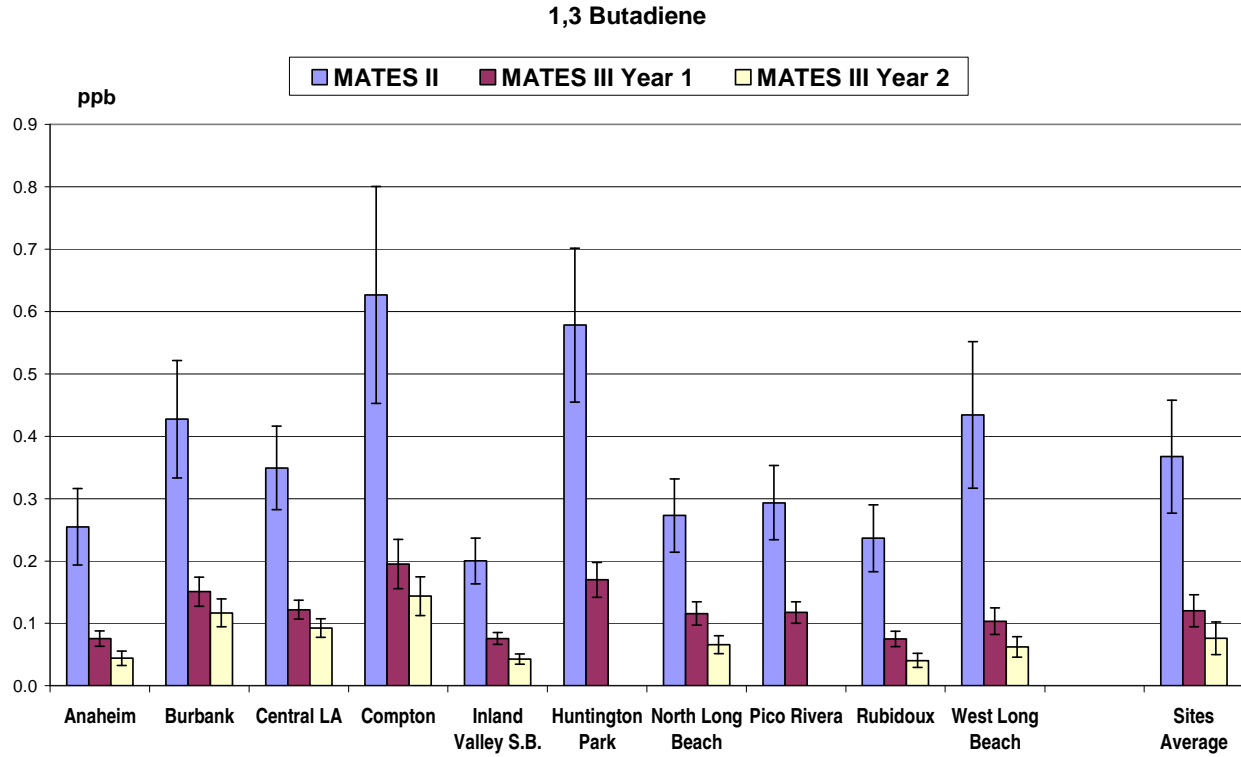
As shown in the charts, diesel particulate is the major contributor to air toxics risk. The average risk over the two years is about 1,200 per million. This compares to about 1,400 per million in the MATES II Study. It should be noted that different methods were used to estimate diesel particulate levels in the MATES III Study, so the results are not strictly comparable. Based on the discussion above, the MATES II Study method may have underestimated the levels of diesel particulate.

On average, diesel particulate contributes about 84% of the total air toxics risk. This is a larger portion of risk compared to the MATES II estimate of about 70%. In addition to the differences in methods for estimating diesel particulate, this may reflect a larger relative decrease in ambient levels of other toxic air contaminants compared to diesel exhaust.

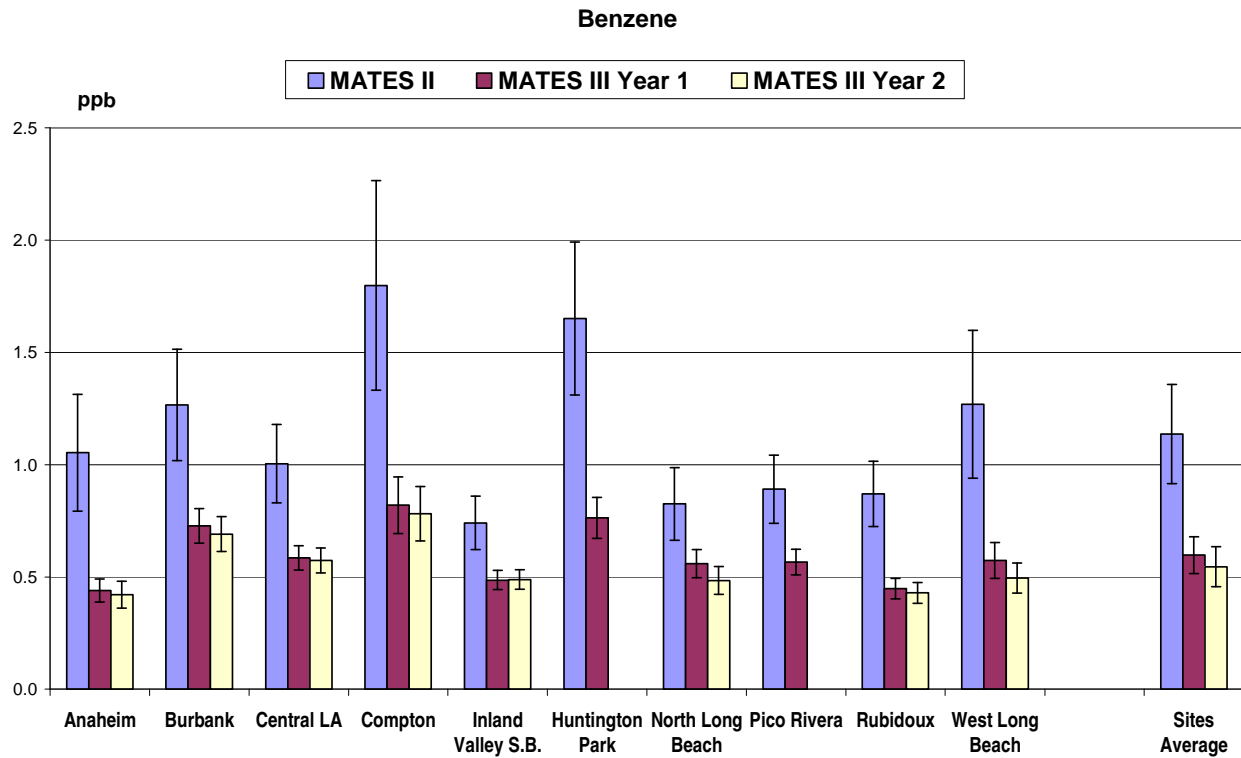
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<sup>1</sup> California Environmental Protection Agency Office of Environmental Health Hazard Assessment, Air Toxics Hot Spots Program Risk Assessment Guidelines. The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments. August 2003.

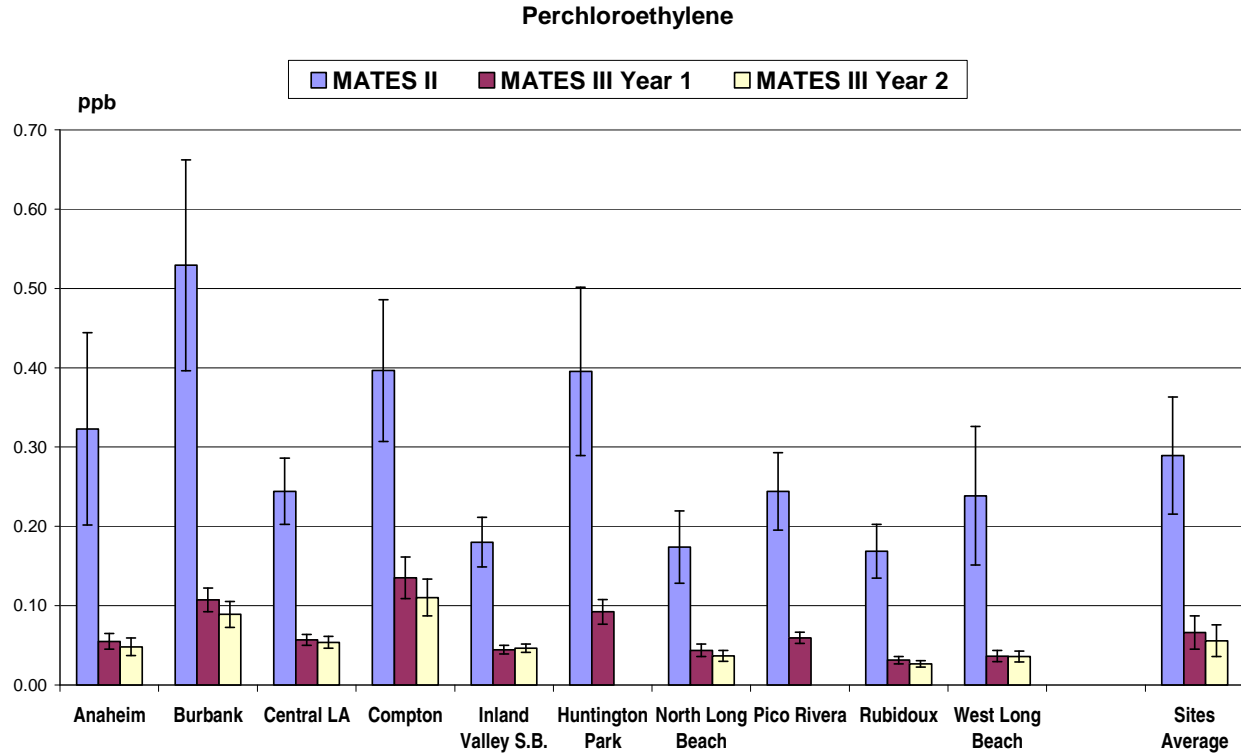




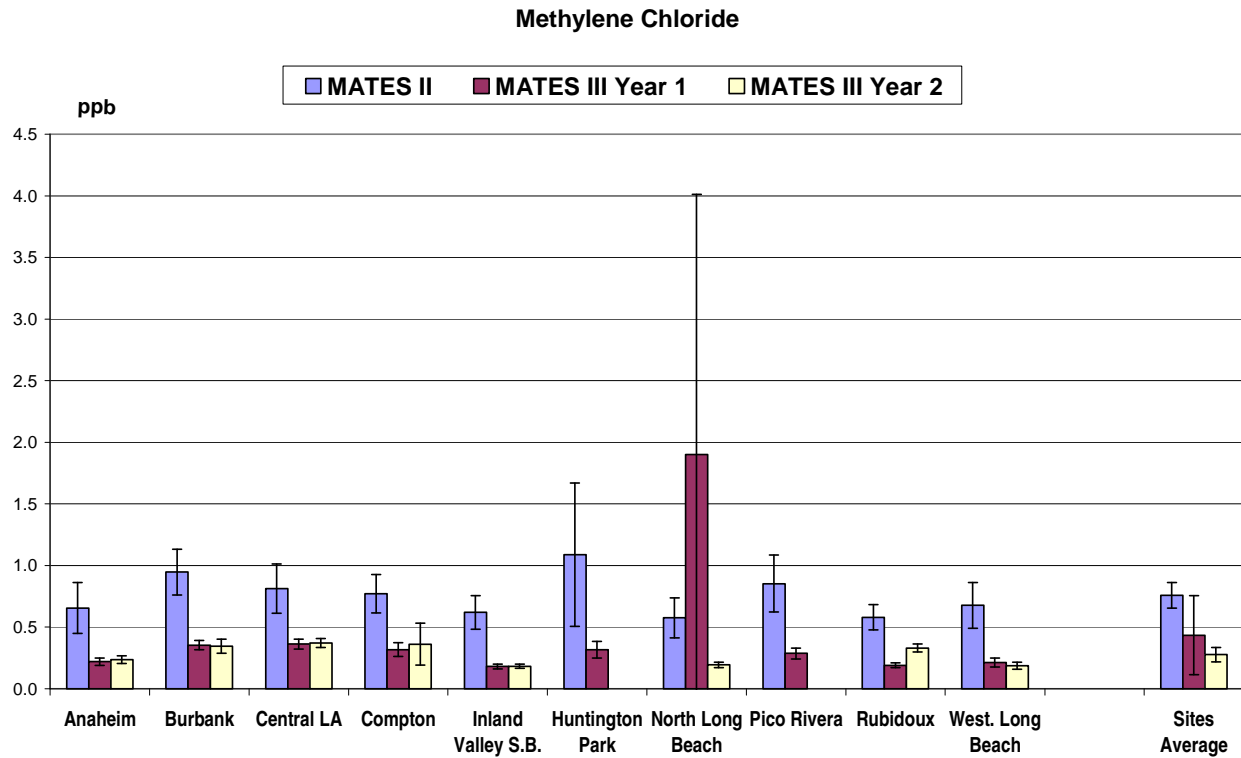
**Figure 2-2 Average Concentrations of 1,3-Butadiene**



**Figure 2-3 Average Concentrations of Benzene**



**Figure 2-4 Average Concentrations of Perchloroethylene**



\*Extremely higher concentrations measured for three samples over a 15-day period.

**Figure 2-5 Average Concentrations of Methylene Chloride**

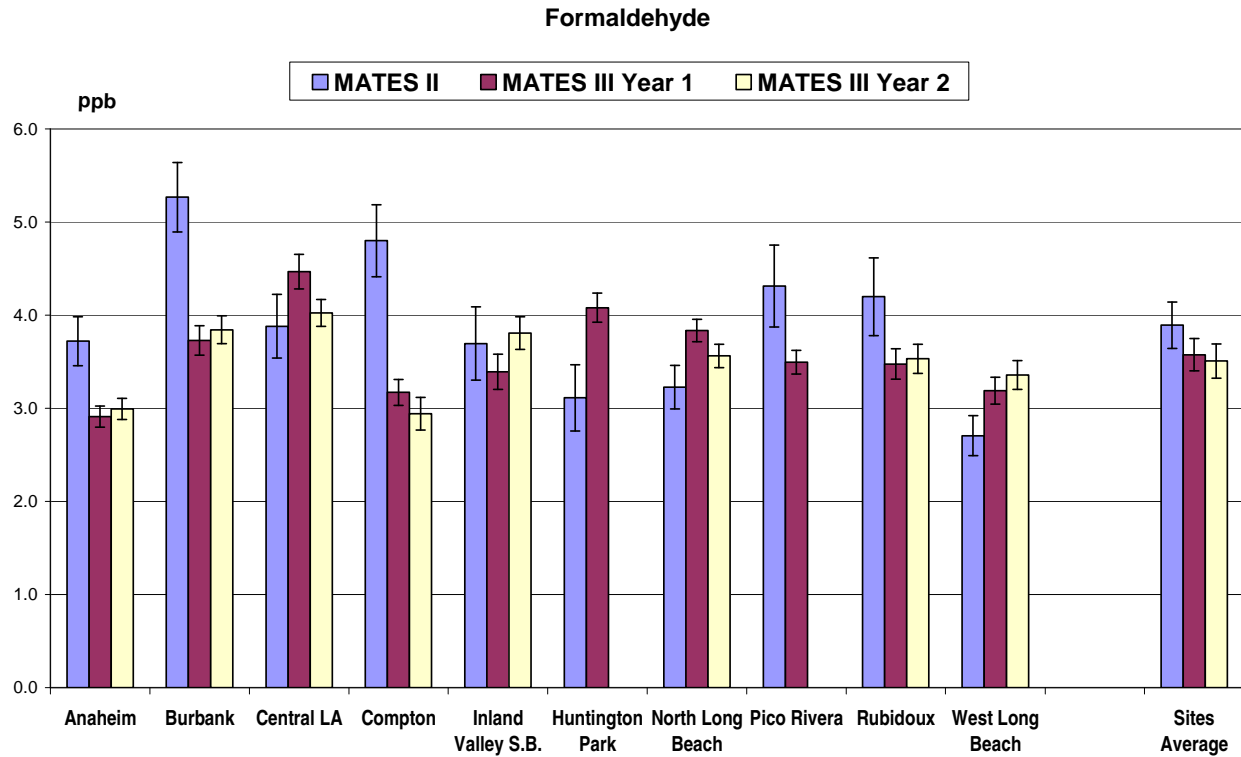


Figure 2-6 Average Concentrations of Formaldehyde

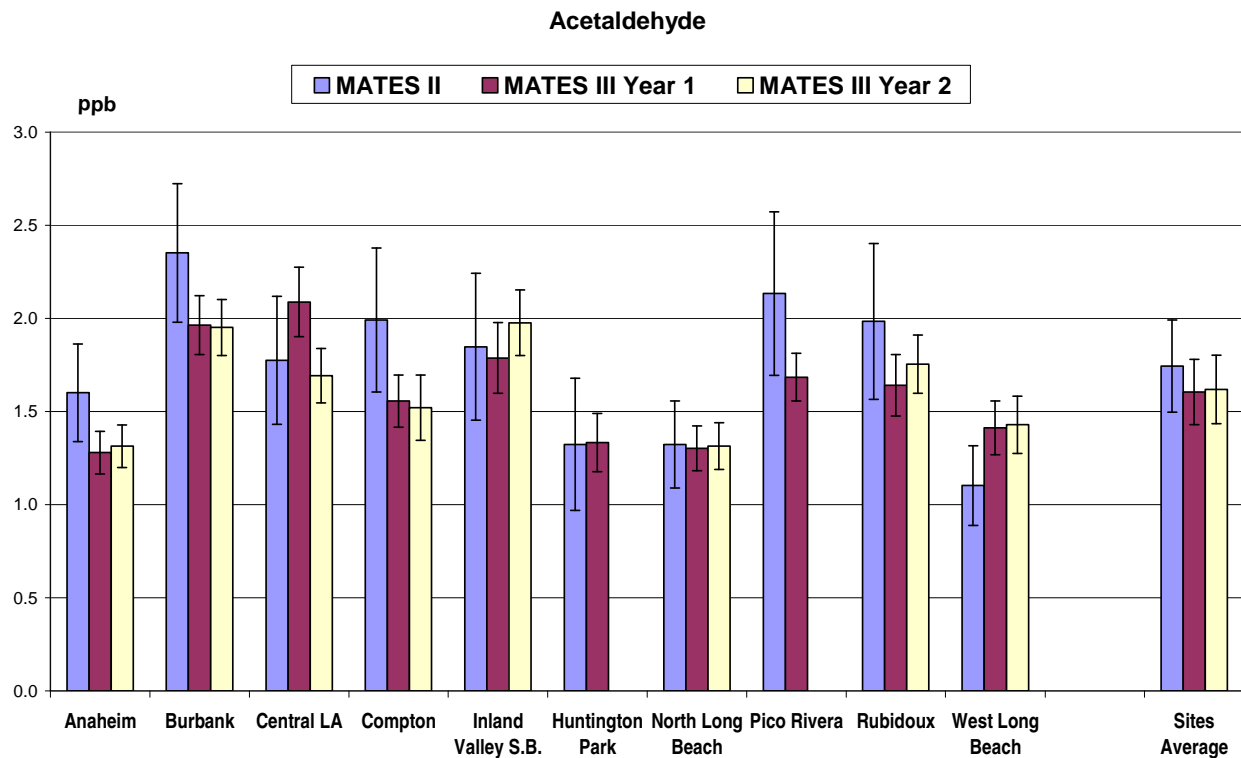
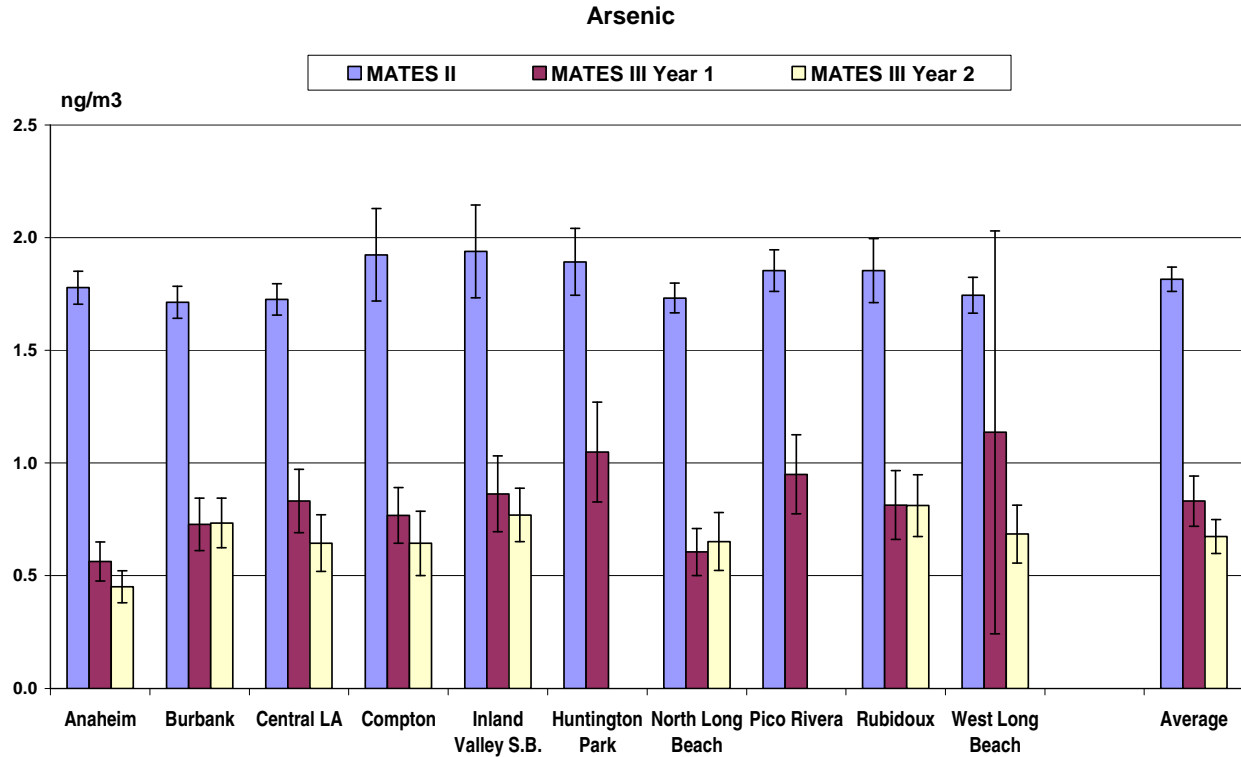
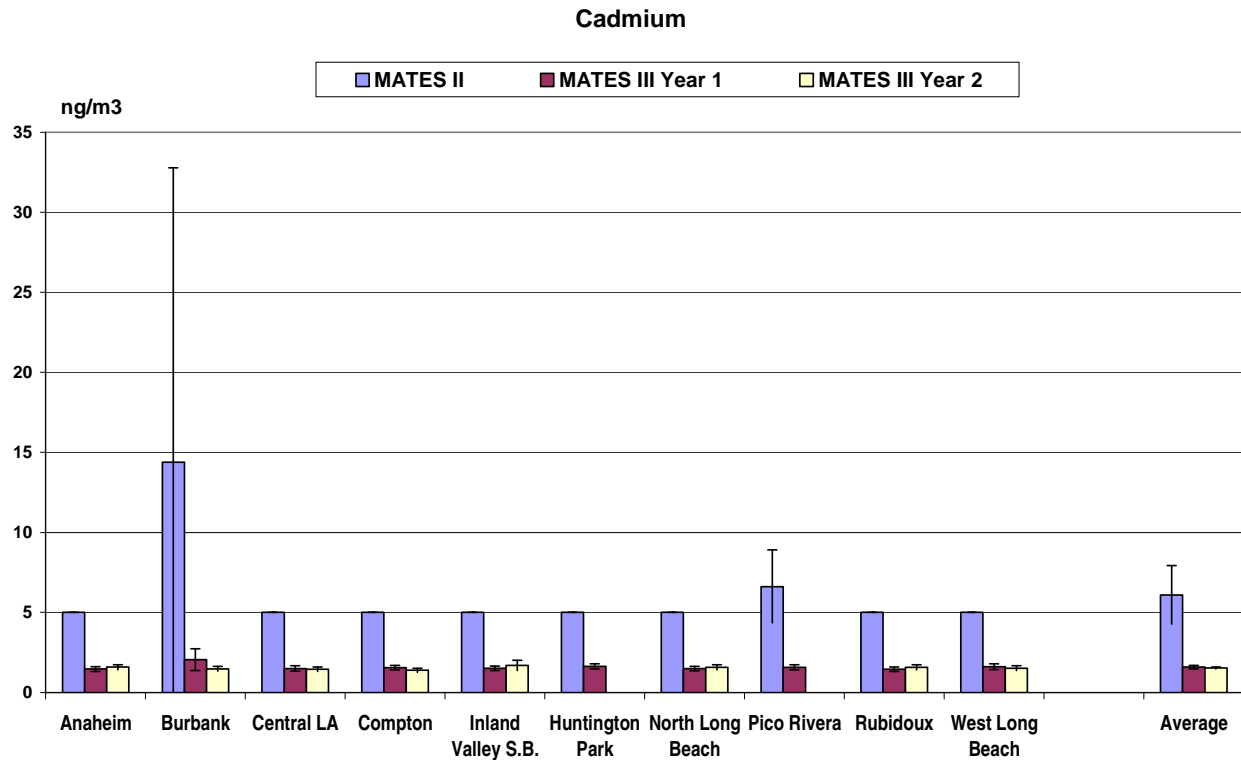


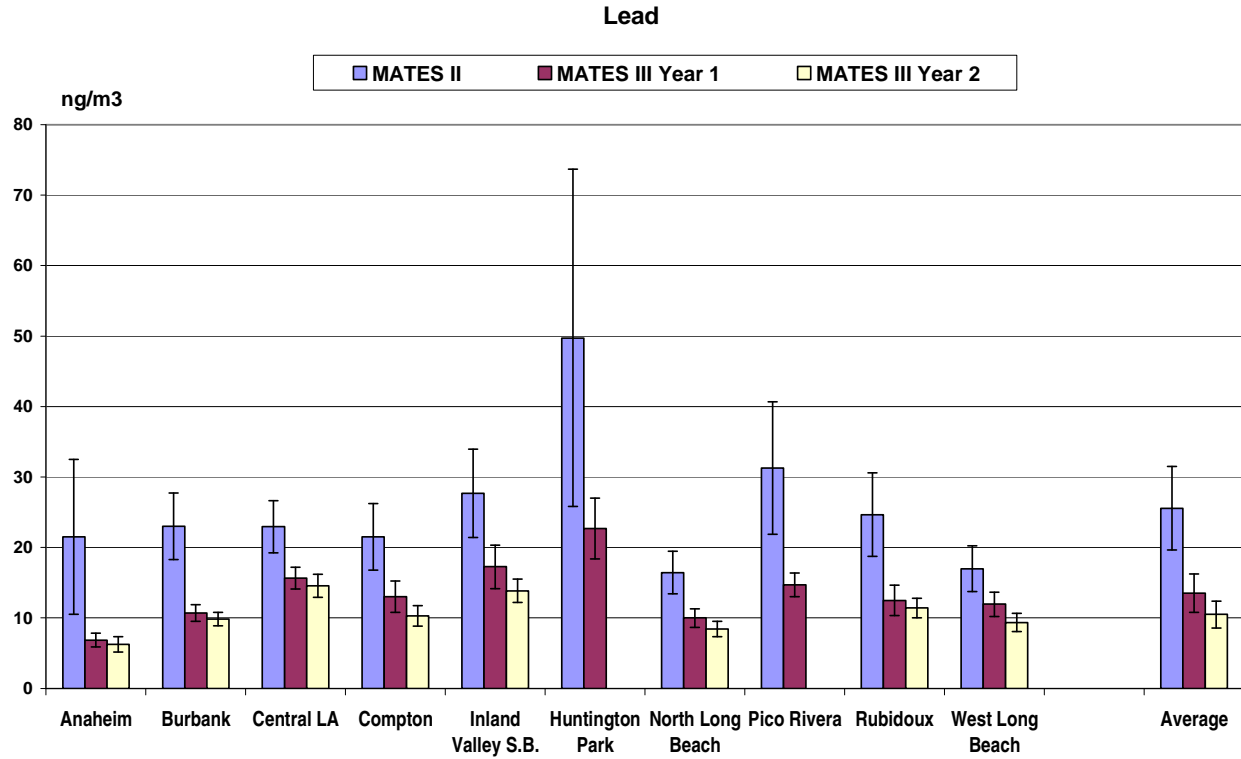
Figure 2-7 Average Concentrations of Acetaldehyde



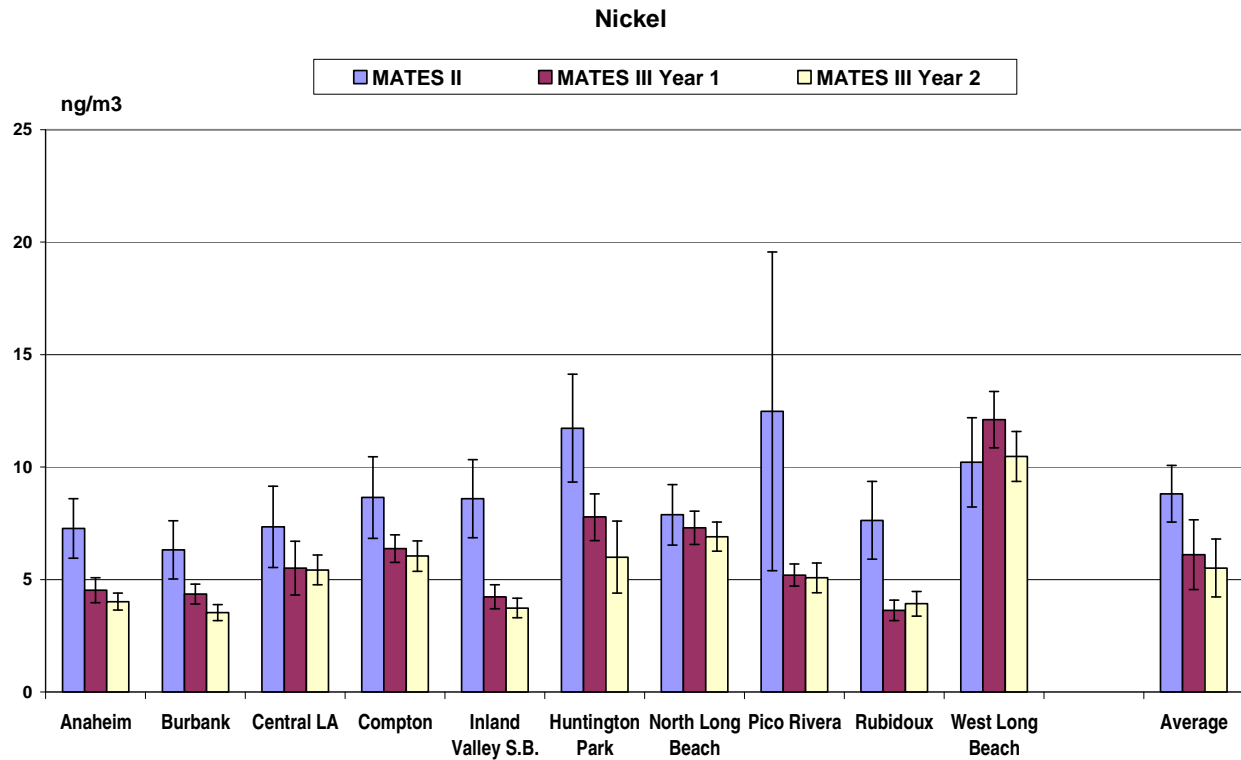
**Figure 2-8 Average Concentrations of Arsenic in Total Suspended Particulate (TSP)**



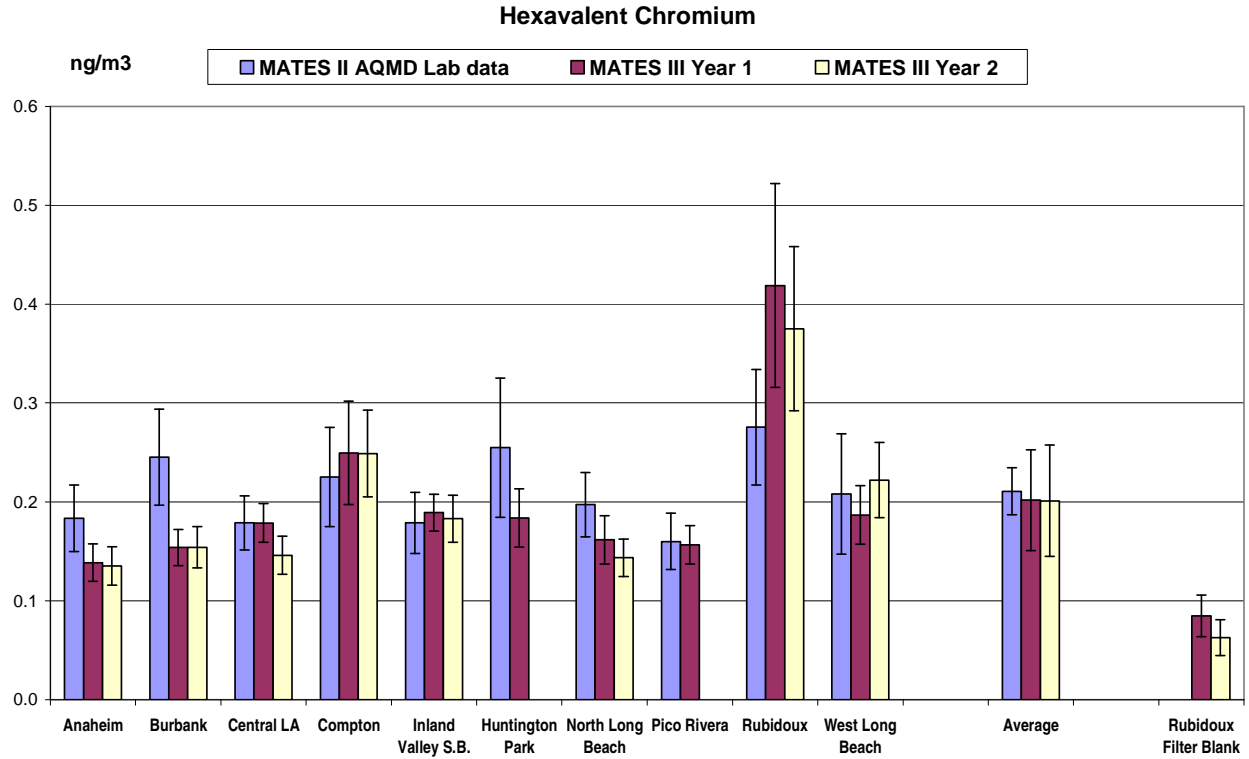
**Figure 2-9 Average Concentrations of Cadmium in Total Suspended Particulate (TSP)**



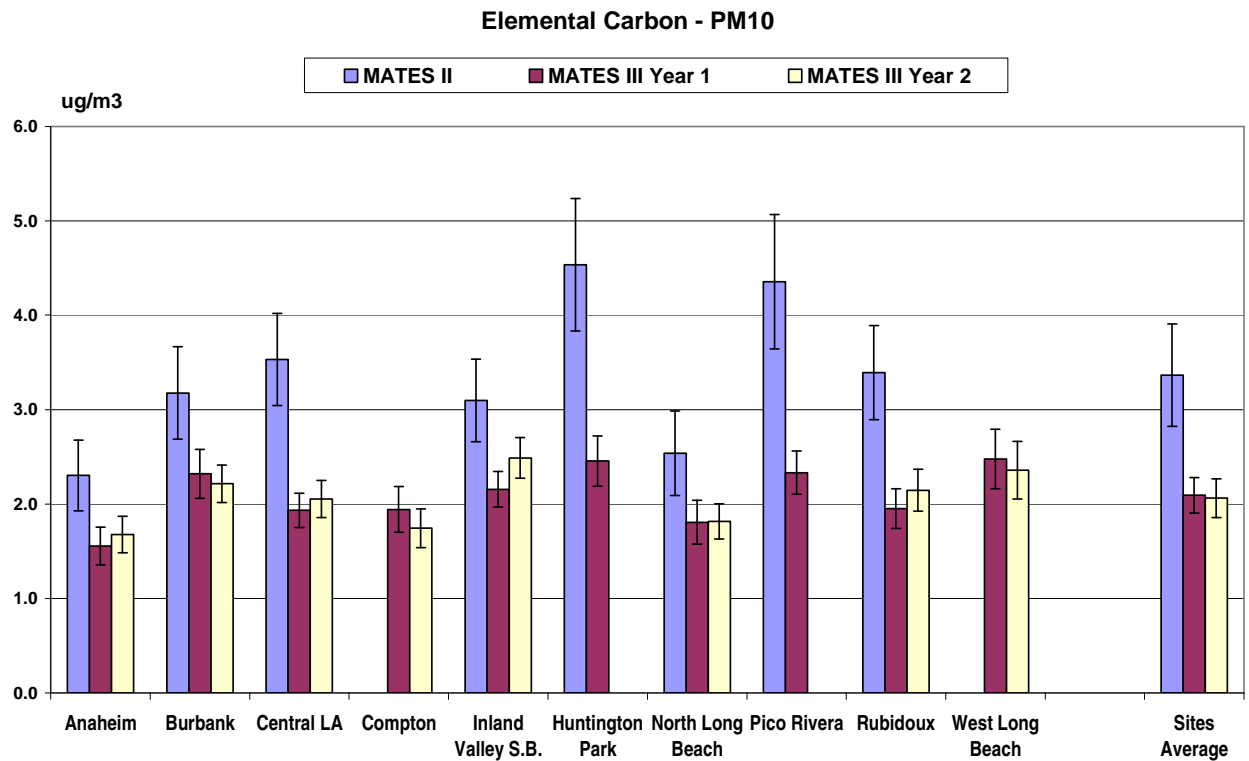
**Figure 2-10 Average Concentrations of Lead in Total Suspended Particulate (TSP)**



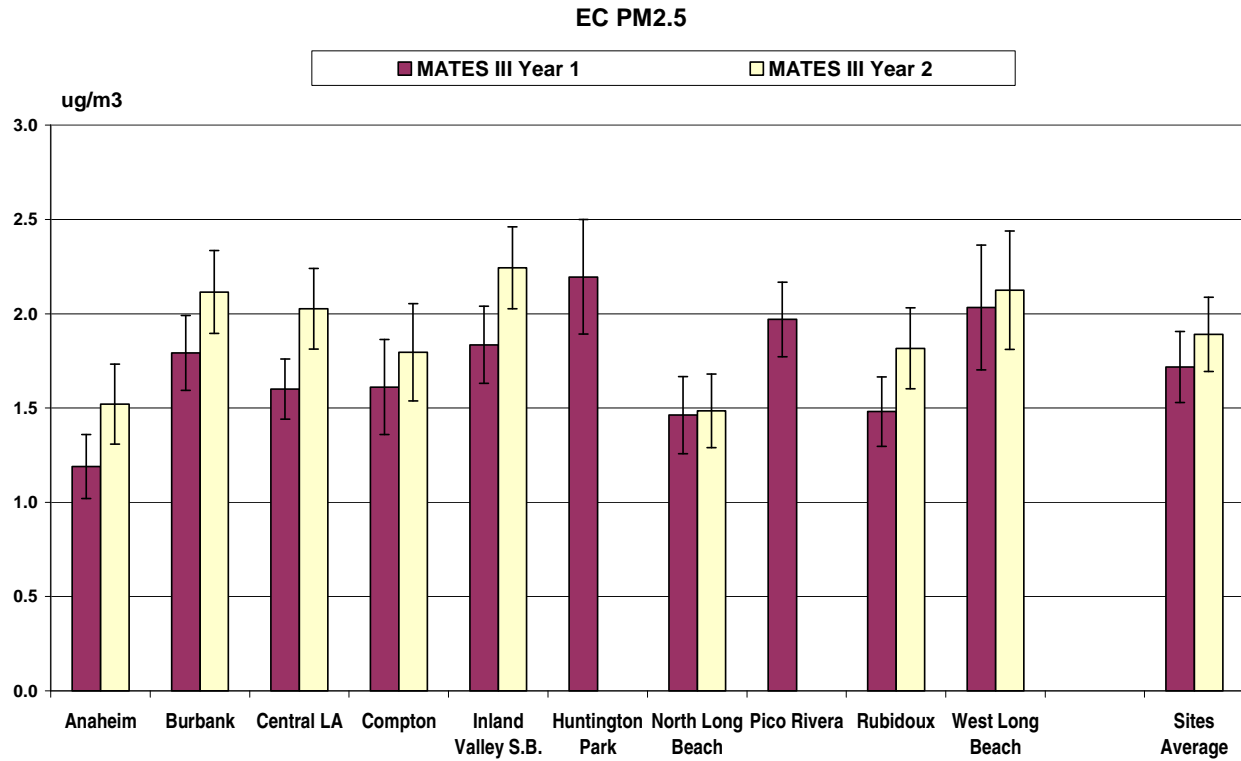
**Figure 2-11 Average Concentrations of Nickel in Total Suspended Particulate (TSP)**



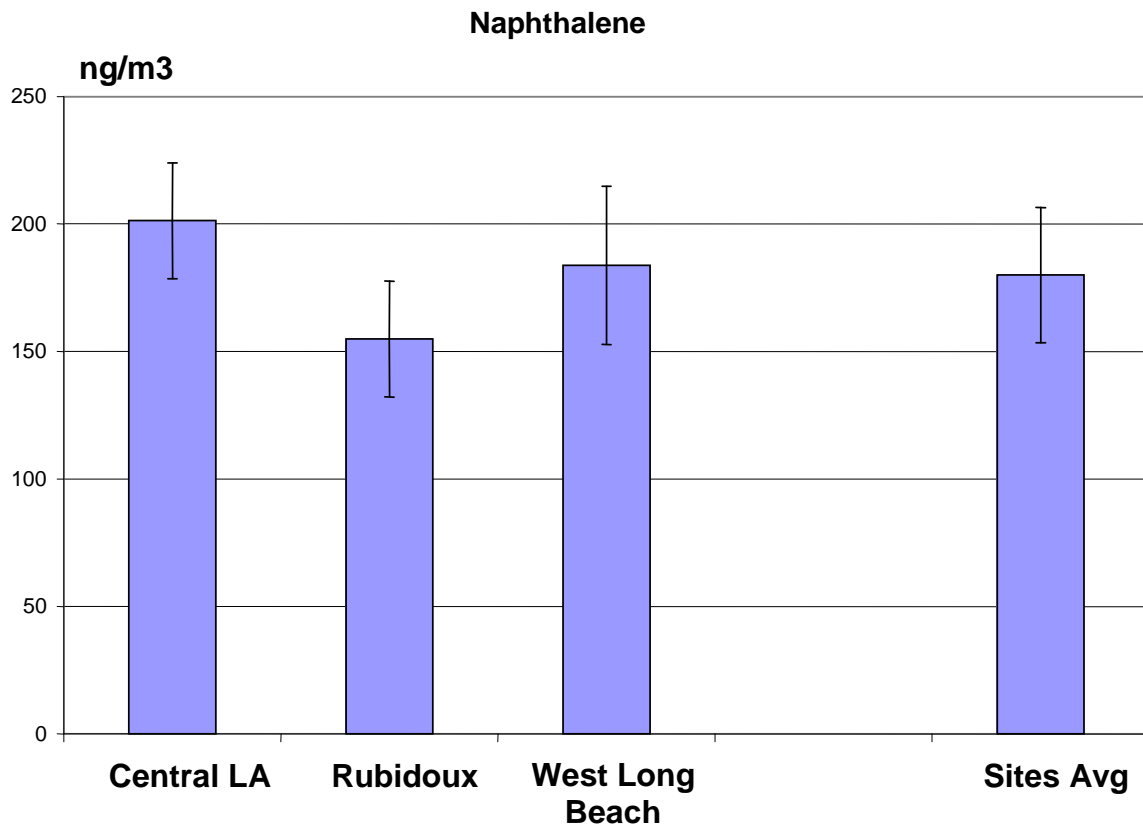
**Figure 2-12 Average Concentrations of Hexavalent Chromium in Total Suspended Particulate (TSP)**



**Figure 2-13 Average Concentrations of PM<sub>10</sub> Elemental Carbon (EC)**



**Figure 2-14 Average Concentrations of PM<sub>2.5</sub> Elemental Carbon (EC)**



**Figure 2-15 Average Monitored Naphthalene Concentrations for MATES III Year 2**

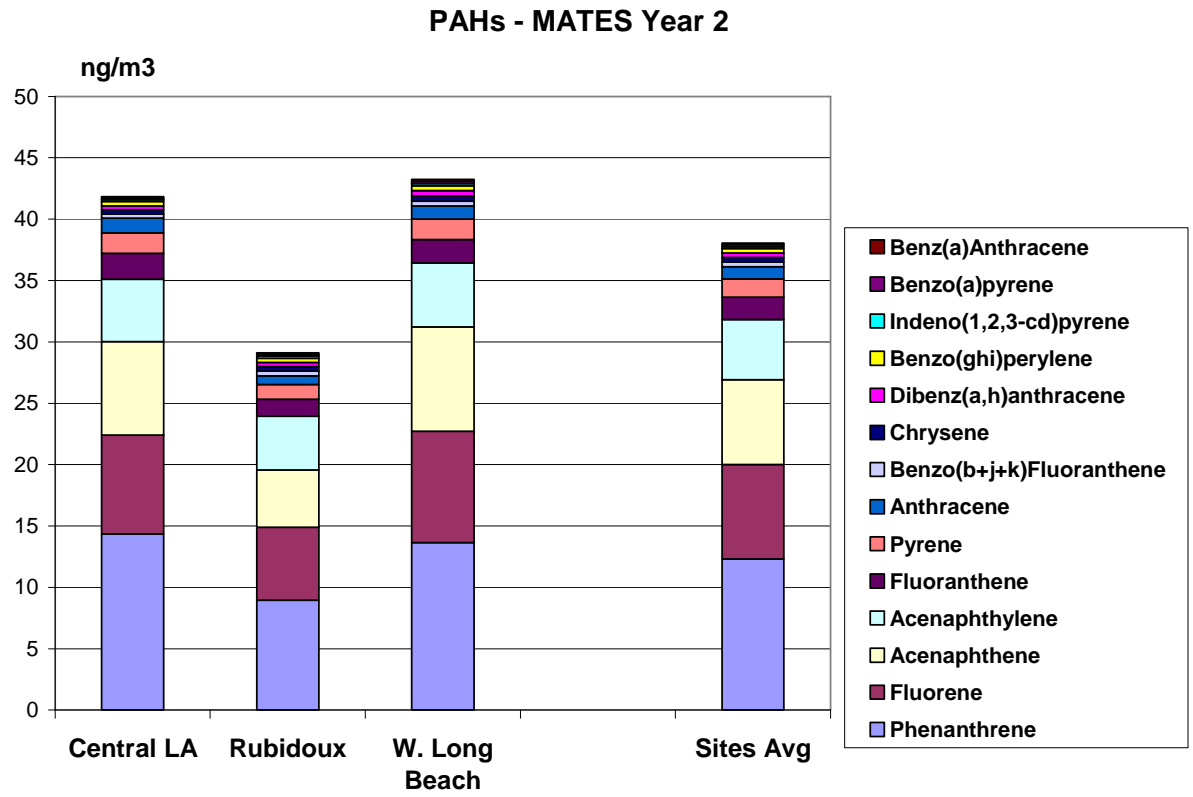


Figure 2-16 Average Concentration of PAHs for MATES III Year 2



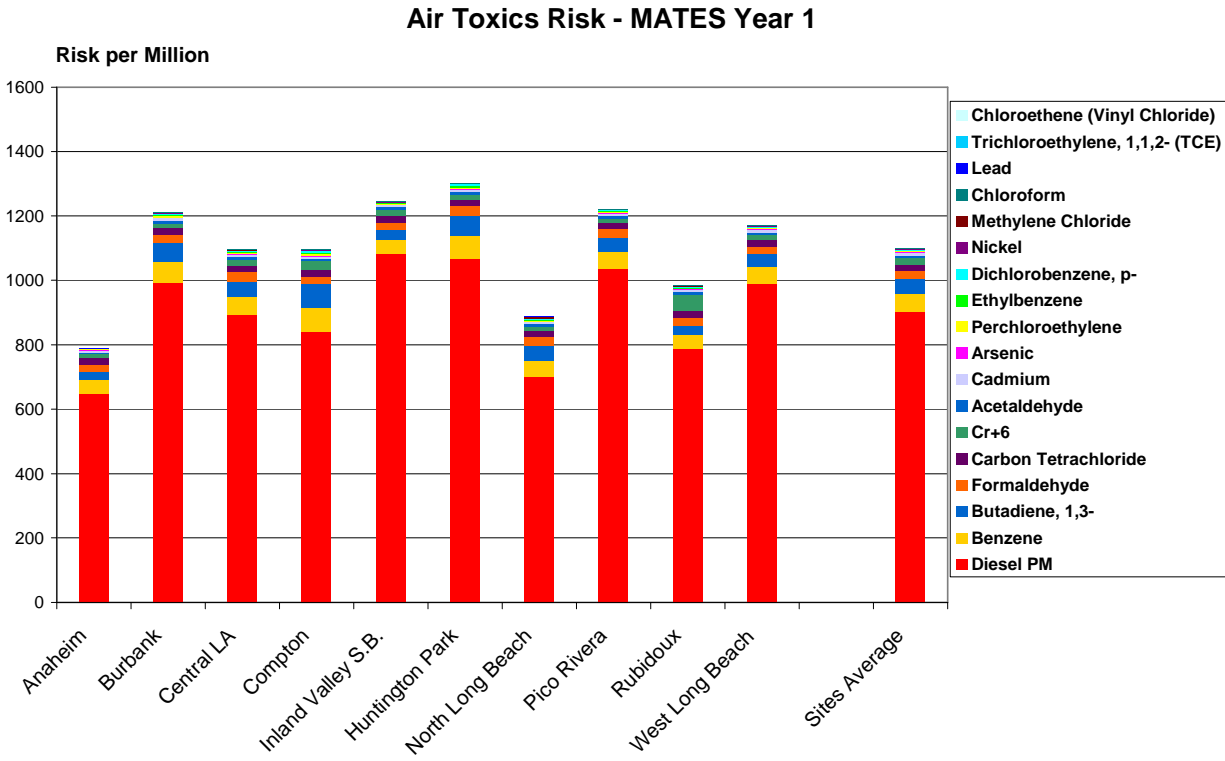


Figure 2-17 Estimated 70-Year Risk from MATES III Year 1 Monitoring Data

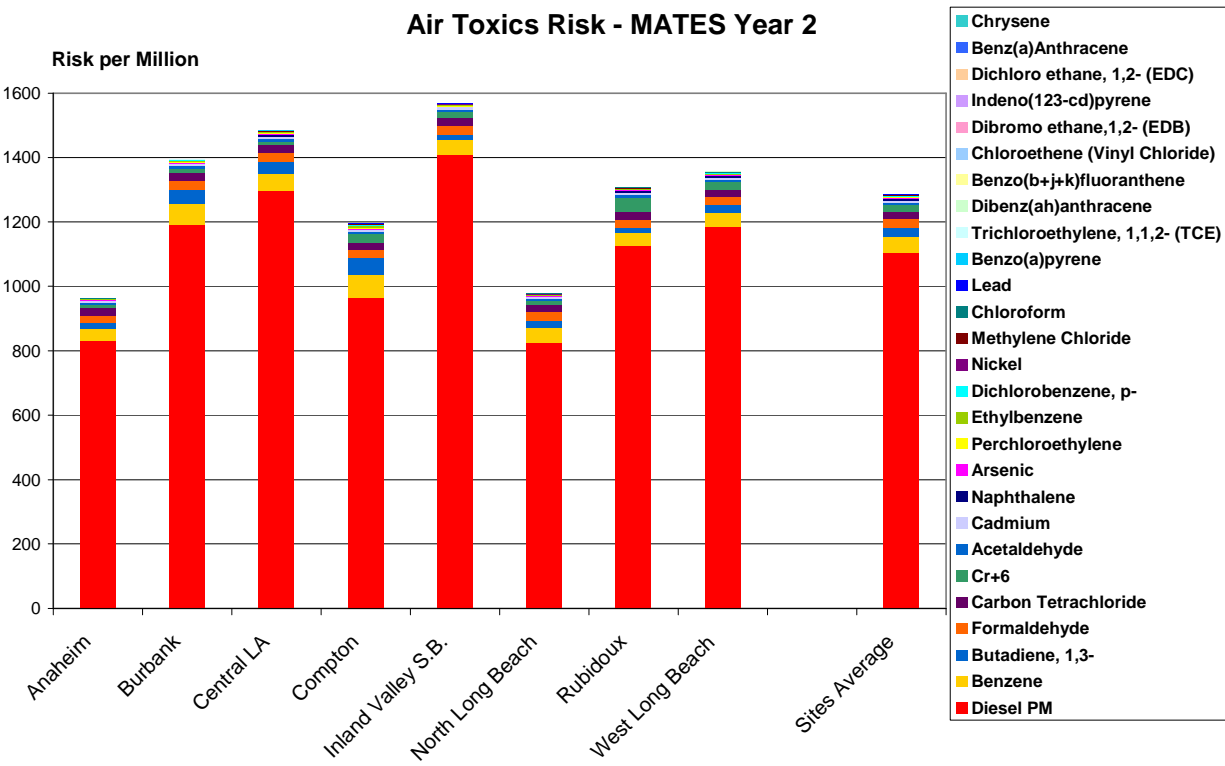


Figure 2-18 Estimated 70-Year Risk from MATES III Year 2 Monitoring Data

### 2.8. Other Data Sources

Measurements of PM<sub>2.5</sub> mass and limited analyses of some PM<sub>2.5</sub> components are available for several other sources and studies. For example, charts and averages of PM<sub>2.5</sub> mass and EC were provided to staff by the ports in comments to the January 2008 draft MATES III report. While useful for geographic comparisons, these data are of limited use for comparing to the MATES III data, as the time periods of sample collection were different, and the sampling periods did not completely overlap the MATES III study period.

In visually comparing the port monitoring data with the MATES III data on a daily basis during the times of sampling overlap, there was a concordance in the reported values. Although the different monitoring sites showed different values, as might be expected, the correlation of the values appeared to be high.

In terms of source apportionment, these data are also limited in that organic components and other species needed for the source apportionment methods are not available.

In terms of comparable data, the EPA Speciation Trends Network (STN) provides data from two of the MATES III monitoring sites, namely Central Los Angeles and Rubidoux. The PM<sub>2.5</sub> sampling methods are equivalent, as the MATES III sampling protocol is based on the method used by EPA. Comparisons of the daily values and averages from data taken over the MATES III monitoring period from these locations are shown in the charts below. The MATES III samples give similar results as the collocated EPA samplers.

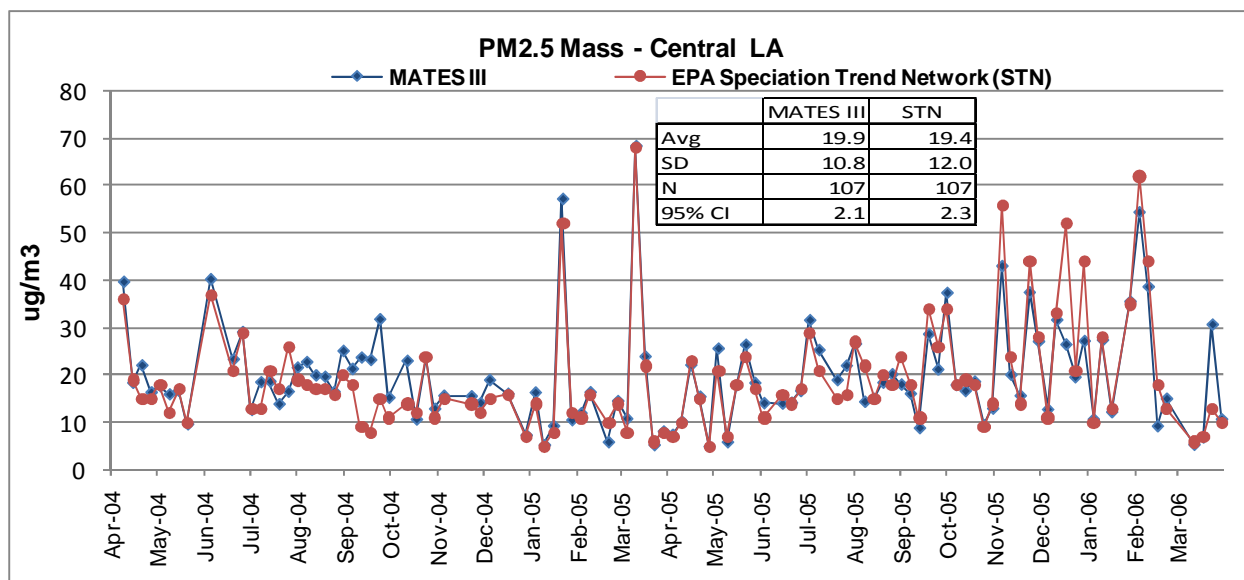
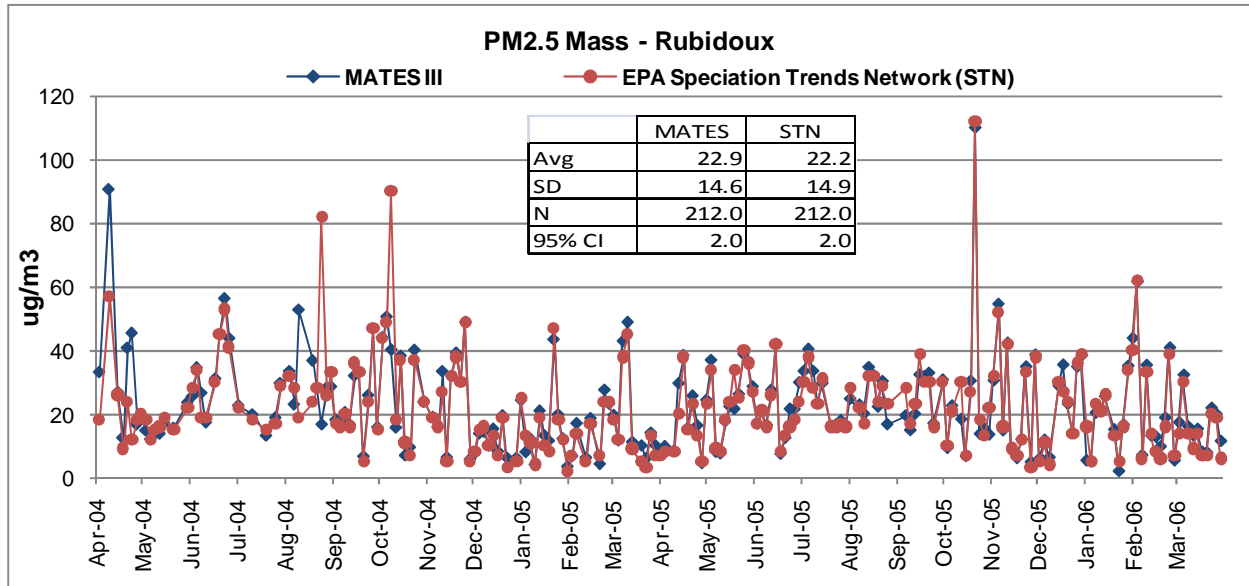


Figure 2-19 PM<sub>2.5</sub> Mass from MATES III and EPA Collocated Samplers at Los Angeles



**Figure 2-20 PM<sub>2.5</sub> Mass from MATES III and EPA Collocated Samplers at Rubidoux**

Commenters on the draft report also provided annual average PM<sub>2.5</sub> mass comparisons from the ambient monitoring data available from the ARB air quality database. These measurements, however, use a different sampler (also referred to as RASS or FRM samplers) that has a different design and higher flow rates than the samplers used in MATES III and the EPA STN network (also referred to as SASS samplers). It is known that the speciation samplers (SASS) give somewhat higher mass values than the samplers (FRM) used in the network designed to assess compliance with ambient air quality standards.